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THE

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OR

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ENCYCLOPÆDIA BRITANNICA.

BURNING GLASSES,

OR

BURNING MIRRORS.

Burning Glasses.

THE name of certain glasses or mirrors which have the property of inflaming combustible substances by the action of the sun's rays, being so formed as to collect all the rays which fall over their whole surface into a single point or spot, more or less distant, according to the form of the glass. In this point the natural heat of the sun is found to be so augmented, owing to such a multitude of rays being all concentrated in so narrow a space, that it produces an intense temperature, and such as is quite sufficient, even with very ordinary glasses, to inflame wood or other combustible substances. There is always one particular point at a certain distance from the glass where the heat is the greatest. If we place the burning body nearer the glass the heat diminishes, till it will no longer take fire; and if we place it farther from it, the same effect takes place. Hence this point, where the heat is the most intense, has received the name of the *focus* of the glass.

Focus.

Refracting and reflecting glasses.

This property of burning glasses, however familiar it may now appear, is certainly very remarkable, and must, at the time of its invention, have excited no small degree of astonishment and of interest, from the striking nature of the effect, and from the uses to which it might be applied. The operation is now perfectly understood from the principles of optics, and is indeed extremely simple. See OPTICS. The rays of light are collected either by refraction in passing through a transparent glass, or by reflection from the polished surface of a mirror. Burning glasses are hence divided into two kinds,—refracting glasses, which can only be made of glass or other transparent substance; and reflecting glasses, which are either made of glass silvered behind, or of polished metal, or any other reflecting substance. Reflectors of polished metal are generally termed *specula*. In the former kind the glasses are of a convex form, and collect the rays of the sun into a focus behind the glass, as at fig. 1, Plate CLII.; each ray, as it strikes more or less obliquely on the surface of the glass, being more or less bent out of its natural course by the refractive medium, so that they are all made to converge to one point or focus of refraction. Reflecting glasses, again, are all concave, and the rays of the sun are collected into a focus in front of the mirror by reflection; each ray, as it strikes more or less obliquely on the surface of the mirror, being reflected back, but at the same time inclined to the centre so that they are all made to converge to a point or focus of reflection in a similar manner, as at fig. 2.

In both these cases it is by the peculiar shape or figure of the glass or mirror that the convergence of all rays to one point is produced; and to ascertain therefore the figure which would do this most perfectly becomes an important object in the construction of glasses, and is, besides, a curious mathematical problem. In the case of refracting glasses, where we have a double surface, one on each side of the glass, it was first shown by the celebrated Descartes, that a glass having its exterior surface convex, and a portion of an elliptic curve, while its interior surface was concave, and formed a portion of a circle, would cause parallel rays, or those of the sun, to converge to a perfect focus, as at fig. 3, where the exterior surface of the lens BAC forms a portion of an ellipse, whose

greater axis AX is to the distance between the foci Ff, as the index of refraction is to unity, and a circle whose centre is at F. Various other forms have been proposed, but, owing to the great difficulty of forming glasses of these compound curves, it was found more convenient in practice to rest content with the exterior surface BAC, a portion of the simple curve of the circle or sphere, particularly as in large glasses, or those of slight convexity, the sphere approaches very nearly to that of the ellipse. Each side of the glass, therefore, is carefully turned and ground into the portion of a sphere, forming together what is termed a *lens;* and the greater the radius of convexity is, the greater is the distance of the focus from the glass. It happens by a curious coincidence, that in glass the focal distance of parallel rays, usually termed the *principal* focus of the lens, in a double convex lens, is just equal to the radius of convexity. In every burning glass, therefore, of this description, it is easy to find the focus by measuring from the centre of the lens a distance equal to the radius of curvature. In the case of burning mirrors, the true figure for converging the rays to a perfect focus is that of the parabola; a form which is frequently constructed, the mirrors being either turned or hammered out of metal, and the figure therefore more readily attained than in glass. The focal distance is always equal to the radius of the concavity at the centre of the mirror. Hence in large mirrors of a shallow concavity, or with a large radius, the spherical form will approach very nearly to that of the parabola, and will therefore produce very nearly the full effect of it.

Focal Image.

The focus may also be found practically by holding the glass up to the sun, and observing where the concentration of the light is the greatest. In doing this a remarkable circumstance is observed. However perfect the figure of the glass, the rays in the focus are never converged to a mathematical point; they are always diffused over a certain space, forming a spot of determinate magnitude. The reason of this will appear very obvious, when we consider that the sun presents a very sensible magnitude, even at the enormous distance at which he is viewed. The rays from different parts of the body, from the opposite limbs, for instance, instead of being parallel, subtend sensible angles. Though all the rays therefore from any one point in the sun are sensibly parallel to each other, and those which fall on different parts of the glass from this single point are all converged to a mathematical point in the focus, this is not the case with rays coming from different points of the sun. These not being parallel, cannot by any means be thrown together in the focus, but each to a distinct point corresponding to that from which it issues in the sun, whether by refraction or reflection, so as to form on the whole an image or figure of the sun, subtending the same angle at the glass as the sun does. This is evident from an inspection of figures 4 and 5, where the rays from each limb by refraction cross one another in the centre of the glass, and again diverge, forming the boundary of the focal image at the same angle as the image itself, or by reflection meet and diverge in returning at the same angle. Hence it follows that the magnitude of the focal image will depend entirely on the focal distance, and in no respect on the magnitude of the glass or mirror. The greater the focal distance the larger will the image be. In every case it will be proportional to the sine of 32′, the angle at which the sun subtends at the glass; and hence the focal diameter will be very nearly $\frac{1}{100}$th part of the focal distance. Hence the reason of a very curious fact, that in any large glass or mirror, though we were to cut off a zone from the exterior circumference, it would not alter in the least the magnitude of the focal image; it would only diminish the intensity of the light. Whether the figure of the glass also be square, or circular, or elliptical, or any other shape, the figure of the image will be invariably a circle.

Limit of concentration.

Such then is the limit of concentration even for the most perfect glasses; and hence we see that it is not absolutely necessary to have the glasses of the perfect figure required by theory, at least it is not of such essential consequence as in the case of telescopes or microscopes, where the distinctness of the image is of as much consequence as the concentration of rays. Here, though the image be ever so confused, seeing it is heat only which we want, it is of no consequence, so that they fall within the limits of the focus. If the spherical figure, then, has been adapted with success to the nice purposes of vision, by using spherical lenses and reflectors of gentle curvature, much more may it suffice for burning glasses, where any imperfections of this kind are of less importance; the only effect of these being to produce in the focus a somewhat less powerful concentration of the rays. In practice, however, the difference with small glasses, such as four, five, or six inches diameter, and focal distances of two or three feet, is really hardly measurable. Even with very large glasses it is far from being considerable. In the great burning glasses of Tschirnhausen, for example, three or four feet in diameter, the focal distance was twelve feet; and hence a perfect image of the sun should have been $\frac{144}{100}$ inches $= 1{\cdot}44$ inches; and it was actually about an inch and a half. The famous lens of Parker had a focal distance of six feet eight inches; and hence the perfect image should have been 0·8 inches, and the actual burning focus was one inch diameter. In reflection, again, the mirror of Vilette had a focal length of about thirty-eight inches, and therefore an image by calculation of 0·38 inches; it was actually about the size of half a louis d'or.

Heating power.

In regard to the actual heating power of burning glasses, if this depended only on the concentration of the rays it would be easily calculated. The degree of concentration is in every case proportional as the square of the diameter of the glass to the square of the diameter of the focal image. In an ordinary reading glass, therefore, say of two inches diameter and six inches focal distance, the focal diameter being thus 0·06, the concentration would be as four to ·0036, or as one to 0·0009, or nearly 1000 times. No wonder, then, that such a glass should so readily produce inflammation. Even in some of the large burning glasses the actual concentration did not so much exceed this as might be imagined. In the compound burning glasses of Tschirnhausen the diameter of the first glass being three and four feet, and the focal diameter of the second glass only eight lines or two thirds of an inch, the concentration would be as 2304 and 1296 to 0·44, or 5184 times in the one case, and 2916 in the other. In Vilette's burning mirror the diameter was thirty inches, and the focal diameter about half an inch. The concentration would thus be 3600 times. But the most powerful of all these glasses is the compound one of Parker. In this the diameter of the first glass was thirty-two and a half inches, and the focal diameter of the second three eighths of an inch; hence the concentration was equal to 7168 times.

Effect of the natural heat of the sun.

In order, however, to calculate the actual increase of temperature, we must first know the effect of the sun's natural heat. The most accurate experiments on this subject are those made by Professor Leslie with his photometer, an instrument of great delicacy, peculiarly adapted for measuring the heat of the sun, as it is entirely free of any extraneous impression from the surrounding atmosphere. "In the latitude of Edinburgh," he says, "the direct impression of the sun at noon, during the summer solstice, amounts to 90° (= 16·2 Fahrenheit); but it regularly declines as his rays become more oblique. At the

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altitude of 17° it is already reduced to one half; and at 3° above the horizon the whole effect exceeds not 1°. In the same parallel of latitude, the greatest force of the solar beams in the depth of winter measures only 25°"[1] (= $4\frac{1}{2}$ Fahrenheit). Taking the average effect, then, at 10°, it would appear that the above reading glass would be capable of producing a heat of 10,000°, which is far above the melting point of brass, copper, silver, and lead. The glasses of Tschirnhausen would produce a heat of 29,160° and 51,840°, the mirror of Vilette 36,000°, and Parker's glass the enormous heat of 71,680°, which is nearly double the highest heat measurable by Wedgewood's pyrometer.

Effect of concentration modified.

But the temperature due to the mere concentration of the rays will evidently be considerably modified, according as the accumulating heat is more or less rapidly dissipated from the focal point into the surrounding medium; and this will depend chiefly on the conducting power of the substance receiving heat, and of those with which it is in contact. This effect is observed, indeed, in the case of a body exposed to the natural heat of the sun. As the accumulating heat raises the temperature of the body, this causes a dispersion both by radiation and contact into the surrounding atmosphere, so that there will be a stream of heat continually escaping from the body, as well as one running in; and when the final temperature is attained, these two effects will exactly balance each other, the quantity dispersed being exactly equal to that which is received during the same time. Now, the quantity dispersed must evidently be proportional to the excess of temperature of the body above the surrounding atmosphere, and also to the surface exposed. Hence a slow conducting body exposed to the sun,—a ball of wood, for instance,—will acquire a higher temperature than a similar ball of copper. In the latter the heat will be quickly diffused over the whole mass, and dispersed into the atmosphere from every part of its surface: in the former it will pass very slowly through the mass, and accumulating more at one side, and having a smaller surface to disperse itself by, will produce there a greater elevation of temperature; or if the copper be surrounded by any slow conducting substance,—if it be bedded in a mass of charcoal or brick, the temperature acquired will be greater, as in the case of fruit-trees on a wall, the brick confining the heat, and causing a greater accumulation and a higher temperature, just as the damming up of any stream of water raises the level of the fluid. The same thing must take place with the rays of light concentrated by the burning glass. The temperature in the focus must continue rising until the dispersion of the heat from the focal point equals what is constantly received; and the more, therefore, this dispersion can be retarded by the interposition of slow conducting substances, the higher will the temperature rise. It has always been found, accordingly, that refractory metals, or stones, melt much more readily when laid in a mass of charcoal. This circumstance explains a fact first proved by Buffon, and invariably experienced in burning glasses, that, even with the same degree of concentration of rays, the effect will be much greater with a large focus than with a small one. The latter operating in a very narrow space, and dispersing the heat rapidly into the surrounding mass, there is little left for accumulation. In the former, the heat increasing as the square of the diameter, while the dispersion into the surrounding substance only increases merely as the diameter, much more remains to accumulate in the centre; and the central portion of the focus, indeed, being surrounded by a zone almost as hot as itself, much less dispersion can take place, and the temperature, therefore, will rise much higher. If we take, for example, a glass two inches diameter, with a concentrating power of 300, and another six inches diameter of the same power, the one will inflame paper in two or three seconds, while the other will hardly accomplish it at all. These circumstances, therefore, greatly modify the effects of concentration, and serve to account for the very feeble powers of small glasses, and the intense heat of larger ones not greatly differing in concentrative action. The most powerful glass, for instance, ever constructed, was that of Parker, and yet its concentrative power was only seven times greater than that of an ordinary reading glass; and this is the reason also, as we shall see, that the reflecting mirrors of Buffon for burning at a distance produced such powerful effects, the concentration being small compared with that of single glasses, but the focal image much larger.

History and description of burning glasses.

Such being the general principles of burning glasses and mirrors, we shall now describe some of the principal instruments of this kind which have been constructed, and their effects. The invention of mirrors or looking-glasses, constructed probably of polished brass, remounts to a very remote antiquity, as they are mentioned by Moses in the sacred writings. At what period they were employed in a concave form to concentrate the solar rays by reflection is not known, but it is very probable that mirrors of this kind were used to rekindle the vestal fires. Plutarch, in his life of Numa, 700 years before Christ, describes the σκαφεῖα, or dishes which were employed for this purpose, and which appear to have been concave segments of a sphere; and he states that the combustible matter was placed in the centre, meaning, no doubt, the focus or centre of concentrated rays. In the time of Socrates, 430 years before Christ, the manufacture of glass had made considerable progress; and it appears from a passage in one of the plays of Aristophanes, that the use of burning glasses was common. The author introduces Socrates as giving lessons in philosophy to Strepsiades, a citizen of Athens, and a man of low cunning. The subjects of these lessons are silly trifles, intended to make Socrates appear ridiculous. Strepsiades, after having asked him how he should avoid paying his debts, proposes the following expedient himself:—"*Strepsiades*, You have seen at the druggists that fine transparent stone with which they kindle fires? *Socrates*, You mean glass, do not you? *Strepsiades*, The very thing. *Socrates*, Well, what will you do with that? *Strepsiades*, When a summons is sent to me, I will take this stone, and, placing myself in the sun, I will melt all the writing of the summons at a distance." The writing, as we know, was traced on wax spread upon a more solid substance.

This description must refer to a burning glass by refraction. Several other ancient observations on the same phenomenon exist. Pliny mentions globes of glass or of crystal, which, being exposed to the sun, would burn clothes, or the flesh of a patient when cauterization was requisite. *Hist. Nat.* lib. xxxvi. and xxxvii. Lactantius, who lived about the year 303, says, "a globe of glass filled with water, and exposed to the sun, will kindle a fire even in the coldest weather." (*De Ira Dei.*)

Burning glasses of Archimedes.

But the most memorable account of burning glasses, and of their effects in all antiquity, and what has excited no small degree of speculation in succeeding times, is the extraordinary achievement ascribed to Archimedes, of setting fire to the Roman fleet engaged in the siege of

[1] *Experimental Enquiry into the Nature and Propagation of Heat*, p. 440. Also, by the same author, *An Account of Experiments and Instruments depending on the relations of Air to Heat and Moisture.*

Syracuse, "launching against it," as Buffon says, "the fire of the solar beams." This, if it can be proved, must, without doubt, be viewed as the most surprising effort of genius and practical skill which the history of human invention presents. By modern opticians, at the head of whom stood Descartes, the fact was long treated as fabulous, chiefly on account of its supposed impracticability; and no doubt this would be the case with single concave mirrors or reflectors, as they imagined Archimedes to have used, and which could not obviously be constructed of sufficient magnitude and focal distance to have any sensible effect. But if we suppose, as is far more probable, and as it is actually described by some authors, that the effect was produced by a number of plane mirrors arranged in a curve, and all uniting their rays in a focus, the impossibility of such a combination is by no means clear; and in fact its perfect practicability, first suggested by Anthemius, and rendered extremely probable by Kircher, was demonstrated by Buffon, and the apparatus actually constructed by him, so as to kindle wood and other inflammable substances at the distance of 200 yards. No doubt, therefore, can remain as to the possibility of producing the effects described. The only question now is in regard to the probability of the fact itself, and the evidence advanced for its support. In the first place, there is nothing improbable in the situation of the place; for Kircher, in his great zeal to throw light on this curious subject, actually made a voyage to Syracuse, in order to examine the situation of the hostile fleet, accompanied by his pupil Scholtus, and they were both satisfied that the ships of Marcellus could not have been more than thirty paces distant from the place where Archimedes might have stood; and in regard to an objection which has been stated, that the vessels might have moved out of the way of the glasses, this does not seem to have much weight, as a moment might have been chosen when they were off their guard, and the glass could have been turned so as to follow them to a certain extent; besides that, the vessels might have been at anchor, or even aground at the time, and not capable of moving away with sufficient expedition. Let us just consider, therefore, the evidence for the fact itself. On the one hand, we have Polybius, Livy, and Plutarch, all silent on the subject, affording certainly a strong proof against the fact, when we consider also that the two former describe so particularly the mechanical contrivances of Archimedes; on the other hand, it has been positively affirmed by Vero, Diodorus Siculus, and Pappus; and though the works of the latter, which speak of the siege of Syracuse, are now lost, they existed in the twelfth century, and the passages which speak particularly of the burning glass of Archimedes are quoted by Zonaras and Tzetzes, writers of that period, and who appear incapable of inventing such a story of themselves. Zonaras states that "Archimedes burnt the fleet of the Romans in an admirable manner, for he turned a certain mirror towards the sun, which received its rays. The air having been heated on account of the density and smoothness of the mirror, he kindled an immense flame, which he precipitated on the vessels which were in the harbour, and reduced them to ashes." He then adds that Proclus, taught by this example, burnt with mirrors of brass the fleet of Vitellius, who besieged Constantinople under the emperor Anastasius in the year 514. Tzetzes, referring to the same authorities, states, that "when the fleet of Marcellus was within bow shot, the old man (Archimedes) brought out a hexagonal mirror which he had made. He placed at proper distances from the mirror other smaller mirrors, which were of the same kind, and which were moved by means of their hinges and certain square plates of metal. He afterwards placed his mirrors in the midst of the solar rays precisely at noon-day. The rays of the sun being reflected by this mirror, he kindled a dreadful fire on the ships, which were reduced to ashes at a distance equal to that of a bow-shot. Dion and Diodorus, who wrote the life of Archimedes, and several other authors, speak of this fact, but chiefly Anthemius, who wrote on the prodigies of mechanics. It is in these works that we read the history of the conflagration occasioned by the mirror of Archimedes."

Testimony of Anthemius.

This passage contains evidently a description of a combination of plane mirrors, so adapted and set to the position of the sun as to unite all the rays reflected from them into one focus. Besides these, we have the direct testimony, as above noticed, of Anthemius of Tralles, an eminent architect, and one besides deeply learned in the mathematical sciences, particularly mechanics. He flourished about the end of the fifth century, in the time of Justinian, with whom he was a favourite, and who employed him in the erection of various edifices, particularly the church of St Sophia at Constantinople, which he carried on for some time in conjunction with Isidore, and, after his death, finished himself. He was also a disciple of Proclus, from whom he may have received information regarding burning mirrors. In a fragment entitled περι παραδοξων μηχανηματων, *Of Wonderful Machines*, and translated and illustrated by Dupuy, a member of the Academy of Belles Lettres in 1777, Anthemius treats particularly of the burning mirrors of Archimedes, on the effects of which he never seems to entertain any doubt. After acknowledging that it was universally admitted in his time that Archimedes had destroyed the Roman fleet by means of burning mirrors, Anthemius observes, "Let us, therefore, bring and collect at one point other different rays, by means of plain and similar mirrors, in such a manner that all these rays, united after reflection, may produce inflammation. This may be effected by means of several persons holding mirrors, which, according to the positions indicated, send the rays to one point.

"But, in order to avoid the embarrassment resulting from intrusting this operation to several persons (for we shall find that the matter intended to be burnt does not require less than twenty-four reflectors), the following construction may be followed: Let there be a hexagonal plain mirror, and other adjoining similar mirrors, attached to the sides of the hexagonal mirror by the smallest diameter, so that they may be moved on these lines by means of plates or bands applied, which unite them to each other, or by means of what are called hinges. If, therefore, we bring the surrounding mirrors into the same plane with the mirror in the centre, it is clear that all the rays will undergo a reflection similar and conformable to the common position of all the parts of the instrument. But if, the centre mirror remaining as it were immovable, we dexterously incline upon it all the other mirrors which surround, it is evident that the rays reflected by them will tend towards the middle of the place where the first mirror is directed. Repeat the same operation, and around the mirrors already described placing other similar mirrors, all of which may be inclined towards the central mirror, collect towards the same point the rays which they send, so that all these united rays may excite inflammation in the given spot.

"But this inflammation will take place better if you can employ for this purpose four or five of these burning mirrors, and even seven, and if they are all at the same distance from the substance to be burnt, so as that the rays which issue from them, mutually intersecting, may render the inflammation more considerable. For, if the mirrors are all in one place, the rays reflected will intersect at very acute angles, so that all the place around the axis

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being heated, the inflammation will not take place at the single point given.

"It is therefore possible, by means of the burning mirrors just mentioned, to carry inflammation to a given distance. Those who have made mention of the mirrors constructed by the divine Archimedes, have not said that he made use of a single burning mirror, but of several; and I am of opinion that there is no other way of carrying inflammation to any distance."

Leonhard Digges.

These testimonies are certainly very favourable, and the subject has been still further explained and illustrated by the labours of succeeding inquirers. About the end of the sixteenth century we find mention of a burning glass on the plan of that of Archimedes, in a work by our countryman Leonhard Digges, entitled *Pantometria*, published in London in 1571, and republished by his son Thomas Digges in 1591. In the preface to the second edition the latter observes, "Archimedes also (as some supposed), with a glasse framed by revolution of a section parabolicall, fired the Roman nauie in the sea, comming to the seige of Syracusa. But, to leaue these celestial causes, and things done of antiquitie, long agoe, my father hath at sundrie times, by the sunne beams, fired powder and discharged ordnance *half a mile* and more distante; which things I am the boulder to report, for that there are yet liuing diuerse of these his doings (*oculati testes*, eye-witnesses), and many other matters far more strange and rare, which I omit as impertinent to this place."

In the twenty-first chapter of the first book, the subject of burning glasses is resumed. "Some have fondly surmised that Archimedes burned the Roman nauie with a portion of a section parabolical, artificiallye made to reflect and unite the sunne beames a great distance off; and for the construction of this glass, toke great peins with high curiositie. to unite large and many intricate demonstrations; but it is a mere fantasie, and utterly impossible with any one glass, whatseuer it be, to fire any thing only one thousand paces off, no, though it were an 100 foote over; marry true it is, the parabola, for his small distance, most perfectly doth unite beames, and most uehemently burneth, of all other reflecting glasses. But how by application of mo glasses to extend this unitie or concourse of beames in his full force, yea to augment and multiply the same, that the farder it is carried the more violently it shall pearse and burne. *Hoc opus hic labor est*, wherein God sparing life and the time which opportunitie serving, and minde to impart to my countrymen some such secrets, as hath, I suppose, in this our age been reueled to very few, no lesse seruing for the securitie and defence of our naturall countrey, than surely to be maruailed at of strangers."

Napier of Merchiston.

A few years after the publication of the *Pantometria* of Leonhard Digges, our illustrious countryman Baron Napier of Merchiston drew up a list of "Secret inventions, profitable and necessary in these days for the defence of this island, and withstanding of strangers, enemies of God's truth and religion." The first and second of these inventions are burning mirrors, which are very briefly described in the following words:—

First, "The invention, proof, and perfect demonstration, geometrical and algebraical, of a burning mirror, which receiving of dispersed beams of the sun, doth reflect the same beams altogether united and concurring precisely in one mathematical point, in the which point most necessarily it engendereth fire; what an evident demonstration of their error who affirm this to be made a parabolic section. The use of this invention serveth for the burning of the enemy's ships, at whatsoever appointed distance."

Secondly, "The invention and sure demonstration of another mirror, which receiving the dispersed beams of any material fire or flame, yieldeth also the former effect, and serveth for the like use."

It does not appear that Napier ever condescended to give any further account of these burning mirrors; for when he was solicited a short time before his death, by one of his most particular friends, "not to bury such excellent inventions in the grave with him," he replied, "that for the ruin and overthrow of man there were too many devices already framed, which, if he could make to be fewer, he would with all his might endeavour to do; and that therefore seeing the malice and rancour rooted in the heart of mankind will not suffer them to diminish the number of them, by any new conceit of his they should never be increased."

Labours of Kircher.

The next author whom we find treating on the subject of the burning glasses of Archimedes, is the learned and indefatigable Kircher, whose zeal we have already mentioned as having led him to Syracuse to examine the practicability of the project on the spot, and who besides investigated the subject by a great variety of experiments. "He began with combining a number of parabolic specula; but this method was quickly abandoned, and he resorted to the use of plane mirrors. Having procured a number of plane and circular glasses, he placed them upon a wall, at such degrees of inclination that they all reflected the light of the sun to one point, and produced a considerable heat. His principal experiments, however, were made with five plain specula fixed in a frame, so that they collected the solar rays at the distance of more than one hundred feet. At this distance he produced a degree of heat which sufficiently convinced him, that by increasing the number of his mirrors, he could have consumed inflammable substances at a much greater distance. He informs us in his *Magica Catoptrica*, that the heat of the first reflection was different from that of direct light; that the light, when doubled, gave a very preceptible increase of heat; that it had the heat of a fire when tripled; that when quadrupled, the heat could still be endured; but that a five-fold reflection made the heat almost intolerable. From these results he concludes that a combination of plane mirrors was capable of producing more powerful effects than mirrors of a parabolic, hyperbolic, or elliptic form; and he entreats future mathematicians to prosecute the subject with a more numerous combination of plane specula."

Of Buffon.

But of all the authors who have laboured in this curious speculation, Buffon is the one who has thrown the clearest light on the subject; and, by the ingenuity, extent, and multiplicity of his experiments, has left little further to be accomplished by succeeding philosophers. Being soon convinced, like his predecessors, of the utter inefficiency of single mirrors, he then tried by experiment the powers of different plane surfaces in reflecting the sun's light, and found that glass, somewhat carefully polished and silvered behind, reflected more powerfully than the best polished metals, better even than what is employed for the specula of telescopes. He next found, by letting the direct light of the sun into a darkened room, and comparing it there with the reflected light from glass, that it only lost one half by reflection, which he judged of by causing one reflected light to cover another, when the two seemed together equal to the direct light. Thirdly, having received, at distances of one hundred, two hundred, and three hundred feet, the same reflected light from large glasses, he found it had lost almost nothing of its intensity by the thickness of the mass of air which it had traversed. Having established these preliminary facts, he then tried what the effect would be of receiving the image of the sun from different glasses at still greater distances; and a curious fact was observed, namely, that whatever

Loss of light by reflection.

Burning Glasses.

Round form of all distant images.

shape the glass might be, whether square or triangular, or any other, the same was the figure of the reflection at short distances: but as the distance increased, the figure became rounded at the angles; as the distance increased, the rounding of the angles increased along with it, until at last the square or triangular figure was changed into one nearly circular, whatever was the original figure of the glass. This effect Buffon justly ascribed to the circumstance of the apparent magnitude of the sun, every portion of the glass reflecting in reality an image of the sun, and the whole reflection being composed of an infinite number of such images, each of which subtended an angle of half a degree. At small distances, therefore, the images are too small in proportion to the magnitude of the figure to affect the shape. As the distance increases, the magnitude of each of the images increasing along with it, while the figure and magnitude of the whole reflection remains in other respects the same, the former becomes at last equal to the latter, and the square or triangular figure is absorbed in that of the circular image of the sun, and every glass comes at last to give nearly the same figure. Hence it followed that the light could be no otherwise enfeebled by distance than as it was diffused by the increasing magnitude of the image. Putting all these circumstances together, Buffon had hopes of being able to burn in this manner at a great distance, by combining a sufficient number of glasses. Still he had doubts; for supposing we wish to burn at two hundred and forty feet distant, the focus or image of the sun at this distance could not be less than two feet. What a diffusion of light, compared with the degree of concentration in very ordinary glasses,—in the mirror of the Academy of Sciences, for instance, of which the diameter is three feet! This was a hundred times larger than the diameter of its focus, which was only one third of an inch; and hence he concluded, that to burn as powerfully at two hundred and forty feet, the diameter of the mirror would have required to be two hundred and sixteen feet, which was impossible. Still, however, he had a suspicion that the effect of a large focus might be greater than the mere effect of concentration, although this was contrary to the received opinion of Descartes and other opticians; and on appealing to actual experiment, he found his suspicions satisfactorily confirmed. On trying, for example, a small burning glass three inches diameter, and the focal distance six inches, and diameter one eighteenth of an inch, with a glass thirty-two inches diameter, and a focus of two thirds of an inch,—in the focus of the latter copper melted in less than a minute, while in that of the former the copper would scarcely be gently heated, according to the principle we have already explained. Encouraged by this experiment, Buffon proceeded to put his plan in execution, and constructed, with the aid of M. Passemant, a compound mirror, represented at fig. 6. This consisted at first of sixty-eight silvered glasses, each eight inches long and six broad, arranged in a square frame parallel to each other, and separated by spaces, about one fourth or one third of an inch. These allowed the glasses to move easily independent of one another, and also allowed the operator to see through and to direct the reflections to one point. In this manner the whole sixty-eight mirrors could be made to unite their force at twenty, thirty, or even a hundred and fifty feet; and by augmenting the size of the compound mirror by adding to the number of small mirrors, the effect might be increased to any extent. The only difficulty consists in moving such a number of glasses, and directing them all to the same object. Great attention must also be paid to the choice of the glasses, which are often very defective, though they may appear well enough at first sight. The sixty-eight above described had to be picked out of more than five hundred. They were tried by observing the reflection on a wall a hundred and fifty feet distant, and those only which gave distinct and well-defined images were taken.

Effect of large focal image.

Compound mirror.

Effects of mirror.

The first experiment was made with the mirror on the 23d of March 1747, at mid-day. With forty glasses only, it set fire to a plank of tarred beech. Not being yet mounted, however, on its stand, it acted under a great disadvantage

The same day, a plank done over with tar and brimstone was set fire to at a hundred and twenty-six feet with ninety-eight glasses, the mirror being still more disadvantageously placed.

On the 3d of April, at four o'clock in the afternoon, the mirror being mounted and placed on its stand, a slight inflammation was produced on a plank covered with shreds of wool at a hundred and thirty-eight feet distance, with a hundred and twelve glasses, although the sun was weak, and the light very pale. One requires to take care of himself in approaching the place where the combustible materials are placed, and avoid looking at the mirror; for if unfortunately the eyes are found in the focus, they would be struck blind by the brightness of the light.

On the 4th of April, at eleven in the morning, the sun being very pale, and covered with vapours and light clouds, the mirror was still capable of producing, with a hundred and fifty-four glasses, at a hundred and fifty feet distance, a heat so considerable, that in less than two minutes it made a tarred plank smoke, which would certainly have been inflamed if the sun had not disappeared all of a sudden. The next day at three P. M., with the sun still more feeble than the preceding, chips of fir coated with sulphur and mixed with charcoal were kindled in less than a minute and a half, with a hundred and fifty-four glasses, at the distance of a hundred and fifty feet. When the sun was brisk it only required a few seconds to produce inflammation.

On the 10th of April, after mid-day, with the sun pretty clear, a plank of tarred fir was kindled at a hundred and fifty feet with only a hundred and twenty-eight glasses; the inflammation was very sudden, and extended over the whole breadth of the focus of sixteen inches diameter. The same day at half-past two the light was directed on a plank of beech tarred in part and covered in some places with shreds of wool. The inflammation was very quickly produced; it commenced with those parts of the wood that were uncovered, and the fire was so violent that it was necessary to immerse the plank in water to extinguish it: there were a hundred and forty-eight glasses, and the distance was a hundred and fifty feet.

On the 11th of April, the focus being only twenty feet distant from the mirror, twelve glasses only were required to inflame little combustible matters. With twenty-one glasses a plank of beech which had been already partly inflamed was set fire to; with forty-five glasses a large flagon of tin, weighing about six pounds, was melted; and with a hundred and seventeen glasses thin pieces of silver were melted, and an iron plate made red hot; and "I am persuaded," says he, "that at fifty feet distant the metals might have been melted as well as at twenty, by employing all the glasses of the mirror; and as the focus at this distance is six or seven inches diameter, it affords a very convenient method of making experiments on the metals, which could not be done with ordinary mirrors, the foci of which are either of feeble power, or a hundred times smaller than that of mine. I remarked that the metals, and particularly silver, smoked much before melting; the smoke was so sensible as to cast a shade on the ground. This I particularly observed, for it was not possible to look at the metal in the focus, the light being much brighter than that of the sun."

Such are the results of Buffon's original experiments, and they are certainly very remarkable, and such as could not have been well anticipated from any previous knowledge of the subject. We have already seen that, according to Professor Leslie's experiments, the greatest heat of the sun in our latitude is 16°; suppose that in France it may amount to 15° in the month of April. The heat required to inflame beech or fir coated with tar cannot be estimated at less than 600° or 800°, which would require a concentration of forty or fifty times; and seeing one half is lost by reflection, it would require eighty or one hundred mirrors; and yet we see at the distance of twenty feet beech was inflamed with only twenty-one mirrors, which we should not have calculated to produce a higher temperature than 157°. Silver, again, cannot be melted with less heat than 4500°, or a concentration of 300 times, and requiring, therefore, 600 mirrors; and yet the pieces of it were melted with 117 mirrors.[1] The same effects were observed at greater distances, making allowance for the distance. At 66 feet tarred beech was inflamed with 40 glasses, at 126 feet with 98, and at 150 feet tarred fir was inflamed very suddenly with 128 glasses. It is not easy to determine the exact diminution of effect by distance, so much will depend on the glasses themselves. Were the reflected image to enlarge itself regularly in receding from the glass, and the light to be equally diffused over the image, the calculation would be simple; but this is not the case, seeing there are rays proceeding from every point of the glass parallel to one another, and the effect of which therefore does not decrease with distance. The rays are also more accumulated in the centre than at the extremities of the image. Still, however, a decided diminution must arise from the distance of the object from the mirror; and the above results, therefore, are still far beyond what could have been looked for from so small a number of glasses employed. The cause of these extraordinary effects of the mirrors it is not easy to explain; and the discrepancy does not seem to have occurred to Buffon, nor to any of the succeeding philosophers who have considered the subject. It is certainly, however, very palpable; and either the original estimate of 15° for the natural heat of the sun is too low, which, however, we have no reason to think from other considerations, as well as the acknowledged accuracy of the observer, and his perfect means of observation; or else, what is more probable, the heat accumulates in the heated body in a higher ratio than that of the amount continually flowing in and discharged. The level of a reservoir, as is well known, rises higher than in proportion to the quantity running in, and discharged by a given opening. It rises to a level increasing as the square of the flow; and something of this kind may perhaps occur with the stream of heat. The subject, however, would require a careful examination, and various new experiments made in a more accurate manner than has yet been done. It is much to be regretted that Buffon did not make use of a thermometer to measure the actual heat in the focus of the mirror. We have no doubt that a few observations with this instrument, or still better with Leslie's thermometric photometer, would lead to curious results.

Besides the above experiments, which were made on the first trials of the mirror, a great number of other experiments were afterwards made, which all confirmed the first. Wood was kindled at 200 feet, and even at 210 feet, with the summer's sun, every time the sky was clear; and with four such mirrors it might be done at 400 feet, and perhaps farther. All the metals also, and metallic minerals, were melted at twenty-five, thirty, and forty feet. It took about half an hour to mount the mirror, and to make all the images coincide in one point; but when it is once adjusted it will serve at all times for any particular distance; but if the focus is to be changed, it will take half an hour to do this,—to change, for example, from 100 feet to 150 feet. The above experiments were made publicly in the Jardin du Roi.

The mirror represented in fig. 6 has 360 glasses. The frame is supported on the axis AB, round which it can be turned by means of the rack FG, and the pinion and handle HK. The axis rests on the two uprights AL BM, which are firmly fixed by mortises into the bottom piece OQ, and cross piece *ab*, and steadied by diagonals; the uprights and frame are movable round an upright pillar or axis, the feet being provided with rollers to cause the whole mirror to turn easily round. The upright pillar or axis is fixed in the centre of a broad square base, or sole of wood, which is capable of turning on rollers or castors, and the whole is moved in any direction. Each of the glasses is fixed on a square plate of metal ABCD, fig. 12, movable on an axis CD, which turns on a small frame, seen from behind in fig. 10, and in front in fig. 11: the screw FE pressing against the back of the plate, and the spring L resisting and pressing in the opposite direction, the plate is held firm in its position, and by turning the screw in or out the angle of the glass is altered. The whole frame and plate are besides movable round another axis CD, perpendicular to the former; this motion being regulated and directed by screws and springs in the same manner: and thus the glass having a universal motion, can easily be set so as to throw the reflection in any direction, and all the glasses by the same means directed towards one point or focus.

Effects of Archimedes' mirror still doubtful.

Such are the effects and construction of the celebrated mirror of Buffon, which actually set fire to wood at so considerable a distance; and proves, therefore, clearly the practicability, with such an apparatus, of setting fire to a vessel at the same distance. That it proves, however, the actual fact related of Archimedes, seems to admit of considerable doubts. A distinguished philosopher in the end of the eighteenth century, with all the advantages of the amazing progress of science and the arts up to that period, has, after a laborious research and numerous experiments with all the leisure of philosophical inquiry, at last succeeded in constructing a combination of mirrors, which inflames combustible materials at a distance, and in a convenient situation. But when we consider the low state of the arts in the time of the Syracusan philosopher, the inferior reflecting power of any mirror then in use, the difficulty and expense of procuring such a number as would be necessary, and of combining them together so as to act with facility and effect on an enemy's fleet,—seeing that even in Buffon's apparatus it took half an hour to bring the mirrors to a focus; and, therefore, in the case of a vessel in motion, it would be next to impossible to follow it, and keep all the glasses steadily directed to one point,—if we consider all these circumstances, the difficulties of the undertaking must appear so enormously increased, that it seems to be no disparagement to the genius even of Archimedes to require stronger proof than has yet been adduced to convince us of the fact; and particularly, as Polybius, Livy, and Plutarch, who have described the prodigies of his mechanical skill, are silent in regard to this, which would have been as wonderful as any, and was calculated to excite fully greater astonishment. That Archimedes had conceived such an idea, and perhaps in part reduced it to practice, appears certain from so many concurring testimonies; but that he actually reduced the Roman fleet to ashes, is probably only one of those exaggerations to which every action, in any degree marvellous, naturally gives rise.

Since the time of Buffon scarcely any thing further has

[1] This is Wedgewood's estimate of the melting point of silver, but the more recent investigations of Daniel reduce it to 1873° Fahr.

Burning Glasses.

Peyrard's mirrors.

been done on the subject of these compound burning mirrors; and as the subject is one more of curiosity than of real utility, for, as to its application as an engine of war, it is now out of the question, enough has perhaps been done. In Peyrard's edition of the works of Archimedes, however, there is a memoir on the subject by the translator, who seems to have bestowed a good deal of attention on the subject, and suggested various ingenious improvements on the mode of combining the mirrors, and directing them with facility to any object even though in motion; but he does not seem actually to have constructed any on this plan. To direct and change so many mirrors quickly would require evidently several operators at the same time, as each mirror must be set separately. But it is extremely difficult in the ordinary way for different hands to act in concert, because if any one of the glasses, for instance, were out of the focus, it would be impossible to tell which it was, and each operator would be moving his own, and thus deranging the whole. Peyrard, therefore, proposes to furnish each mirror with a telescope, adjustable in such a manner that, being turned to any object, the reflected rays from the mirror should fall in the same direction. The adjusting apparatus consists of a telescope attached parallel to the sides of the mirror, and also capable of turning on its axis and carrying the mirror round with it. The mirror is besides capable of turning on an axis of its own, perpendicular to that of the telescope, and by this double motion the adjustment is effected. The mirror is first turned on the axis of the telescope until its own particular axis becomes perpendicular to the plane of the incident and reflected rays; and this is done by observing when the shadow of the edge of the frame of the mirror falls on a particular point, marked on an index projecting from the telescope. The mirror is then turned on its own axis until the angle of incidence becomes equal to the angle formed by the mirror and telescope; and this is known by a shadow made through an opening in the silver of the mirror falling on a particular spot in the index. In this manner one operator can adjust all the mirrors intrusted to him with accuracy and facility, and without knowing at all what the others are doing. The apparatus is represented at fig. 7, and the following is Peyrard's description.

Where AB is a common telescope with only one tube, containing the object-glass at B, and the eye-glass at A. The tube is movable on its axis between the two collars CC, C′C′, which are fixed to a piece of metal, DD. This piece of metal is supported on a stand like a common telescope, having a vertical and horizontal motion, by which the axis of the telescope may be directed with facility to any given point. The axis of the instrument is marked out by the intersection of a pair of cross wires placed in the anterior focus of the eye-glass; and when this point of intersection is directed to any object, the whole instrument is kept steady in its place by the screws F and G, the former of which prevents any motion in a vertical direction, and the latter in a horizontal direction. From the middle of the tube AB rises a cylindrical piece of metal M M, and upon the eye-glass extremity a branch of iron HHH, wrought square, is fixed firmly in a direction parallel to the axis of the cylindrical piece MM.

A plane silvered glass mirror IL, inserted into a proper frame, is made to turn on two pivots, one of which, *m m*, rests on the cylinder MM, while the other, *o o*, is inserted in the horizontal part of the branch HH. The straight line which passes through the centre of these pivots must be exactly parallel to the silvered back of the mirror, and at right angles to the axis of the telescope, and the black mark N, produced by a scratch upon the silvered surface, must be bisected by the axis of the mirror.

Above the object end B of the tube is fixed a plate of metal, seen in the figure; and behind this plate is seen another square plate, *z z*, on which are shown the lines *x x*, *y y*, crossing each other at right angles. By means of a piece of brass fixed to the last of these plates, and traversing a square hole made in the other plate, the square plate may be moved up and down, and from right to left; and it is kept in any position which is thus given to it, by a screw on the back of the fixed plate. The movable square plate must be adjusted in such a manner that the line *x x* may intersect the axis of the telescope, and be parallel to the axis *o m* of the mirror. The position of the line *y y* must also be such that its distance from the axis of the telescope is equal to the distance of the line IK from the same axis. When the plate *z z* is thus adjusted, the straight line *y y* will always be in the same plane with the line IK, whatever may be the position of the mirror; and a line drawn from a point at N, where the axis of the mirror cuts IK, to the point where *y y* intersects *x x*, will be parallel to the axis of the telescope.

The spring QQ′ is fixed at Q to the arm HH, and by a screw R working into its other extremity Q′ the end H of the horizontal arm may be made to press the pivot *o o* upon the frame of the mirror. The horizontal branch HH, which is represented separately in fig. 10, is surrounded with several pieces. The piece *d b* and pivot *o* are fixed in an invariable manner. The pivot *o o* is inserted in a square hole through the piece VV, and through the extremity of the arm HH. The piece *d b* may be moved either before or behind by turning the screw; and the piece VV may be moved from right to left with the piece *d b* by means of the screw S.

The apparatus being thus constructed, the next thing to be considered is the method of adjusting it. In order to effect this, the axis of the mirror must be perpendicular to the axis of the telescope; the line drawn from a point near N, where the axis of the mirror cuts the line IK, to the point of intersection of *x x* and *y y*, must be parallel to IK, and the straight line *y y* must always be in the same plane with IK.

The mirror is first placed in such a manner that the line IK is at right angles to the axis of the telescope. By turning the screw I, the lower edge of the frame is made a tangent to the circular surface MM′, which is parallel to the axis of the telescope. The screw I is then turned in order to fix the piece *d b* in an invariable manner.

The axis of the telescope is next directed to a point on a plane surface placed at a certain distance. This point must be situated in a vertical plane, perpendicular to the plane surface, and passing through the eye of the observer and the centre of the sun. A horizontal line being drawn through this point, a second point is taken, as far from the first as the centre of the mirror is distant from the axis of the object-glass. By unscrewing S, turning the telescope on its axis, and the mirror also about its own axis, the piece VV is moved backwards or forwards until the centre of the reflected image falls upon the second point. The square plate *z z* is then adjusted in such a manner that the shadow of the line IK falls on the line *y y*, and that the shadow of NN is bisected by the line *x x*. When this happens, the plate *z z* is firmly fixed. Hence it follows that whenever this adjustment is made, and when the intersection of the cross wires of the telescope is directed to any point, the rays reflected by the mirror will be parallel to the axis of the telescope, and will always continue so while the shadow of IK falls on *y y*, and while the shadow of NN is bisected by *x x*.

In making use of the mirror, the intersection of the cross wires must be first directed to any point of the ob-

Burning Glasses.

ject which is to be inflamed. The telescope must next be turned round in the collars CC, C′C′, till the shadow of the line IK falls upon *y y*; and finally, the mirror must be turned about its own axis till the shadow of NN is bisected by the line *x x*. The centre of the reflected image will consequently fall upon a point of the object as far distant from the point to which the intersection of the wires was directed, as the centre of the mirror is from the axis of the telescope. The image may obviously be preserved in this position as long as we choose, by keeping the shadow of IK and N in the same position.

Calculation of Peyrard.

The above apparatus is certainly well contrived for effecting its object, but seems at the same time rather complex and expensive for any purpose to which such a mirror might be required. In regard to the power of such a combination of mirrors, M. Peyrard has only made some calculations founded on the observations of Buffon. In the first place, in regard to the effect of the distance of the mirrors from the object, he calculates that, with one about eighteen inches diameter, the rays are so diffused as to reduce the heating effect to one half at 66 feet; to one third at 118 feet; to one fourth at 161 feet; to one fifth at 200 feet; and to one tenth at 348 feet. The next question is to determine, at the shortest distance from the glass, how many times the sun's heat must be multiplied by the glasses to produce inflammation, or boiling or fusing of metals, or any other similar effects, in order to calculate how many glasses would be sufficient for the purpose, such reflection being, as Buffon found, one half of the sun's heat. This question is solved by Peyrard, from the observations of Buffon already stated, allowing for the distances by the above rule, and reducing them all to the shortest, or when the object is placed as close as possible to the glasses. Hence he finds, that on the 23d March, calculating for the number of glasses and the distance, four times the heat of the sun would set fire to a plank of tarred beech, and $4\frac{1}{12}$ times to a plank coated with tar and sulphur; *2dly*, that on the 10th of April a plank of tarred fir was set fire to by $4\frac{4}{15}$ times the sun's heat; *3dly*, on the 11th of April a plank of beech which had been already on fire was inflamed by $5\frac{1}{4}$ times the sun's heat. The same day small combustible materials were inflamed with three times the sun's heat, and also a block of tin weighing six pounds was melted by $11\frac{1}{4}$ times the sun's heat; also thin pieces of silver were melted, and a plate of iron made red hot, by $29\frac{1}{4}$ times the sun's heat; and Peyrard on the whole draws the conclusion, in the view of setting fire to a fleet of ships, that five times the heat of the sun would be sufficient to inflame tarred planks, and eight times this heat would be sufficient to inflame all sorts of wood, and less in general would do it. Hence he deduced, in regard to distance, that sixteen of these glasses would be sufficient to inflame wood at the distance of 66 feet; twenty-four at 118 feet; thirty-two at 161 feet; forty at 200; eighty at 348; and at 3750, or nearly three quarters of a mile, it would require 590.

In regard to these calculations, and particularly that of the effect of the sun's heat, it appears so much beyond what might naturally be looked for, that its accuracy may well be questioned; and it is surprising this should have escaped the notice of the author, and of succeeding writers, who have copied without comment all these results. If four times the sun's heat be sufficient to inflame wood, then eight glasses would do it at a small distance, which is hardly credible. At any rate, if it be so, it implies an accumulation of heat which is quite unaccountable on any of the usual principles on which this fluid acts. In fact, we have already seen, from the observations of the photometer, that the greatest effect of the sun's heat in our latitude does not exceed sixteen degrees. Supposing this the amount of it in France in the month of April, four times this would only be sixty-four degrees, while the heat of inflammation cannot be less than 800°, twelve times what Peyrard supposes. Again, thirty times the sun's heat would only amount to 480°; and yet he says that silver was melted with this heat, which requires a temperature of 4500°, nearly ten times as much. We have already stated and explained how much the effects of Buffon's mirrors exceed what might reasonably be expected from their concentrative power. But these calculations carry them still farther. The difference seems to arise from the principle on which Peyrard has calculated the effect of distance. He supposes it to diminish as the square of the distance from a point situated so far behind the mirror, that the latter subtends at that point the same angle with the sun, as at fig. 9, where AB is the diameter of the glass, AG and BG two lines, one from each extremity of the glass, and forming together an angle, AGB, of 32′. These lines being prolonged, indicate the boundary of the extreme rays reflected from the glass; and the sections MI ON RS of the cone diminish as the square of GD GP and G. In this view it would be the same as if all the light proceeded from the point G, so that all the rays would diverge from it. This, however, is far from being the case, as all the rays which fall on the glass from any given point of the sun are reflected in lines sensibly parallel, which do not diverge from that or any other point, and cannot therefore suffer diminution from distance. This calculation, therefore, would require considerable modification; and the whole subject would require, as already stated, to be re-examined experimentally.

Single reflectors.

Such are the compound mirrors which have been made on the principle of that of Archimedes. In regard to single concave mirrors, a great many of these have been constructed at different periods, remarkable for their powerful effects. We shall just describe some of the principal ones. M. Vilette, a French artist at Lyons, constructed no fewer than five mirrors of this kind, of considerable magnitude. One of them was bought by M. d'Alibert for 1500 livres; another was purchased by Tavernier, and presented to the king of Persia; a third was sent by the French king to the Royal Academy; a fourth was bought by the king of Denmark; and the fifth was brought to England for public exhibition. The first of these mirrors was thirty inches in diameter, and weighed above a hundredweight. Its focal length was about three feet, and the size of the sun's image was about half a louis d'or. It was mounted on a circular frame of steel, and could easily be put into any required position. This mirror was made in 1670, and having been brought to St Germains by order of the king, his majesty was so well pleased with it, that he rewarded Vilette with a hundred pistoles for the sight of it, and afterwards purchased it and placed it in the Royal Observatory of Paris. The effects were the following:

Vilette's burning mirrors.

	Seconds.
A small piece of pot iron was melted in	40
A silver piece of fifteen pence was pierced in	24
A thick nail (*le clou de paysan*) melted in	30
The end of a sword blade of Olinde burnt in	43
A brass counter was pierced in	6
A piece of red copper was melted in	42
A piece of chamber quarrystone was vitrified in	45
Watch-spring steel melted in	9
A mineral stone, such as is used in harquebusses *à rouet*, was calcined and vitrified in	1
A piece of mortar was vitrified in	52

Green wood and other bodies took fire instantly.

The mirror of M. Vilette which was brought to England was put into the hands of Dr Harris and Dr Desaguliers, who made several trials with it. It was a composi-

tion of copper, tin, and tin glass; and its reflection had something of a yellow cast. There were only a few small flaws in the concave surface, but there were some holes in the convex side, which was polished. The diameter of the mirror was 47 inches, its radius of curvature 76 inches, and its focal length 38 inches. The following results were obtained in June 1718, between nine and twelve o'clock in the morning, and the time was measured by a half-second pendulum.

	Seconds.
A red piece of Roman patera began to melt in	3
and was ready to drop in	100
A black piece of the same melted in	4
and was ready to drop in	64
Chalk taken out of an echinus spatangus filled with chalk only fled away in	23
A fossil shell calcined in	7
and did no more in	64
The black part of a piece of Pompey's pillar melted in	50
and the white part in	54
Copper ore, with no metal visible, vitrified in	8
Slag or cinder of the iron work said to have been wrought by the Saxons was ready to run in	29½

The mirror now became hot, and burned with much less force.

	Seconds.
Iron ore fled at first, but melted in	24
Talc began to calcine at	40
and held in the focus	64
Calculus humanus was calcined in	2
and only dropped off in	60
The tooth of an anonymous fish melted in	32½
The asbestos seemed condensed a little in	28

But it now became cloudy. M. Vilette says that the mirror usually calcines asbestos.

A golden marcassite broke, and began to melt in	30
A silver sixpence melted in	7½
A King William's copper halfpenny melted in	20
and ran with a hole in it in	31
A King George's halfpenny melted in	16
and ran in	34
Tin melted in	3
Cast iron melted in	16
Slate melted in	3
and had a hole in	6
Thin tile melted in	4
and had a hole and was vitrified through in	80
Bone calcined in	4
and vitrified in	33

An emerald was melted into a substance like Turquoise stone, and a diamond that weighed 4 grains lost $\frac{7}{8}$ths of its weight.

This mirror was made by M. Vilette some years after the first, and with the assistance of his two sons. It came into the possession of M. Vilette the son, engineer and optician to his electoral highness of Cologne, bishop and prince of Liege, where he commonly resides. At the desire of several learned men, M. Vilette brought it to London, where its effects were exhibited in Priory Garden, Whitehall.

Maginus and Manfredi. Large burning mirrors were made by Maginus, and by Manfredi, canon of Milan, one twenty inches diameter, and the other three and a half feet; but, from the accounts of them in the *Philosophical Transactions*, they appear to have had but a feeble power compared with those of Vilette.

Garouste's mirror. In the year 1685 M. de la Garouste presented to the Academy of Sciences a large metallic mirror, five feet two inches in diameter, and five feet in focal length. It was not equally polished, and a piece was inserted in the middle of it where the metal had failed. This circumstance, however, did not seem to diminish its force. Several trials were made with this mirror in the academy, by order of M. de Louvois, but the precise effects which it produced have not been detailed. It is merely stated that those who tried it were satisfied with the results, and that its effects would have been much greater had it been better polished, and mounted upon a proper stand.

Smethwick's mirror. On the 27th of February 1667–8, Francis Smethwick, Esq. produced before the Royal Society two burning concave glasses, ground of a *newly invented figure*, which was probably that of a parabola. One of them was six inches diameter, with three inches of focal length; and the other was of the same diameter, with its focus ten inches distant. When these were brought towards a large lighted candle, they somewhat warmed the faces of those that were four or five feet distant; and when held to the fire, they burnt gloves and garments at the distance of about three feet from the fire. At another experiment made in the presence of Dr Seth Ward, the deeper of the two burned a piece of wood into flame in the space of ten seconds, and the shallower one in five seconds. This experiment was made in autumn, at nine o'clock in the morning, when the weather was gloomy. By exposing the deeper concave to a northern window on which the sun did not shine, it was found to warm the hand by "collecting the warmed air in the day time, which it would not do after sunset."

This last effect is extremely remarkable; it must have arisen from the mirror collecting the radiations of heat from the distant atmosphere warmed by the heat of the day. The existence of these radiations was then perfectly unknown, and not suspected, indeed, until they were discovered only a few years ago by Professor Leslie, and actually measured by the ethrioscope.

The burning mirror to which we have already alluded, made by the celebrated Tschirnhausen, was formed of thin copperplate, about one sixteenth of an inch thick. According to one account it was about three Leipsic ells, equal to five feet diameter, and burnt at the distance of three feet and a half. According to another its diameter was four feet and a half, and its focal distance twelve feet.

The following are its effects:—

1. A piece of wood held in the focus flames in a moment, so that a fresh wind can hardly put it out.
2. Water applied in an earthen vessel immediately boils; and the vessel being kept there some time, the water evaporates all away.
3. A piece of tin or lead three inches thick melts away in drops as soon as it is put in the focus; and when held there a little time is in a *perfect fluor*, so that in two or three minutes it is quite pierced through.
4. A plate of iron or steel becomes immediately red hot, and soon after a hole is burnt through it.
5. Copper, silver, &c. melt in five or six minutes.
6. Stones, brick, &c. soon become red hot.
7. Slate becomes red hot, but in a few minutes turns into a fine sort of black glass.
8. Tiles which had been exposed to the most intense heat of fire melt down into a yellow glass.
9. Pot-shreds that had been much used in the fire melt into a blackish yellow glass.
10. Pumice stone melts into a white transparent glass.
11. A piece of a very strong crucible melted into a glass in eight minutes.
12. Bones were converted into a kind of opaque glass, and a clod of earth into a yellow or greenish glass.
13. The beams of the full moon when at her greatest altitude were concentrated by this speculum; but no perceptible degree of heat was experienced.

A plan for constructing burning mirrors of wood gilded

over was proposed by Zacharias Quabenus, in his work *In Nervo Optico*. They were joined in twenty, or even a hundred concave pieces, on a turned wooden dish or scuttle, and the surface coated with pitch and gilded.

Neuman mirror.

It is possible to construct mirrors of still more slender materials; and Zahnius, in his work *In Oculo Artifico*, fundam. 3, states, that an engineer of Vienna of the name of Neuman formed burning mirrors of pasteboard, covered in the inside with straw glued to it: and that they were capable of melting metals almost instantly. It is evident from what we have stated, that mirrors of this kind, from the great surface exposed, and the concentration in a perfect form not being absolutely necessary, may produce very powerful effects.

Hoesen and Ehrard's mirrors.

Parabolic mirrors of a large size and very considerable power were constructed by M. Hoesen of Dresden, and afterwards by M. Ehrard. These mirrors were composed of several pieces of solid wood, and on the convex part were pieces of wood, both diverging from the vertex and transversely, nicely fitted and strengthened. The concave part of this framing was covered with copperplate one eighth of an inch in thickness, four and a half feet long, and two and a half feet broad, so as to resemble one piece finely polished. The speculum was so supported as to be easily managed, and the anterior part of it was subtended by an iron arch half an inch thick. The middle of this arch, which coincided with the place of the burning focus, was perforated into a ring, which supported from both sides an iron fork for receiving the body to be examined. Four of M. Ehrard's mirrors constructed in this way had the following dimensions:—

	Perimeter.		Diameter or Ordinate		Depth or Absciss.		Focal Length.	
	Feet.	Inches.	Feet	Inches.	Feet.	Inches.	Feet.	Inches
No. 1	29	4	9	7	1	4	4	0
2	21	0	6	8	0	$10\frac{1}{2}$	3	1
3	16	4	5	1	0	$10\frac{1}{2}$	1	10
4	13	$2\frac{1}{2}$	4	2	0	7	1	9

The celebrated Wolfius, who had witnessed the effects of these mirrors, states that in burning, calcining, melting, and vitrifying, they far exceeded any thing of the kind ever known. The hardest stones scarcely resisted a few seconds. Metals were rapidly perforated, and vegetables and bones were immediately burnt to a cinder and vitrified.

Dr Gregory's burning mirror.

Our celebrated countryman Dr James Gregory turned his attention to the construction of burning machines about the year 1670; and in a letter to Mr Collins, dated St Andrews, 7th March 1673, he states his views on this subject, and requests Mr Collins to communicate them to Sir Isaac Newton, who returns a favourable opinion of the invention in a letter to Mr Collins. The passages in these letters are too interesting to be given in any other form than in the original words of these distinguished authors.

"Mr Newton's discourse of reflection," says Dr Gregory, "puts me in mind of a notion I had of burning glasses several years ago, which appears to me more usefull than subtile. If ther be a concave speculum of glasse, the leaded convex surface having the same center with the concave, or to speak preciselie, albeit perchance to little more purpose, let the radius of the convexitie be c, the thickness of the glasse *in axis transitu* f, the radius of the convexitie equal to $\frac{9c^2+18cf+5f^2}{9c+f}$, this speculum sal have the *foci* of both the surfaces in the same point; and not onlie that, but all the rays which are reflected betwixt the two surfaces, sal, in their egresse, come, *quam proximé*, to the common focus. The making of such an speculum requireth not much more airt than an ordinar plane glasse, seing great subtiltie is not necessar here; so that I believe they who mak the plane miroir glasses, wold mak one of these, three foot in diameter, for four or five pounds sterling, or little more: for I have seen plane glasses, almost of that bignes, sold even here for less money. Now seing (as Mr Newton observeth) that al reflecting metalls lose more than one third of the rayes; this concave glasse, even *cæteris paribus*, wold have an great advantage of a metall one; for certainlie an exactlie polished thin miroir glasse, of good transparent mater, after a few reflections, doeth not lose one fourth of the rayes; and, upon other accounts, this hath incomparable advantages, seeing it is more portable, free from tarnishing, and, above al, hardlie $\frac{1}{20}$th of the value. The great usefulness of burning concaves, this being so obvious, and as yet (for quhat I kno) untouched by anie, makes me jcalous that there may be in the practice some fallacie. Ye may communicate this to intelligent persons, and especiallie to Mr Newton; assuring him that none hath a greater veneration for him, admiring more his great and subtile inventions, than his and yours.

"P. S. If ye please, let me hear, with the first convenience, what may be judged the result of this burning concave; for I am as much concerned to be undeceived, if ther be any insuperable difficultie, as to be informed of an most surprising success. I have spoke of it to severals here, but al were as ignorant of it as my self," &c.

Sir Isaac Newton's reply to Mr Collins is dated Cambridge, April 9th, 1673, and contains the following passage:—

"The design of the burning speculum appears to me very plausible, and worthy of being put in practice. What artists may think of it I know not; but the greatest difficulty in the practice that occurs to me, is to proportion the two surfaces so that the force of both may be in the same point according to the theory. But perhaps it is not necessary to be so curious; for it seems to me that the effect would scarce be sensibly less, if both sides should be ground to the concave and gage of the same tool," &c. &c.

Sir Isaac Newton's mirrors.

The attention of Sir Isaac Newton being thus accidentally directed to the subject of burning instruments, he procured seven concave glass mirrors, each of which was eleven and a half inches in diameter, and six of these were placed round the seventh, and contiguous, but so as to have one common focus. The general focal length was twenty-two inches and a half, and about an inch in diameter. It melted gold in about half a minute, and vitrified brick or tile in one second. The effect of these speculæ was obviously much less than seven times the effect of any one of them. The rays of the sun could fall perpendicularly only on the one in the middle; and, in consequence of this obliquity of incidence, none of the speculæ intercepted a column of rays of the same diameter, and the image formed in the focus of each could not be exactly circular.[1]

Zeiher's mirrors.

Burning mirrors composed of glass were constructed by

[1] No account of this burning glass of Sir Isaac Newton's is given in the *Philosophical Transactions*; and we are informed, upon very good authority, that no such instrument is in the possession of the Royal Society. Mr Derham, however, a fellow of the Royal Society, gives the same account which we have followed in the text. (See Derham's *Astrotheologia*, lib. vii. cap. i. note.)

M. Zeiher of St Petersburg. His object was to convert plates of plain glass into concave mirrors, which he effected by placing the glass upon a convex tool, and exposing it to a strong heat, till it assumed the exact curvature of the tool. Zeiher made numerous trials with plates of various sizes, and, after several failures, he succeeded in finding the proper method of conducting the operation. No particular difficulties occurred in giving the proper shape to plates five or six inches in diameter; but, in forming one of sixteen inches, the circumference was moulded to the tool before the central parts, where a number of vesicles of air had collected; and, in some other cases, the glasses cracked after they had received the proper shape. The following method is that which Zeiher always found to succeed:—

A small bit of the glass to be used must first be exposed to the fire till it becomes red hot, and if, after cooling, it has preserved its polish and transparency, the glass is fit for the required purpose; for it sometimes happens that the glass becomes quite black after the operation. The plate of glass is next placed on a concave iron dish of the required curvature, and put into a furnace. Coals are placed below and above the dish, and on all sides of it. The greatest care must then be taken that the glass shall become equally hot both at the circumference and at the centre; for if the red colour should get deeper in the middle, the glass will be in great danger. As soon as the whole is red hot, the instant of its bending to the shape of the mould must be carefully watched; and when this happens, which may be observed from the reflected images of the surrounding coals, all the fire must be removed from above the glass, and also a great part of the fire at its sides. The glass must then be covered with warm ashes, that have been passed through a sieve, and it must be allowed to cool gradually. It is of the utmost importance to mark the precise moment when the glass applies itself to the surface of the mould; for, if it remain too long, a part of the scoriæ which separates from the mould will adhere to the glass. When the glass is covered with the hot ashes the fire must still be allowed to remain below the mould, lest the glass should crack by being cooled too suddenly. When the glass is taken from the furnace, its convex sides may then be silvered for a burning speculum; or, if a lens is required, two of the pieces of glass may be joined, so as to contain a fluid.

M. Zeiher also constructed burning glasses by making a concave frame of wood, and covering the concave surface with a paste made of flour, chalk, &c. till it had the requisite degree of curvature. A number of pieces of silverized glass mirrors, about half an inch square, were then fixed upon the concave side, so as to constitute a polygonal reflecting surface.

Buffon's mirrors of bended plates.

Buffon also, besides the experiments already related, made a good many on the bending of flat plates into a curve. He took circular plates of glass about eighteen inches, two feet, and three feet, in diameter, and having perforated them at the centre with an aperture two or three lines in diameter, he placed them in a circle of iron that was truly turned. A very fine screw, connected with a box stretching across the back of the glass, passed through the hole in the centre into a nut on the other side, so that by turning the screw the circular piece of flat glass was gradually incurvated till it formed a concave mirror. The glass of three feet diameter, when it was bent about five eighths of a line, had its focus fifty feet distant, and set fire to light substances; when it was bent two lines, it burned at the distance of forty feet; when it was bent two and three-fourth lines, its focal length was thirty feet; but in attempting to reduce its focal length to twenty feet, it was broken in pieces. The glass of two feet diameter shared the same fate; but the one of eighteen inches, which had a focal length of twenty-five feet, was preserved as a model of this species of mirror. The accident which happened to the two largest of these mirrors appears to have been owing to the perforation in the centre. In order to remedy this evil, Buffon proposed to place a circular piece of glass at the extremity of a cylindrical drum, made of iron or copper, and completely air tight. The cavity being exhausted by means of an air-pump, the glass at one extremity would be pressed in by the weight of the atmosphere, and would have its focal length inversely proportional to the degree of refraction. This contrivance is represented in fig. 1, Plate CLIII., and also a section of it.

A still more simple and ingenious method of exhausting the air in the drum was contrived by Buffon. He proposed to grind the central part of the plain glass into the form of a small convex glass, and in the focus of this convex portion to place a sulphur match, so that when the mirror was directed to the sun, the rays concentrated by the convex portion would inflame the match, which, being set on fire, would absorb the air, and thus produce a partial vacuum, and consequently an incurvation of the plain glass.[1] See fig. 2.

Mirrors of this kind, with a movable focus, were regarded by Buffon as of great use for measuring the effects of the solar rays, when concentrated into foci of different sizes. As the quantity of incident light and heat is nearly the same to whatever curvature the glass is successively bent, we might thus determine the size of focus by which a maximum effect was produced.

Buffon likewise made a number of concave mirrors by bending plates of glass on moulds of a spherical form. Some of these were as large as three, four, four feet six, and four feet eight inches, in diameter; but the utmost care is requisite in the formation of those of such a large diameter. After these glasses were moulded to the proper shape in appropriate furnaces, their concave and convex sides were carefully ground so as to be perfectly concentric, and the convex side was afterwards silvered by M. de Bernieres. Out of twenty-four mirrors of this kind which Buffon had moulded, he was able to preserve only three, the rest having broken, either by exposure to the air, or in the operation of grinding. One of these three, which was forty-six inches in diameter, was presented to the king of France, and was regarded as the most powerful burning mirror in Europe. The other two were thirty-seven inches in diameter, and one of them was deposited in the Cabinet of Natural History in the Jardin du

[1] Instead of grinding the central part of the glass plate into a convex form, Zeiher proposes that a small burning glass should be applied to inflame the sulphur; or, what is still better than either of these plans, a convex lens might be fastened, by the balsam of Tolu, or any transparent cement, to the centre of the glass plate.

M. Zeiher employed a more effectual method of bending circular plates of glass than that which was used by Buffon. The circular piece of glass was placed in an iron ring, across which was fixed a thin piece of iron, with a hole containing a female screw, so placed as to be above the centre of the glass. A strong bar of brass was also placed across the centre of the speculum; and a screw working in the centre of this, and in the female screw already mentioned, pressed the thin iron bar against the glass, and bent it into the proper curvature. A plate of Venetian glass, two lines thick and twenty Rhinland inches in diameter, was bent in this way till it protruded two lines in the middle, so as to have a focal length of fifteen feet, which was a greater curvature in proportion than any of Buffon's. The glass was kept in this state for several days without suffering any injury. (See *Nov. Comment. Petrop.* 1758, 1759, p. 250, note.)

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Roi. Buffon concentrated the rays of the moon by means of the mirror of forty-six inches diameter; but, though his thermometer was very sensible, no heat was perceived.

Burning lenses. Tschirnhausen's lens.

In regard to burning lenses, the first of any magnitude were constructed by M. Tschirnhausen. These were compound glasses; the light, after passing through one large glass, being still farther concentrated by a second smaller one. The large glasses were three and four feet in diameter, their focal length was about twelve feet, and the focal image about one and a half inch diameter. The focal image of the smaller glass did not exceed eight lines. The large lens, which weighed 160 pounds, was purchased by the Duke of Orleans, and presented by him to the French Academy. The following are the remarkable effects produced by it:—

1. All sorts of wood, whether hard or green, and even when wet, were burnt in an instant.

2. Water in a small vessel boiled immediately.

3. All the metals, when the pieces were of a proper size, were easily melted.

4. Tiles, slates, delft ware, pumice stone, talc, whatever was their size, grew red and vitrified.

5. Sulphur, pitch, and resins, melted under water.

6. When the metals were placed in charcoal, they melted more readily, and were completely dissipated.

7. The ashes of wood, vegetables, paper, and cloth, were converted into a transparent glass.

8. All the metals were vitrified upon a plate of porcelain. Gold received a fine purple colour.

9. Substances that would not melt in pieces were easily melted in powder; and those that resisted the heat in this form melted by adding a little salt.

10. A substance easily fused assists in melting more refractory substances when placed along with them in the focus; and it is very singular, that two substances which are very difficult to melt separately, are very easily melted when exposed together, such as flint and English chalk.

11. A piece of melted copper being thrown suddenly into cold water, produced such a violent concussion that the strongest earthen vessels were broken to pieces, and the copper was thrown off in such small particles that not a grain of it could be found. This did not happen with any other metal.

12. All bodies except the metals lose their colour. The precious stones are instantly deprived of it.

13. Certain bodies vitrify easily, and become as transparent as crystal; but by cooling they grow as white as milk, and lose all their transparency.

14. Other bodies that are opaque when melted become beautifully transparent when they are cooled.

15. Substances that are transparent both when melted and cold become opaque some days after.

16. Substances which the heat renders at first transparent, but which afterwards become opaque by being melted with other substances that are always opaque, produce a beautiful glass, always transparent.

17. The rays of the moon concentrated by this lens, though extremely brilliant, have no heat.

Buffon's fluid burning lenses.

M. de Buffon, whose ingenuity and research extended themselves into every branch of this subject, constructed various burning lenses of different kinds. His first object was to form burning glasses, by combining two circular segments of a glass sphere so as to form a lenticular cavity to be filled with water. These glass segments were first moulded into their proper shape, and then regularly ground on both sides, so that the concave and convex surfaces were exactly parallel. The one which he constructed was thirty-seven inches in diameter, with a focal length of about five feet and a half; and the segments were of considerable thickness, to prevent them from breaking or altering their form by the weight of the included water. This lens is represented at fig. 3. As the refractive power of water is very small, Buffon proposed to increase it by saturating it with salt; but notwithstanding every precaution, he found that the focus of lenses of this kind was never well terminated, nor reduced to its smallest size, and that the different refractions which the rays sustained produced a very great degree of aberration. Buffon also proposed to make each segment consist of a number of smaller segments put together into a frame; but as the water could not easily be prevented from insinuating itself between the joints of the segments, and as there would be a great difficulty in arranging them in the same spherical circumference, this kind of burning glass does not seem to have ever been executed.

Buffon's lenses with concentric zones.

Having made some experiments on the loss of light in passing through thick glasses, Buffon found it very considerable, so that it detracted greatly from the power of large burning glasses, which must of necessity be proportionally thick in the centre. Bouguer had formerly estimated the loss of light in passing through glass one twelfth of an inch, at two sevenths of the whole. But the glass used by him must have been extremely imperfect; for Buffon found, with glass from St Gobin, the loss of light in passing through one twelfth of an inch, one seventh of the whole, or only half the amount of Bouguer's estimate. Through glass one third of an inch thick, the loss was about two thirds. Hence in very large lenses the central portions must become nearly quite inefficient, from the quantity of light obstructed by them. On considering this subject, Buffon conceived a very ingenious plan for obviating the effect, and which has since become of great importance, from the extensive application of it in France in the construction of the large lenses now used there with such advantage in the light-houses, in place of reflectors. It consisted in forming the lens, not of one mass, but of several detached pieces united together into one. The central portion was a lens of much smaller diameter than the one intended to be formed, not one third perhaps, but having the same focal distance, and being therefore much thinner than the central portion of a whole lens would be; round this a second portion is set, forming a complete zone, and filling up another third of the diameter of the glass; lastly, another similar zone round the second, forming the exterior portion of the lens. Each of these zones forms a portion of a lens of the same focal distance as the central one, only much thinner; and then we obtain a very large lens, and yet extremely thin in proportion, so as to pass a much larger quantity of light than the others. Fig. 4 is a view of one of this sort of lenses, and fig. 5 sections of several lenses, which will render it quite intelligible. This species of glass Buffon considers as the most perfect of the kind; and when it is made three feet diameter, and an inch and a fourth thick at the centre, and six feet focus, he thinks it will give a degree of heat four times greater than that of the most powerful lenses yet known. "I venture to predict," he says, "that this glass in pieces, which I have thought of for twenty years, will be one of the most useful instruments of physics." Instead of having each zone in one entire piece, it is obvious that, without altering the effect, the zones, as proposed by Sir David Brewster, may be composed of two or more pieces, which facilitates the perfect execution; and this is the mode in which they are now constructed in France, constituting one of the most important improvements hitherto made in light-houses. Besides their thinness, these glasses possess other advantages. The pieces which compose the compound ones can be easily obtained, and selected of the purest kind and freest from flaws and veins; whereas in large lenses it was extremely difficult to obtain one entire mass of glass free from impurities and imperfections. The spherical aber-

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ration, which is very considerable in large glasses, can here be avoided by making the exterior segments of such focal lengths as to throw the rays to the same point with the central part. Fig. 6 shows a section of one of these lenses, and a view of one of the pieces.

Trudaine's lens.

The next burning lens of any magnitude was constructed by M. Bernieres, for M. Trudaine de Moutigny, an honorary member of the Royal Academy of Sciences. This gentleman, whose liberality and zeal deserve to be recorded, engaged to be at the expense of a large burning glass, formed under the direction of several commissioners named by the academy. This lens consisted of two spherical segments eight feet radius and eight lines thick. The lenticular cavity was four feet in diameter, and six inches and five lines thick at the centre, and was filled with spirits of wine, of which it held no less than 140 pints. The focal length of a zone at the circumference, about six or seven lines broad, was ten feet and six lines, the focal length of a portion at the centre, about six inches in diameter, was ten feet seven inches and five lines, the diameter of the focus was fourteen lines and three fourths. When the whole surface was covered, except a zone at the circumference of six or seven lines, the following were the foci of the different rays:

	Feet.	Inches.	Lines.	
Violet	9	6	4½	from the centre of the lens.
Blue	9	7	10½	
Yellow	10	2	3	
Orange	10	2	10	
Red	10	3	11½	

The following experiments were made in October 1774, in the Jardin de l'Infante, by MM. Trudaine, Macquer, Cadet, Lavoisier, and Brisson, the commissioners appointed by the academy.

1. The burning power of the anterior half of the lens was much greater than that of the exterior half.

2. On the 5th of October, after mid-day, the sky not being very clear, two farthings placed upon charcoal were completely melted in half a minute.

3. In order to melt forged iron, it was found necessary to concentrate the rays by a second lens eight inches and a half diameter, twenty-two inches eight lines in focal length, and placed at eight feet seven inches from the centre of the great lens. At this place the cone of rays was eight inches in diameter, and the burning focus, now reduced to eight lines in diameter, was one foot from the small lens.

4. In the focus of the small lens, upon a piece of hollow charcoal small pieces of forged iron were placed, which were instantly melted. After fusion, the metal bubbled up, and fumed like nitre in fusion, and then sent off a great number of sparks. This effect (which was observed during the experiments with Tschirnhausen's lens) always took place after the fusion of iron, forged iron, or steel.

5. In order to try the effect upon greater masses, pieces of forged iron, and the end of a nail, were exposed to the focus, and were melted in fifteen seconds. A piece of nail five lines long and one fourth of a line square, which was added to the rest, was instantly fused; and the same was the case with a screw that had a round head, and was eight lines in length.

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6. Some days afterwards, a bar of steel, four inches long and four lines square, was exposed, so as to receive the focal image upon the middle of its length. This part was completely melted in five minutes, after having begun to run at the end of the second minute.

7. Platina, in grains, appeared to draw together, to diminish in bulk, and to prepare for fusion. A little after, it bubbled up and smoked. All the grains were united into one mass, without however forming a spherical button like other melted metals. After the platina had undergone this semifusion, it was not attracted by the magnet as it was before the operation.

8. A portion of platina, deprived of the iron which it contained, and therefore not affected by the magnet, lost a part of its bulk, smoked, and formed one mass, which was extended under the hammer.[1]

9. Several experiments were made in order to find the lens that was most proper for collecting the rays after refraction by the large lens. A spirit of wine lens two feet in diameter and four feet focus, a solid lens eighteen inches in diameter and three feet focus, and another thirteen inches in diameter, were successively tried, but none of them produced such a powerful effect as the lens eight inches and a half in diameter, and twenty-two inches and eight lines focus, though it was full of vesicles and striæ.

Messrs Cadet and Brisson made a number of experiments on the refractive power of different fluids, by inclosing them in the lens of M. Trudaine, and observing the variations in its focal length. The object of their experiments was to find a fluid that possessed a greater refractive power than spirits of wine, and was at the same time sufficiently cheap and transparent to be used between the glass segments. Liquid turpentine was the most refractive fluid that they employed; but as they found that its dispersive power was to that of crown-glass as 34 to 28, this fluid was obviously, on this account, unfit for the purpose.[2] The fluid which they preferred was a saturated solution of sal-ammoniac or distilled water.

The most powerful burning-glass that has yet been constructed was made by Mr Parker of Fleet Street. After a great number of experiments, and an expense of above L.700, this able artist succeeded in completing a burning lens of flint-glass three feet in diameter. This powerful instrument is represented in fig. 7. The large lens, which is placed in the ring at A, is doubly convex, and when fixed in its frame, it exposes a surface of two feet eight inches and a half. It is three and a fourth inches thick at the centre, its focal distance is six feet eight inches, the diameter of the burning focus one inch, and the weight of the lens 212 pounds. The rays that were refracted by this lens were received (according to the method of Tschirnhausen) upon a second lens B, whose diameter is sixteen inches out of the frame, and thirteen inches in the frame; its central thickness is an inch and five eighths. The length of its focus is twenty-nine inches, the diameter of the focal image three eighths of an inch, and the weight of the lens twenty-one pounds. The combined focal length of these lenses is five feet three inches, and the diameter of the focus half an inch. These

[1] Messrs Macquer and Beaume are said to have melted small grains of platina by a concave glass twenty-two inches in diameter and twenty-eight inches focus.

[2] Cadet and Brisson, in the course of their experiments, were led to the discovery of achromatic fluid object-glasses, a discovery which has hitherto been referred to a much later date. This discovery is most distinctly contained in the following passage. "Comme la térébinthe cause une dispersion de rayons assez differente de celle que cause le verre, comme nous nous en sommes assurés par l'expérience, ne pourroit on pas faire des objectifs dans lesquels: pour les rendre achromatiques, on feroit usage de cette résine á la place du flint-glass, matière si difficile à se procurer d'une densité uniforme, et sans défauts, surtouts en grands morceaux; mais le développement de cette idée nous meneroit trop loin, et ne fait pas partie de notre sujet actuel!" (*Mem. Acad. Par.* 1777, p. 551.)

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lenses are placed at the extremities of a truncated conical frame, consisting of twelve ribs of wood. Near the smaller end B is fixed a rack D, which passes through the pillar L, and is movable by means of a pinion within the pillar, driven by the handle E. A bar of wood F, fixed at G, between the two lower ribs of the cone, carries an apparatus H, which turns on a universal joint at K, and also moves to or from F in a chased mortise. This apparatus, which carries the iron plate I for holding the substances to be examined, may thus be placed exactly in the focus of the lens B. The conical framing is supported by pivots upon a strong iron bow AC, which rests upon a mahogany frame LL, with three feet MMM furnished with castors. Friction wheels are placed under the table N, to facilitate the horizontal motion.

The following experiments with this lens were made in the presence of Major Gardner, and of several members of the Royal Society.

Substances fused, with their weight and time of fusion.	Weight in grains.	Time in seconds.
Common slate	10	2
Scoria of wrought iron	12	2
Gold, pure	20	3
Platina, do.	10	3
Nickel	16	3
Cast iron, a cube	10	3
Silver, pure	20	4
Crystal pebble	7	6
Terra ponderosa, or barytes	10	7
Lava	10	7
Asbestos	10	10
Steel, a cube	10	12
Bar iron, do.	10	12
Garnet	10	17
Copper, pure	33	20
Onyx	10	20
Zeolites	10	23
Pumice stone	10	24
An oriental emerald	2	25
Jasper	10	25
White agate	10	30
Flint, oriental	10	30
A topaz or chrysolite	3	45
Common limestone	10	55
Volcanic clay	10	60
Cornish moor-stone	10	60
White rhomboidal spar	10	60
Rough carnelian	10	75
Rotten stone	10	80

A diamond of ten grains, when exposed to the lens for thirty minutes, was reduced to six grains. It opened, foliated, and emitted whitish fumes, and when again closed it bore a polish and kept its form.

Gold retained its metallic state though exposed for many hours.

The specimens of platina were in different states of approach to a metallic form.

Copper did not lose any of its weight after an exposure of three minutes.

Iron steel shear melted first at the part in contact with the charcoal, while the other part exposed to the focus was unfused.

Iron scoria melted in much less time than the turnings of iron.

Calx of iron from vitriolic acid, precipitated by mild fixed alkali, weighed five grains before exposure, and five and a quarter after it.

The remains of regulus of zinc, after it had melted and was nearly evaporated, were magnetic. It was not pure.

Regulus of cobalt was completely evaporated in 57″.

Regulus of bismuth exposed in charcoal was nearly evaporated. In black lead it began to melt in 2″, and was soon after completely fused. Iron, on exposure of 180″, lost only half a grain; when placed on bone ash it fused in 3″.

Regulus of antimony, thirty-three grains, on charcoal, were fused in 3″, and eleven grains only remained after 195″.

Fine kearsh from the cannon foundery evaporated very fast during 120″, and 30″ afterwards the remainder flowed in globules, which were attracted by the magnet when cold.

Crystal pebble of North America, five grains, contracted in 15″, were perfectly glazed in 135″, ebullesced in 150″, and became of a slate colour and semitransparent.

Agate, oriental flint, cornelian, and jasper, were rendered externally of a glossy form.

Garnet, placed upon black lead, fused in 120″. It became of a darker hue, lost one fourth of a grain, and was attracted by the magnet. Ten cut garnets from a bracelet ran into one another in a few seconds.

Mr Wedgewood's pyrometrical clay ran into a white enamel in a few seconds. Other seven kinds of clay sent by that gentleman were vitrified.

Limestone was sometimes vitrified and sometimes agglutinated. A globule from one of the specimens flew into a thousand pieces when put into the mouth.

Stalactites zeolithus spatosus, nine grains, took a globular form in 60″. The globule began to become clear in 148″. It became perfectly transparent in 155″. When cold, its transparency diminished, and it assumed a beautiful red colour.

Lavas and other volcanic products likewise yielded to the power of this lens.

In the year 1802 Sir Joseph Banks, Dr Crawford, and some other members of the Royal Society, were present at an experiment for concentrating the lunar rays; but though the most sensible thermometers were applied, it was rather thought that there was a diminution than an increase of heat.

It was not to be expected that this powerful lens, which cost so large a sum of money, could have been retained in the hands of Mr Parker. That ingenious artist was naturally desirous to indemnify himself for the expense of its construction. A subscription was therefore opened for purchasing the lens as a national instrument; but this subscription failing, Mr Parker was induced to sell it to Captain Mackintosh, who accompanied Lord Macartney to China. This valuable instrument was left at Pekin, where it still remains.

This glass of Parker's is perhaps the largest solid lens that can be made in practice, without very great difficulties and expense in procuring so large a quantity of material of sufficient purity, and casting it in the lenticular form free of faults; and supposing these overcome, we have still the great thickness in the centre, and the enormous absorption of light in consequence of it, while the exterior portion of the glass by the spherical aberration disperses the rays from the focal point. With the compound lenses of Buffon, again, there is no limit to the magnitude further than what arises from the reflection of light near the circumference of the glass when the rays fall there very obliquely. If the diameter of the lens were to be equal to the chord of 48° of the sphere to which the lens has been formed, the whole of the incident light near the circumference would be reflected.

Burning sphere of Sir David Brewster.

To augment still further the power of burning instruments, Sir David Brewster proposes a compound instrument, which he terms a burning sphere, consisting of lenses and reflectors combined together,—a series of lenses be-

ing arranged in a circle having their foci all in the centre, and having each a plane reflector so situated as to throw the sun's rays in the direction of the axis of the lens. The following is his description of it as represented in fig. 8, which is merely a section of the sphere, and represents only five of the lenses and four of the mirrors. The lenses A, B, C, D, E, which may be of any diameter and focal length, are so placed in the spherical surface AMN, that their principal foci exactly coincide in the point F. If any of the lenses have a different focal length from the rest, the coincidence of its focus with that of the other may be easily effected by varying its distance from F. The whole spherical surface, whose section is AMN, except a small opening for admitting the object to be fused, may be covered with lenses, having all their foci coincident at F; though it will, perhaps, be more convenient to have the posterior part MN without lenses, and occupied by a mirror of nearly the same radius FA as the sphere. The object of this mirror is to throw back upon the object at F the light that passes by it, without producing any effect. Each of the lenses, except the lens A, is furnished with a plane glass mirror, which may be either fixed to the general frame of the sphere, or placed upon a separate stand. When this combination is completed the sphere is exposed to the sun, so that its rays may fall at right angles upon the lens A, which will of course concentrate them at F, and produce a pretty intense heat. The plane mirror PQ, when properly adjusted, will reflect the sun's light perpendicularly upon the lens B, by which it will be refracted accurately to the focus F, and produce a degree of heat fully one half of what was produced by the direct refracted rays of the sun through the lens A. A similar effect will be produced by the mirror RS and lens D, the mirror TU and lens C, the mirror VW and lens E, and by all the other mirrors and lenses which are not seen in the section. The effect may be still further increased by the addition of a large lens at XX. As the angle which the surface of each mirror forms with the axis of its corresponding lens is a constant quantity, the mirrors may be all fixed to the general frame of the sphere, and therefore the only adjustment which the instrument will require is to keep the axis of the lens A parallel to the direction of the solar rays.

In order to estimate the advantages of this construction, let us compare its effects with those of a solid lens, which exposes the same area of glass to the incident rays.

1. In the burning sphere, almost the only diminution of light is that which arises from reflection by the plane mirrors, and which may be estimated pretty accurately at one half of the incident light; but this loss can be amply compensated by adding a few more lenses.

2. In the solid lens a great diminution of light arises from the thickness of the central portions, and from the obliquity of the parts at the circumference, which, we conceive, will be fully equal to the light lost by reflection in the burning sphere.

3. In the burning sphere the lenses may be obtained of much purer glass than can be got for a solid lens; and therefore, *cæteris paribus*, they will transmit more light.

4. Owing to the small size of each lens in the burning sphere, the diminution of effect arising both from spherical aberration and from the aberration of colour will be very much less than in the solid lens.

5. In the burning sphere the effect is greatly increased, in consequence of the shortness of the focal length of each lens, and the greater concentration of the incident light.

6. In the burning sphere all kinds of lenses may be combined. They may be made of any kind of glass, of any diameter, and of any focal length; and the lenses belonging to different individuals may be combined for any occasional experiment in which a great intensity of heat is requisite.

For further information on the subject of burning instruments, see Buffon, *Supplément à Histoire Naturelle*, tome première, 4to; *Sixième Mémoire*, p. 399; Kircher, *Ars Magna Lucis et Umbræ*, p. 772; Wolfii, *Opera Mathematica*, tom. ii. p. 165; Traberus, *In Nervo Optic.* lib. ii.; *Phil. Trans.* No. 6, p. 95; *Ibid.* No. 33, p. 631; *Ibid.* No. 40, p. 795; *Ibid.* 1719, vol. xxx.; No. 360, p. 976; *Ibid.* 1687, vol. xvi.; Tschirnhausen, vol. xix. 1768; Vilette, *Journal des Savans*, 1666; La Garouste, *Mém. Acad. Par.* 1679, tom. i.; Nollet, *Mém. Acad. Par.* 1757; Courtivron, *Mém. Acad. Par.* 1747; Trudaine, *Mém. Acad. Par.* 1774; Cadet and Brisson, *Mém. Acad. Par.* 1777; *Act. Erudit.* 1687; Richman, *Nov. Com. Petrop.* tom. iii.; Zeiher, *Nov. Com. Petrop.* tom. vii. 1758, 1759; *Journal Encyclopedique*, 1777; Dupuy, *Mém. Acad. Inscript.* 1777; *Œuvres d'Archimède*, par T. Peyrard, tom. ii.; Bossuet, *Histoire des Mathematiques*; Duten, *Du Miroir Ardent d'Archimède*, Paris, 1755; *A description of the great Burning Glass made by M. Vilette and his two Sons, with some Remarks on the surprising and wonderful effects thereof*, London, 1719, &c. (G. B.)

BURNISHER, one who burnishes. The instrument called a burnisher is of different kinds; as a piece of round polished steel, a dog's or wolf's tooth, a piece of agate, &c. The burnishers of engravers on copper usually serve with one end to burnish, and with the other to scrape.

BURNLEY, a market-town of England, 22 miles north of Manchester, in the county of Lancaster, hundred of Blackburn, and parish of Whalley. It is pleasantly situated in a narrow valley on the Burn, from which it derives its name. Besides the chapel, an ancient structure of various styles of architecture, there are places of worship for Methodists, Independents, Roman Catholics, &c. There is a free grammar-school, national, British, and other schools, mechanics' institute, savings-bank, and several charities. The chief manufactures are cotton and woollen goods, with iron and brass foundries, breweries, tanneries, and roperies. In the vicinity are coal mines, and limestone and slate quarries. Market-days Monday and Saturday. The Leeds and Liverpool canal nearly surrounds the town, which is connected by railway with Manchester, &c. Pop. (1851) 20,828.

BURNS, Robert, the national bard of Scotland, was born on the 25th of January 1759, in a clay-built cottage about two miles south of the town of Ayr. He was the eldest son of William Burnes, or Burness, who at the period of Robert's birth was gardener and overseer to a gentleman of small estate; but resided on a few acres of land which he had on lease from another person. The father was a man of strict religious principles, and also distinguished for that penetration and knowledge of mankind which was afterwards so conspicuous in his son. The mother of the poet was likewise a very sagacious woman, and possessed an inexhaustible store of ballads and legendary tales, with which she nourished the infant imagination of him whose own productions were destined to excel them all.

These worthy individuals laboured diligently for the support of an increasing family; nor, in the midst of harassing struggles, did they neglect the mental improvement of their offspring; a characteristic of Scottish parents, even under the most depressing circumstances. In his sixth year Robert was put under the tuition of one Campbell, and subsequently under Mr John Murdoch, a

Burns.

very faithful and pains-taking teacher. With this individual he remained for a few years, and was accurately instructed in the first principles of composition. The poet and his brother Gilbert were the aptest pupils in the school, and were generally at the head of the class. Mr Murdoch, in afterwards recording the impressions which the two brothers made on him, says, "Gilbert always appeared to me to possess a more lively imagination, and to be more of the wit, than Robert. I attempted to teach them a little church-music. Here they were left far behind by all the rest of the school. Robert's ear in particular was remarkably dull, and his voice untunable. It was long before I could get them to distinguish one tune from another. Robert's countenance was generally grave, and expressive of a serious, contemplative, and thoughtful mind. Gilbert's face said, *Mirth, with thee I mean to live;* and certainly, if any person who knew the two boys had been asked which of them was the most likely to court the muses, he would never have guessed that *Robert* had a propensity of that kind."

Besides the tuition of Mr Murdoch, Burns received instructions from his father in writing and arithmetic. Under their joint care he made rapid progress, and was remarkable for the ease with which he committed devotional poetry to memory. The following extract from his letter to Dr Moore in 1787 is interesting, from the light which it throws upon his progress as a scholar, and on the formation of his character as a poet:—"At those years," says he, "I was by no means a favourite with any body. I was a good deal noted for a retentive memory, a stubborn sturdy something in my disposition, and an enthusiastic idiot piety. I say *idiot* piety, because I was then but a child. Though it cost the schoolmaster some thrashings, I made an excellent scholar; and by the time I was ten or eleven years of age, I was a critic in substantives, verbs, and particles. In my infant and boyish days, too, I owed much to an old woman who resided in the family, remarkable for her ignorance, credulity, and superstition. She had, I suppose, the largest collection in the country, of tales and songs concerning devils, ghosts, fairies, brownies, witches, warlocks, spunkies, kelpies, elf-candles, dead-lights, wraiths, apparitions, cantrips, giants, enchanted towers, dragons, and other trumpery. This cultivated the latent seeds of poetry; but had so strong an effect on my imagination, that to this hour, in my nocturnal rambles, I sometimes keep a sharp look-out in suspicious places; and though nobody can be more sceptical than I am in such matters, yet it often takes an effort of philosophy to shake off these idle terrors. The earliest composition that I recollect taking pleasure in was *The Vision of Mirza*, and a hymn of Addison's, beginning, *How are thy servants blest, O Lord!* I particularly remember one half-stanza, which was music to my boyish ear—

For though on dreadful whirls we hung
High on the broken wave.—

I met with these pieces in *Mason's English Collection*, one of my school-books. The first two books I ever read in private, and which gave me more pleasure than any two books I ever read since, were, *The Life of Hannibal*, and *The History of Sir William Wallace*. Hannibal gave my young ideas such a turn, that I used to strut in raptures up and down after the recruiting drum and bagpipe, and wish myself tall enough to be a soldier; while the story of Wallace poured a tide of Scottish prejudice into my veins, which will boil along there till the flood-gates of life shut in eternal rest."

Mr Murdoch's removal from Mount Oliphant deprived Burns of his instructions; but they were still continued by the father of the bard. About the age of fourteen he was sent to school every alternate week for the improvement of his writing. In the meanwhile he was busily employed upon the operations of the farm; and, at the age of fifteen, was considered as the principal labourer upon it. About a year after this he gained three weeks of respite, which he spent with his old tutor Murdoch at Ayr, in revising the English grammar, and in studying the French language, in which he made uncommon progress. Ere his sixteenth year elapsed, he had considerably extended his reading. The vicinity of Mount Oliphant to Ayr afforded him facilities for gratifying what had now become a passion. Among the books which he had perused were some plays of Shakspeare, Pope, the works of Allan Ramsay, and a collection of songs which constituted his *vade-mecum*. "I pored over them," says he, "driving my cart or walking to labour, song by song, verse by verse, carefully noticing the true tender or sublime from affectation and fustian." So early did he evince his attachment to the lyric muse, in which he was destined to surpass all who have gone before or succeeded him.

At this period the family removed to Lochlea, in the parish of Tarbolton. Some time before, however, he had made his first attempt in poetry. It was a song addressed to a rural beauty about his own age; and though possessing no great merit as a whole, it contains some lines and ideas which would have done honour to him at any age. After the removal to Lochlea his literary zeal slackened, for he was thus cut off from those acquaintances whose conversation stimulated his powers, and whose kindness supplied him with books. For about three years after this period he was busily employed upon the farm; but at intervals he paid his addresses to the poetic muse, and with no common success. The summer of his nineteenth year was spent in the study of mensuration, surveying, &c. at a small sea-port town, a good distance from home. He returned to his father's considerably improved. "My reading," says he, "was enlarged with the very important addition of Thomson's and Shenstone's works. I had seen human nature in a new phasis; and I engaged several of my school-fellows to keep up a literary correspondence with me. This improved me in composition. I had met with a collection of letters by the wits of Queen Anne's reign, and I pored over them most devoutly; I kept copies of any of my own letters that pleased me; and a comparison between them and the composition of most of my correspondents flattered my vanity. I carried this whim so far, that though I had not three farthings worth of business in the world, yet almost every post brought me as many letters as if I had been a broad plodding son of day-book and ledger."

His mind, peculiarly susceptible of tender impressions, was continually the slave of some rustic charmer. In the "heat and whirlwind of his love," he generally found relief in poetry, by which, as by a safety valve, his turbulent passions were allowed to have vent. He formed the resolution of entering the matrimonial state; but his circumscribed means of subsistence as a farmer preventing his taking that step, he resolved on becoming a flax-dresser, for which purpose he removed to the town of Irvine in 1781. The speculation turned out unsuccessful; for the shop catching fire, was burnt, and the poet returned to his father without a sixpence. During his stay at Irvine he had met with Ferguson's poems. This circumstance was of some importance to Burns, for it roused his poetic powers from the torpor into which they had fallen, and in a great measure finally determined the *Scottish* character of his poetry. He here also contracted some friendships, which he himself says did him mischief; and, by his brother Gilbert's account, from this date there was a serious change in his conduct. The venerable and ex-

cellent parent of the poet died soon after his son's return. The support of the family now devolving upon Burns, in conjunction with his brother he took a sub-lease of the farm of Mossgiel, in the parish of Mauchline. The four years which he resided upon this farm were the most important of his life. It was here he felt that nature had designed him for a poet; and here, accordingly, his genius began to develope its energies in those strains which will make his name familiar to all future times, the admiration of every civilized country, and the glory and boast of his own.

The vigour of Burns's understanding, and the keenness of his wit, as displayed more particularly at masonic meetings and debating clubs, of which he formed one at Mauchline, began to spread his fame as a man of uncommon endowments. He now could number as his acquaintance several clergymen, and also some gentlemen of substance; amongst whom was Mr Gavin Hamilton, writer in Mauchline, one of his earliest patrons. One circumstance more than any other contributed to increase his notoriety. "Polemical divinity," says he to Dr Moore in 1787, "about this time was putting the country half mad; and I, ambitious of shining in conversation-parties on Sundays, at funerals, &c. used to puzzle Calvinism with so much heat and indiscretion, that I raised a hue-and-cry of heresy against me, which has not ceased to this hour." The farm which he possessed belonged to the Earl of Loudon, but the brothers held it in sub-lease from Mr Hamilton. This gentleman was at open feud with one of the ministers of Mauchline, who was a rigid Calvinist. Mr Hamilton maintained opposite tenets; and it is not matter of surprise that the young farmer should have espoused his cause, and brought all the resources of his genius to bear upon it. The result was *The Holy Fair*, *The Ordination*, *Holy Willie's Prayer*, and other satires, as much distinguished for their coarse severity and bitterness, as for their genius.

The applause which greeted these pieces emboldened the poet, and encouraged him to proceed. In his life by his brother Gilbert, a very interesting account is given of the occasions which gave rise to the poems, and the chronological order in which they were produced. The exquisite pathos and humour, the strong manly sense, the masterly command of felicitous language, the graphic power of delineating scenery, manners, and incidents, which appear so conspicuously in his various poems, could not fail to call forth the admiration of those who were favoured with a perusal of them. But the clouds of misfortune were gathering darkly above the head of him who was thus giving delight to a large and widening circle of friends. The farm of Mossgiel proved a losing concern; and an amour with Miss Jane Armour, afterwards Mrs Burns, had assumed so serious an aspect, that he at first resolved to fly from the scene of his disgrace and misery. One trait of his character, however, must be mentioned. Before taking any steps for his departure, he met Miss Armour by appointment, and gave into her hands a written acknowledgment of marriage, which, when produced by a person in her situation, is, according to the Scots law, to be accepted as legal evidence of an *irregular* marriage having really taken place. This the lady burned at the persuasion of her father, who was adverse to a marriage; and Burns, thus wounded in the two most powerful feelings of his mind, his love and pride, was driven almost to insanity. Jamaica was his destination; but as he did not possess the money necessary to defray the expense of his passage out, he resolved to publish some of his best poems, in order to raise the requisite sum. These views were warmly promoted by some of his more opulent friends; and a sufficiency of subscribers having been procured, one of the finest volumes of poetry that ever appeared in the world issued from the provincial press of Kilmarnock.

It is hardly possible to imagine with what eager admiration and delight they were everywhere received. They possessed in an eminent degree all those qualities which invariably contribute to render any literary work quickly and permanently popular. They were written in a phraseology of which all the powers were universally felt, and which being at once antique, familiar, and now rarely written, was therefore fitted to serve all the dignified and picturesque uses of poetry, without making it unintelligible. The imagery and the sentiments were at once natural, impressive, and interesting. Those topics of satire and scandal in which the rustic delights; that humorous imitation of character, and that witty association of ideas familiar and striking, yet not naturally allied to one another, which has force to shake his sides with laughter; those fancies of superstition, at which one still wonders and trembles; those affecting sentiments and images of true religion, which are at once dear and awful to the heart; were all represented by Burns with the magical power of true poetry. Old and young, high and low, grave and gay, learned and ignorant, all were alike surprised and transported.

In the mean time, a few copies of these fascinating poems found their way to Edinburgh, and having been read to Dr Blacklock, obtained his warmest approbation; and he advised the author to repair to Edinburgh. Burns lost no time in complying with this request; and accordingly, towards the end of the year 1786, he set out for the capital, where he was received by Dr Blacklock with the most flattering kindness, and introduced to every person of taste among that excellent man's friends. Multitudes now vied with each other in patronising the rustic poet. Those who possessed at once true taste and ardent philanthropy were soon united in his praise; those who were disposed to favour any good thing belonging to Scotland, purely because it was Scottish, gladly joined the cry; while those who had hearts and understandings to be charmed without knowing why, when they saw their native customs, manners, and language, made the subjects and the materials of poesy, could not suppress that impulse of feeling which struggled to declare itself in favour of Burns.

Thus did Burns, ere he had been many weeks in Edinburgh, find himself the object of universal curiosity, favour, admiration, and fondness. He was sought after, courted with attentions the most respectful and assiduous, feasted, flattered, caressed, and treated by all ranks as the great boast of his country, whom it was scarcely possible to honour and reward in a degree equal to his merits.

A new edition of his poems was called for; and the public mind was directed to the subject by Henry Mackenzie, who dedicated a paper in the *Lounger* to a commendatory notice of the poet. This circumstance will ever be remembered to the honour of that polished writer, not only for the warmth of the eulogy he bestowed, but because it was the first printed acknowledgment which had been made to the genius of Burns. The copyright was sold to Creech for L.100; but the friends of the poet advised him to forward a subscription. The patronage of the Caledonian Hunt, a very influential body, was obtained. The list of subscribers rapidly rose to 1500; many gentlemen paying a great deal more than the price of the volume; and it was supposed that the poet derived from the subscription and the sale of his copy-right a clear profit of at least L.700.

The conversation of Burns, according to the testimony of all the eminent men who heard him, was even more wonderful than his poetry. He affected no soft air nor graceful motions of politeness, which might have ill accorded

with the rustic plainness of his native manners. Conscious superiority of mind taught him to associate with the great, the learned, and the gay, without being overawed into any such bashfulness as might have rendered him confused in thought or hesitating in elocution. He possessed withal an extraordinary share of plain common sense or mother-wit, which prevented him from obtruding upon persons, of whatever rank, with whom he was admitted to converse, any of those effusions of vanity, envy, or self-conceit, in which authors who have lived remote from the general practice of life, and whose minds have been almost exclusively confined to contemplate their own studies and their own works, are but too prone to indulge. In conversation he displayed a sort of intuitive quickness and rectitude of judgment upon every subject that arose. The sensibility of his heart, and the vivacity of his fancy, gave a rich colouring to whatever opinions he was disposed to advance; and his language was thus not less happy in conversation than in his writings. Hence those who had met and conversed with him once, were pleased to meet and to converse with him again and again.

For some time he associated only with the virtuous, the learned, and the wise, and the purity of his morals remained uncontaminated. But unfortunately he fell, as others have fallen in similar circumstances. He suffered himself to be surrounded by persons who were proud to tell that they had been in company with Burns, and had seen Burns as loose and as foolish as themselves. He now also began to contract something of arrogance in conversation. Accustomed to be among his associates what is vulgarly but expressively called "the cock of the company," he could scarcely refrain from indulging in a similar freedom and dictatorial decision of talk, even in the presence of persons who could less patiently endure presumption.

After remaining some months in the Scottish metropolis, basking in the noontide sun of a popularity which, as Dugald Stewart well remarks, would have turned any head but his own, he formed a resolution of returning to the shades whence he had emerged, but not before he had perambulated the southern border. On the 6th of May 1787 he set out on his journey, and, visiting all that appeared interesting on the north of the Tweed, proceeded to Newcastle and other places on the English side. He returned in about two months to his family at Mauchline; but in a short period he again set out on an excursion to the north, where he was most flatteringly received by all the great families. On his return to Mossgiel he completed his marriage with Miss Armour. He then concluded a bargain with Mr Miller of Dalswinton, for a lease of the farm of Elliesland, on advantageous terms.

Burns entered on possession of this farm at Whitsunday 1788. He had formerly applied with success for an excise commission, and during six weeks of the summer of this year he had to attend to the business of that profession at Ayr. His life for some time was thus wandering and unsettled; and Dr Currie mentions this as one of his chief misfortunes. Mrs Burns came home to him towards the end of the year, and the poet was accustomed to say that the happiest period of his life was the first winter he spent in Elliesland. The neighbouring farmers and gentlemen, pleased to obtain for a neighbour the poet by whose works they had been delighted, kindly sought his company, and invited him to their houses. Burns, however, found an inexpressible charm in sitting down beside his wife, at his own fireside; in wandering over his own grounds; in once more putting his hand to the spade and the plough; in forming his inclosures, and managing his cattle. For some months he felt almost all that felicity which fancy had taught him to expect in his new situation. He had been for a time idle; but his muscles were not yet unbraced for rural toil. He now seemed to find a joy in being the husband of the mistress of his affections, and in seeing himself the father of children such as promised to attach him for ever to that modest, humble, and domestic life, in which alone he could hope to be permanently happy. Even his engagements in the service of the excise did not, at first, threaten either to contaminate the poet or to ruin the farmer.

From various causes, the farming speculation did not succeed. Indeed, from the time he obtained a situation under government, he gradually began to sink the farmer in the exciseman. Occasionally he assisted in the rustic occupations of Elliesland, but for the most part he was engaged in very different pursuits. In his professional perambulations over the moors of Dumfriesshire he had to encounter temptations which a mind and temperament like his found it difficult to resist. His immortal works had made him universally known and enthusiastically admired; and accordingly he was a welcome guest at every house, from the most princely mansion to the lowest country inn. In the latter he was too frequently to be found as the presiding genius, and master of the orgies. However, he still continued at intervals to cultivate the muse; and, besides a variety of other pieces, he produced at this period the inimitable poem of Tam o'Shanter. Johnson's Miscellany was also indebted to him for the finest of its lyrics. One pleasing trait of his character must not be overlooked. He superintended the formation of a subscription library in the parish, and took the whole management of it upon himself. These institutions, though common now, were not so at the period of which we write; and it should never be forgotten that Burns was amongst the first, if not the very first, of their founders in the rural districts of southern Scotland.

Towards the close of 1791 he finally abandoned his farm; and obtaining an appointment to the Dumfries division of excise, he repaired to that town on a salary of L.70 per annum. All his principal biographers concur in stating that after settling in Dumfries his moral career was downwards. Heron, who had some acquaintance with the matter, says, "His dissipation became still more deeply habitual; he was here more exposed than in the country to be solicited to share the revels of the dissolute and the idle; foolish young men flocked eagerly about him, and from time to time pressed him to drink with them, that they might enjoy his wit. The Caledonian Club, too, and the Dumfriesshire and Galloway Hunt, had occasional meetings in Dumfries after Burns went to reside there; and the poet was of course invited to share their conviviality, and hesitated not to accept the invitation. In the intervals between his different fits of intemperance he suffered the keenest anguish of remorse, and horribly afflictive foresight. His Jane behaved with a degree of conjugal and maternal tenderness and prudence, which made him feel more bitterly the evil of his misconduct, although they could not reclaim him."

This is a dark picture, perhaps too dark. The Rev. Mr Gray, who, as the teacher of his son, was intimately acquainted with Burns, and had frequent opportunities of judging of his general character and deportment, gives a more amiable portrait of the bard. Being an eye-witness, the testimony of this gentleman must be allowed to have some weight. "The truth is," says he, "Burns was seldom *intoxicated*. The drunkard soon becomes besotted, and is shunned even by the convivial. Had he been so, he could not have long continued the idol of every party." This is strong reasoning; and he goes on to mention other circumstances which seem to confirm the truth of his position. In balancing these two statements, a juster estimate of the moral deportment of Burns may be formed.

In the year 1792 party politics ran to a great height in Scotland, and the liberal and independent spirit of Burns did certainly betray him into some indiscretions. A general opinion prevails, that he so far lost the good graces of his superiors by his conduct, as to consider all prospects of future promotion as hopeless. But this appears not to have been the case; and the fact that he acted as supervisor before his death is a strong proof to the contrary. Of his political verses few have as yet been published. But in these he warmly espoused the cause of the Whigs, which kept up the spleen of the other party, already sufficiently provoked; and this may in some measure account for the bitterness with which his own character was attacked.

Whatever opinion may be formed of the extent of his dissipation in Dumfries, one fact is unquestionable, that his powers remained unimpaired to the last; it was there he produced his finest lyrics, and they are the finest, as well as the purest, that ever delighted mankind. Besides Johnson's *Museum*, in which he took an interest to the last, and contributed most extensively, he formed a connection with Mr George Thomson of Edinburgh. This gentleman had conceived the laudable design of collecting the national melodies of Scotland, with accompaniments by the most eminent composers, and poetry by the most eminent writers, in addition to those words which were originally attached to them. From the multitude of songs which Burns wrote from the year 1792 till the commencement of his illness, it is evident that few days could have passed without his producing some stanzas for the work. The following passage from his correspondence, which was also most extensive, proves that his songs were not hurriedly got up, but composed with the utmost care and attention. "Until I am complete master of a tune in my own singing, such as it is," says he, "I can never compose for it. My way is this. I consider the poetic sentiment correspondent to my idea of the musical expression,—then choose my theme,—compose one stanza. When that is composed, which is generally the most difficult part of the business, I walk out,—sit down now and then,—look out for objects in nature round me that are in unison or harmony with the cogitations of my fancy, and workings of my bosom,—humming every now and then the air, with the verses I have framed. When I feel my muse beginning to jade, I retire to the solitary fireside of my study, and there commit my effusions to paper; swinging at intervals on the hind legs of my elbow-chair, by way of calling forth my own critical strictures, as my pen goes. Seriously, this, at home, is almost invariably my way." This is not only interesting for the light which it throws upon his method of composition, but it proves that conviviality had not as yet greater charms for him than the muse.

From his youth Burns had exhibited ominous symptoms of a radical disorder in his constitution. A palpitation of the heart, and a derangement of the digestive organs, were conspicuous. These were, doubtless, increased by his indulgences, which became more frequent as he drew towards the close of his career. In the autumn of 1795 he lost an only daughter, which was a severe blow to him. Soon afterwards he was seized with a rheumatic fever; and "long the die spun doubtful," says he, in a letter to his faithful friend Mrs Dunlop, "until, after many weeks of a sick bed, it seems to have turned up life, and I am beginning to crawl across my room." The cloud behind which his sun was destined to be eclipsed at noon had begun to darken above him. Before he had completely recovered, he had the imprudence to join a festive circle; and, on his return from it, he caught a cold, which brought back his trouble upon him with redoubled severity. Sea-bathing was had recourse to, but with no ultimate success. He lingered until the 21st of July 1796, when he expired. The interest which the death of Burns excited was intense. All differences were forgotten; his genius only was thought of. On the 26th of the same month he was conveyed to the grave, followed by about ten thousand individuals of all ranks, many of whom had come from distant parts of the country to witness the solemnity. He was interred with military honours by the Dumfries volunteers, to which body he had belonged.

Thus, at the age of thirty-seven, an age when the mental powers of man have scarcely reached their climax, died Robert Burns, one of the greatest poets whom his country has produced. It is unnecessary to enter into any lengthened analysis of his poetry or character. His works are universally known and admired, and criticism has been drawn to the dregs upon the subject; and that, too, by the greatest masters who have appeared since his death,—no mean test of the great merits of his writings. He excels equally in touching the heart by the exquisiteness of his pathos, and exciting the risible faculties by the breadth of his humour. His lyre had many strings, and he had equal command over them all; striking each, and frequently in chords, with the skill and power of a master. That his satire sometimes degenerates into coarse invective, cannot be denied; but where personality is not permitted to interfere, his poems of this description may take their place beside any thing of the kind which has ever been produced, without being disgraced by the comparison. It is unnecessary to re-echo the praises of his best pieces, as there is no epithet of admiration which has not been bestowed upon them. Those who had best opportunities of judging, are of opinion that his works, stamped as they are with the impress of sovereign genius, fall short of the powers he possessed. It is therefore to be lamented that he undertook no great work of fiction or invention. Had circumstances permitted, he would probably have done so; but his excise duties, and without doubt his own follies, prevented him. His passions were strong, and his capacity of enjoyment corresponded with them. These continually precipitated him into the vortex of pleasure, where alone they could be gratified; and the re-action consequent upon such indulgences (for he possessed the finest discrimination between right and wrong) threw him into low spirits, to which he was also constitutionally liable. His mind, being thus never for any length of time in an equable tone, could scarcely pursue with steady regularity a work of any length. His moral aberrations, as detailed by some of his biographers, have been exaggerated, as already noticed. This has been proved by the testimony of many witnesses, from whose authority there can be no appeal; for they had the best opportunities of judging. In fine, it may be doubted whether he has not, by his writings, exercised a greater power over the minds of men, and the general system of life, than has been exercised by any other modern poet. A complete edition of his works, in four vols. 8vo, with a life, was published by Dr Currie of Liverpool, for the benefit of his family, to whom it realized a handsome sum. Editions have been since multiplied beyond number; and several excellent biographies of the poet have been published, particularly that by Mr Lockhart. (J. F. S.)

BURNTISLAND, a small seaport town, and a royal and parliamentary burgh in the district of Kirkcaldy, in the county of Fife, on the opposite shore of the Frith of Forth from Leith, from which it is about six miles distant, in Lat. 56. 4. N. Long. 3. 13. W. The town is pleasantly situated on the sea-coast, and is clean and well built. The beach is sandy and admirably adapted for bathing, and the town is on this account much frequented by the people of Edinburgh and other parts of Scotland during the summer months. A large proportion of the inhabitants are engaged

in the herring and whale fisheries; and there is a considerable though decreasing trade in ship-building. The quantity of spirits manufactured at the distilleries is very large. The general aspect of the town has greatly improved since the completion of the Edinburgh and Northern railway, which connects Burntisland with Edinburgh on the one side, and the more important towns of the north of Scotland on the other. Steamers pass and repass between Burntisland and the opposite shore every hour. There are no public buildings of any importance in the town except the town-hall, the church, a dissenting chapel, and the school-house. The town is governed by a municipal council, consisting of a provost and twenty-one councillors, and its revenue amounts to L.1022. It is in the presbytery of Kirkcaldy; and the living, which is worth L.180 per annum, is in the patronage of the crown. There is a lighthouse at the end of the pier, erected in 1845, which is seen at the distance of eight miles. Pop. (1851) 2329.

BURROW, Sir James, master of the Crown-office, was born in 1701. He was elected a fellow of the Royal Society and of the Society of Arts in 1751: and on the death of Mr West in 1772, he filled the president's chair at the Royal Society till the anniversary election, when he resigned it to Sir John Pringle. In 1773, when the society presented an address to His Majesty, he received the honour of knighthood. He published two volumes of valuable law reports in 1766; two others in 1771 and 1776; and a volume of decisions of the court of king's bench upon settlement cases from 1732 to 1772, to which was subjoined an Essay of Punctuation, in three parts, 4to, 1768, 1772, 1776. The Essay was also printed separately in 4to, 1773. He published, without his name, A few Anecdotes and Observations relating to Oliver Cromwell and his family, serving to rectify several errors concerning him, published by Nicol. Comm. Papadopoli, in his *Historia Gymnasii Patavini*, 1763, 4to. Sir James died in 1782.

BURSAR, or Burser (*Bursarius*, from *bursa* a purse), is used by the middle-age writers for the treasurer or cash-keeper of a college or monastery.

Bursar also denotes one who receives a small sum out of a burse or fund appropriated for that purpose; as the exhibitioners in the Scottish universities.

BURSE (French *bourse*), a public edifice in certain continental cities, for the meeting of merchants to negotiate bills, and to confer on matters of trade and money. In England and in America, such building is called an *exchange*. The first place of this kind to which the name *burse* was given was at Bruges. From this city the name was afterwards transferred to the like places in others, as in Antwerp, Amsterdam, Bergen in Norway, and London. This last, anciently known by the name of the *common burse of merchants*, had the denomination of the *royal exchange* given it by Queen Elizabeth. In the time of the Romans there were public places for the meeting of merchants in most of the trading cities in the empire. That built at Rome B.C. 495, in the consulate of Appius Claudius and Publius Servilius, was denominated the *college of merchants*. Some remains of it are still to be seen, and are known by the modern Romans under the name *loggia*. The Hans towns, after the example of the Romans, gave to their burses the name of *colleges*.

BURSLEM, a market-town of Staffordshire, in the hundred of Pirehill and parish of Burslem, 17 miles south of Manchester, and 150 miles from London. It stands on a gentle eminence near the Trent and Mersey canal, and is the principal town in the "Potteries' district." It has numerous neat and commodious dwellings for the working-classes, large manufactories, and some handsome villas. The chief public buildings are the chapel with an ancient tower, the market-house, the town-hall, newsroom, mechanics' institute, &c. Pop. (1851) 15,954, principally engaged in the potteries. Josiah Wedgewood, whose name is so intimately associated with earthenware manufactures, was born here in 1730.

BURTON, John, D.D., a learned divine, born in 1696, at Wembworth in Devonshire, of which parish his father was rector. He was educated at Corpus Christi College, Oxford. In 1725, being then pro-proctor and master of the schools, he spoke before the determining bachelor a Latin oration, entitled "*Heli*, or an Instance of a Magistrate's erring through unseasonable Lenity;" and he afterwards treated the same subject still more fully in four Latin sermons before the university, and published them with appendices. He also introduced into the schools Locke and other eminent modern philosophers, as suitable companions to Aristotle, and printed a double series of philosophical questions for the use of the younger students. When the settling of Georgia was in agitation, Dr Bray, Dr Stephen Hales, Dr Berriman, and other learned divines, entreated Mr Burton's pious assistance in that undertaking. This he readily gave, by preaching before the society in 1732, and publishing his sermon, with an appendix on the state of that colony. About the same time, on the death of Dr Edward Littleton, whose widow he subsequently married, he was presented by Eton College to the vicarage of Maple-Derham, in Oxfordshire. In 1760 he exchanged his vicarage of Maple-Derham for the rectory of Worplesdon in Surrey. He collected and published, in one volume, all his scattered pieces, under the title of *Opuscula Miscellanea;* and soon after died, on the 11th of February 1771.

Burton, *Robert*, known to the learned by the name of *Democritus junior*, was a younger brother of the William Burton who wrote the "Antiquities of Leicestershire." He was born of an ancient family at Lindley, in that county, on the 8th of February 1576. He received the rudiments of his education at the free school of Sutton Colefield, in Warwickshire; in the year 1593 he was sent to Brasennose College, Oxford, and in 1599 was elected student of Christ Church. In 1616 he was presented by the dean and canons of Christ Church to the vicarage of St Thomas, in the west suburb of Oxford, to the parishioners of which it is said that he always gave the sacrament in wafers; and this, with the rectory of Segrave in Leicestershire, given him some time afterwards by George Lord Berkeley, he held to the day of his death, which happened in January 1639. He was a man of great general learning, a distinguished philosopher, an exact mathematician, and, what constitutes the peculiarity of his character, a very curious calculator of nativities. Though he was extremely studious, and of a melancholy disposition, he was an agreeable companion, and possessed a large fund of humour. The *Anatomy of Melancholy*, by *Democritus junior*, as he calls himself, shows that these different qualities were strangely mixed together in his composition. This book was printed first in quarto, afterwards in folio, in 1624, 1632, 1638, and 1652, to the great emolument of the bookseller, who, as Wood tells us, got an estate by it. Some circumstances attending his death occasioned strange suspicions. He died in his chamber at or very near the time which, it seems, he had some years before predicted from the calculation of his nativity; and this exactness made it whispered about, that for the glory of astrology and rather than that his calculation should fail, he became a *felo de se*. This, however, was generally discredited. He was buried with due solemnity in the cathedral of Christ Church, and had a handsome monument erected to his memory. He left behind him a very choice collection of books, many of which he bequeathed to the Bodleian Library, along with L.100 to Christ Church, the interest of which was to be laid out yearly in books for the library of that college.

BURTON-UPON-TRENT, a market-town in the parish of the same name, hundred of North Offlow, and

county of Stafford, is situated on the Trent, 11 miles S.W. of Derby. Pop. (1851) 7934. An abbey was founded here by one of the earls of Mercia as early as 1004, of which some remains are still to be seen. The river is here crossed by an ancient bridge erected before the Conquest, measuring 1545 feet in length, and having 37 arches. There are two churches and numerous dissenting places of worship, a grammar-school, town-hall, assembly-rooms, savings-bank, subscription library, and several charities. Market-day Thursday. The river is navigable for barges up to the town. It was formerly noted for its alabaster works, but is now chiefly celebrated for the ale to which it gives name. The Grand Trunk canal uniting the Mersey with the Trent passes the town.

BURTSCHEID, or BORCETTE, a town of Prussia, in the province of the Rhine and government of Aix-la-Chapelle, immediately S.E. of the town of that name. It has considerable manufactures of woollen-cloth cassimeres, Prussian blue, &c., and several hot sulphurous springs. Pop. (1849) 5657.

BURY, a parliamentary borough, and manufacturing town of England, in the county of Lancaster, on the Irwell, 8 miles N.N.W. of Manchester. The general appearance of the town has latterly been much improved by the widening of the streets and the erection of many handsome edifices. The parliamentary borough, comprising the townships of Bury and Elton, in 1851, had 31,262 inhabitants. Registered electors (1851–52) 959. It has returned one member to parliament since the passing of the Reform bill; and is governed by 3 constables appointed by the Earl of Derby, lord of the manor. It has 3 churches, 6 chapels, and numerous dissenting places of worship, Kay's free grammar-school, with two exhibitions of L.25 each at either university, a newsroom, mechanics' institute, several public libraries, a savings-bank, and a dispensary. Its manufactures are very extensive and flourishing, consisting principally of cotton and woollen goods, with print and bleaching works, which received a great impulse from Kay's invention of the fly-shuttle and dross-box, and the establishment of extensive print-works by the father of the late Sir Robert Peel. That illustrious statesman was born at Chamber Hall in the vicinity. It is connected by railways, as well as by canals, with Manchester, Bolton, &c. In the vicinity are extensive coal mines.

BURY, *Richard de*, see AUNGERVYLE.

BURY ST EDMUNDS, a municipal and parliamentary borough and market-town of England, in the county of Suffolk, on the Larke, 23 miles N.W. of Ipswich, and 71 miles from London. It is governed by a mayor, 6 aldermen, and 18 councillors, and returns two members to parliament. Pop. (1851) 15,900. Registered electors (1851–52) 741. The town is pleasantly situated on a gentle eminence, in a fertile and richly cultivated district, and is clean and well built. It is supposed to be the *Villa Fasestina* of the Romans, and numerous Roman remains have been dug up here. It was the Beodericsworth of the Saxons, and by them made a royal town of East Anglia. Its present name is derived from St Edmund, the king and martyr who was taken prisoner and put to death by the Danes in 780. In 1010 a monastery was founded there by Canute, which for magnificence and splendour surpassed every other establishment of the kind in Britain, with the exception of that of Glastonbury. It was 505 feet long and 212 wide, and contained 12 chapels. The abbot had a seat in parliament, with the power to inflict capital punishment, and judge in all civil causes within the liberty. The privilege of coining was granted to the abbot by Edward the Confessor, and both Edward I. and Edward II. had mints here. The "church" gate, one of the finest specimens of Saxon architecture in the kingdom, and the western gate, erected about the middle of the fourteenth century, with a small portion of the walls, are all that now remain of that magnificent structure. St Mary's church, a fine Gothic edifice, with a beautifully carved roof, was erected in the earlier part of the fifteenth century, and contains the tomb of Mary Tudor, Queen of France. St James's church is also a very fine building, containing several handsome monuments. The free grammar-school, founded by Edward VI., has two scholarships at Cambridge, and six exhibitions to either university. It has a shire-hall where assizes for the county and liberty are held, a guildhall, public library, news and assembly rooms, mechanics' institute, theatre, savings-bank, botanic gardens, county jail, bridewell, a general hospital, and about 100 alms-houses. Market-days Wednesday and Saturday. About a mile below the town the river becomes navigable for barges to Lynn, whence coals and other commodities are brought. In the vicinity is Ickworth, the magnificent seat of the Marquis of Bristol. Sir Nicholas Bacon and Bishop Gardner were born here. It gives the title of Viscount to the Keppel family.

BURYING ALIVE, in ancient Rome, was the punishment of a vestal who violated her vow of chastity. The unhappy priestess was scourged, was attired like a corpse, and then let down into a vault containing some bread, water, milk, oil, a burning lamp, and a couch. Earth was then cast upon her till the pit was filled up. Her paramour was scourged to death in the Forum. Some middle-age writers seem to make burying alive the punishment of a female thief.

BURYING PLACE. The ancients buried out of cities and towns; a usage which we find equally among Jews, Greeks, and Romans. Amongst the last, burying within the walls was expressly prohibited by a law of the twelve tables. The usual places of interment were in the suburbs and fields, but especially by the way sides. We have instances, however, of persons buried in the city; but it was a favour allowed only to a few of singular merit in the commonwealth. Plutarch says, those who had triumphed were indulged in it. Val. Publicola, and C. Fabricius, are said to have had tombs in the Forum; and Cicero adds Tubertus to the number. Lycurgus allowed the Lacedæmonians to bury their dead within the city and round their temples, that the youth, being inured to such spectacles, might be the less terrified with the apprehension of death. Two reasons are alleged why the ancients buried out of cities; the first, an opinion that the sight, touch, or even neighbourhood of a corpse, defiled a man, especially a priest; whence that rule in A. Gellius, that the *flamen dialis* might not on any account enter a place where there was a grave: the second, to prevent the air from being corrupted by the effluvia of putrified bodies, and the buildings from being endangered by the frequency of funeral fires.

Burying in churches was not allowed for the first three centuries after Christ; and the same was severely prohibited by the Christian emperors for many ages afterwards. The first step towards it appears to have been the practice of erecting churches over the graves of some martyrs in the country, and translating the relics of others into churches in the city; the next was, allowing kings and emperors to be buried in the atrium or church-porch. In the sixth century, the people began to be admitted into the churchyards; and some princes, founders, and bishops, into the church. From that time the matter seems to have been left to the discretion of the bishop.

BUSACO, a convent of Portugal, in the province of Beira, on the ridge called the Serra-de-Busaco, 20 miles N.N.E. of Coimbra. Here, on the 27th Sept. 1810, a French force of 65,000 men under Massena was repulsed with great loss in an attack on the position occupied by the English and Portuguese army, amounting to about 40,000, under the Duke of Wellington.

BUSBECQ, AUGIER, GHISLEN DE, a distinguished ambassador and scholar, was born at Commines in 1522, and

educated at the universities of Louvain, Paris, Venice, Bologna, and Padua. He was engaged in several highly important employments and negotiations, and in particular was twice sent ambassador by the king of the Romans to the court of Solyman II. He made a collection of curious inscriptions and manuscripts; and in his second journey to Constantinople he carried with him an artist to make drawings of the rarest plants and animals. In 1562 he was appointed tutor to the sons of Maximilian, then king of the Romans. Busbecq died at St Germain, near Rouen, Oct. 28. 1592. He wrote a Discourse of the State of the Ottoman Empire, and a Relation of his Two Journeys to Turkey, which were much esteemed.

BUSBY, Richard, D.C.L., head master of Westminster school, was born at Lutton in Lincolnshire in 1606. He was educated at the school which he afterwards superintended for so long a period, and first signalized himself by gaining a king's scholarship. From Westminster he removed to Christ Church College, Oxford, where he graduated in 1628. In his thirty-third year he had already become renowned for the obstinate zeal with which he supported the falling dynasty of the Stuarts, and was rewarded for his services with the prebend and rectory of Cudworth, with the chapel of Knowle annexed in the Church of Wells. Next year he became head master of Westminster school. His reputation as a teacher soon became so great that many of the noblest families intrusted their children to his care. He himself once boasted that sixteen of the bishops who then occupied the bench had been birched with his "little rod." No school in England has on the whole produced so many eminent men as Westminster did under the régime of Busby. Among the more illustrious of his pupils may be mentioned South, Dryden, Locke, Prior, and Bishop Atterbury. Busby wrote and edited many works for the use of his scholars. His original treatises (the best of which are his Greek and Latin grammars), as well as those which he edited, have, however, long since fallen into disuse. Busby died in 1695, in his 90th year, and was buried in Westminster Abbey, where his effigy is still to be seen.

BUSCA, a town of Piedmont, on an affluent of the Po, nine miles N.N.W. of Cuneo. It is situated in a fertile district, and produces good wine. Pop. 8000.

BUSCHING, Anthony Frederick, an eminent geographer, born at Stadthagen in Westphalia, Sept. 27, 1724. In his youth he laboured under peculiar disadvantages, till fortunately a clergyman of the name of Hauber, pleased with the promising talents of the young man, undertook to give him gratuitous instruction, and afterwards supplied him with the means of continuing his studies at Halle. There, by his application to learning, and his irreproachable conduct, he acquired numerous friends, and was appointed tutor in the family of the Count de Lynars, who was then going as ambassador to St Petersburg. On this journey he became sensible of the defective state of geographical science, and resolved to devote his life to its improvement. He withdrew as soon as possible from the Count's family, and went to reside at Copenhagen, devoting himself entirely to this new pursuit. In 1752 he published a *Description of the Counties of Sleswig and Holstein*, a work that was much approved. He soon after removed to Gottingen, and married Christiana Dilthey, a young lady of great accomplishments, and the author of a volume of poems. Here, on account of a work which appeared to dissent from some of the Lutheran tenets, he was excluded from the theological chair, for which he had become a candidate. The chagrin occasioned by this disappointment induced him to accept an invitation to the German congregation at St Petersburg. He was employed there, also, in organizing a school, which, under his auspices, soon became one of the most flourishing in the north. This school was superintended by Marshal Munich, who at first showed great favour to Busching; but in consequence of the marshal's unreasonable exactions, Busching announced his intention of returning to Germany. The empress expressed much dissatisfaction at the conduct of Munich, and made high offers to Busching if he would remain; but his resolution was made, and returning to Germany, he went to reside at Altona. Next year, however, he was called to superintend an extensive educational establishment, which had been formed at Berlin under the auspices of Frederick the Great. His writings and example gave a new impulse to education throughout Prussia. He superintended the progress of every pupil, and inspected the minutest details connected with the prosperity of the institution. He also gave lectures on the history of the arts and sciences. This labour did not interrupt the composition of his numerous works. He continued to prosecute his academical labours till a dropsy, under which he had long suffered, terminated his life on the 28th May 1793. Busching was twice married. By the first marriage he had two children, who survived him; by the second he had six, who, except one, all died in infancy.

Few authors, even in Germany, have produced a greater number of works than Busching. The entire number, as enumerated by Meusel in his *Lexicon of German Authors*, amounts to more than a hundred. They may all be classed under the following heads: 1. Geography and History; 2. Education; 3. Religion; 4. Biography. The first class comprehends those upon which his fame chiefly rests. He possessed not, indeed, the geographical genius, if we may so speak, of D'Anville; but he may be regarded as the creator of modern *Statistics*. Devoid of the ornaments of style, his works, from their nature, are rather useful to consult than profitable to read. His great work is the *Neue Erdbeschreibung, New Geographical Description of the Globe*. The first four parts, which comprehend Europe, were published in four successive volumes, from 1754 to 1761, and have been translated into all the European languages. They appeared in English with a preface by Murdoch, in six volumes 4to, London, 1762. He published also, in 1768, the fifth part, being the first volume upon Asia, containing *Asiatic Turkey* and *Arabia*. It displays an immense extent of research, and is generally considered as his masterpiece.

Busching was also the editor of a valuable collection entitled *Magazine for the History and Geography of Modern Times*, 22 vols. 4to, 1767–88; also of a *Journal appropriated to the Notice of Maps*, Berlin, 1773–87.

The elementary works on education published by Busching are very numerous, and have long held a distinguished place, even in a country so eminent as Germany, in this branch of literature. His theological writings are not much esteemed. In biography he wrote a number of articles for the *Historical Magazine*; also *A Collection of Biography*, in six volumes, 1783–9, including a very elaborate life of Frederick the Great.

BUSH, Paul, the first bishop of Bristol, was born in 1490. He became a student in the university of Oxford about 1513, and five years later took the degree of B.A. He afterwards became a brother of the order called *bonhommes*; of which, after studying some time among the friars of St Austin, now Wadham College, he was elected provincial. In that station he had lived many years, when, on account of his great knowledge in divinity and physic, he was appointed chaplain to Henry VIII., and in 1542 to the newly erected episcopal see of Bristol. In consequence of his marriage, he was, on the accession of Mary, deprived of his dignity, and spent the remainder of his life in a private station at Bristol, where he died in 1558. Wood says that Bush, while a student at Oxford, was numbered among the celebrated poets of that university.

He wrote, 1. An Exhortation to Margaret Burgess, wife to John

Burgess, clothier, of King's Wood, in the county of Wilts. London, printed in the reign of Edward VI. 8vo. 2. Notes on the Psalms. 3. Treatise in Praise of the Crosse. 4. Answer to certain Queries concerning the abuse of the Mass, Records, No. 25. 5. Dialogues between Christ and the Virgin Mary. 6. Treatise of Salves and Curing Remedies. 7. A Little Treatise, called the Extirpation of Ignorancy. 8. Carmina diversa.

BUSHEL. See WEIGHTS and MEASURES.

BUSHIRE, ABUSCHEHR, a town of Persia, in the province of Fars, situated in the Persian Gulf. The surrounding country is a parched and barren desert, consisting of brown sand or gray clay and rock, unenlivened by any kind of vegetation. The town, which is of a triangular form, occupies the northern extremity of a peninsula eleven miles long and four broad, and is encircled by the sea on all sides except the south. It is fortified on the land side by a mud wall with round towers. The houses being mostly built of white stone gives the city when viewed from a distance a rather clean and handsome appearance, but on closer inspection the streets are found to be narrow, irregular, ill-paved, and filthy. Almost the only handsome buildings are the sheik's palace and the East India Company's factory. Ships of 300 tons are obliged to lie in the roads six miles from the town. The water immediately east of the town is deep, but its navigation is impeded by a bar, which can only be passed by vessels drawing not more than eight or nine feet of water, except at spring-tides, when there is a rise of from eight to ten feet. It carries on a considerable trade, particularly with Calcutta, Bombay, and Madras. Its imports are indigo, sugar, rice, spices, steel, cotton and woollen goods, coffee, &c.; and its principal exports are raw silk, Kerman wool, shawls, silk goods, carpets, horses, dried fruits, wine, grain, copper, turquoises, pearls, assafœtida, and gall-nuts. The climate is excessively hot, particularly in the months of June, July, and August. The water is very bad; that fit for drinking requires to be brought in goat skins a distance of 16 miles. Pop. variously estimated at from 10,000 to 20,000.

BUSIRIS, a town in Egypt, now called Busyr or Abousir. It is situated on the left bank of the Damietta branch of the Nile, and contains nothing remarkable except the ruins of an ancient temple of Isis. It derived its name from the mythical Busiris, of whom many conflicting accounts are given by ancient writers. The most notable incident in the life of this Busiris is recorded by Apollodorus. For nine consecutive years the Egyptians had suffered from a dearth of corn, which a Cyprian soothsayer, by name Phrasius, declared would cease if Busiris would sacrifice every year a stranger to Jupiter. The soothsayer himself was the first victim of his own prophecy, which was annually obeyed till the arrival of Hercules. When this hero was led to the altar to be sacrificed, he burst his bonds and slew Busiris and his son. The story of Busiris was believed by Greeks and Egyptians to be a myth, and numerous attempts were made by writers of both nations to explain away the tradition.

BUSKIN (*cothurnus*), an ancient kind of boot, which covered the foot, and half of the leg, or even more. Buskins were laced in front so as closely to embrace the leg, and were sometimes ornamented in a very elaborate style. They were chiefly worn by hunters, horsemen, and persons of rank. The cothurnus used in Athenian tragedy had a sole of great thickness for the purpose of increasing the apparent stature of the wearer. In classic authors the word is frequently used as synonymous with tragedy; and it was likewise used to indicate an elevated style in poetry and in painting. See COTHURNUS.

BUSS, an old word signifying a kiss, and to kiss or salute with the lips.

BUSS, a small two-masted vessel, used in the herring fishery, commonly from fifty to seventy tons burden. It has a small shed or cabin at each end.

BUSSORA, BASSORA, BALSORA, or BASRA, a celebrated city of Asia, in the government of Baghdad, situated on the western bank of the Shat-el-Arab, about seventy miles from the mouth of this noble stream, which is navigable to the city for ships of 500 tons burden after passing the bar at its mouth, which however, they can only do at spring-tides. Bussora is surrounded by walls, which are kept in a tolerable state of repair. They have five gates, and are at the lowest computation about seven miles in circuit. Two canals, cut from the river, surround the town on either side, and uniting beyond it on the western side, form a complete ditch to the fortifications. The houses are meanly built, partly of sun-dried and partly of burnt bricks, with flat roofs surrounded by a parapet; and the bazaars, though stocked with the richest merchandise, are miserable structures, not arched as in Baghdad and the Persian towns, but covered with mats laid on rafters of date trees, which hardly afford protection from the scorching rays of the sun. The streets are irregular, narrow, and unpaved, and the town itself is disgustingly filthy. Of the vast area within the walls, the greater proportion is occupied with gardens and plantations of palm trees, intersected by a number of little canals, cleansed twice daily by the ebb and flow of the tide, which rises here about nine feet. The largest of these canals, which approaches the English factory and the palace of the governor situated about two miles from the river, is continually crowded with small vessels. The town has scarcely any public buildings that deserve notice. It has khans and coffee-houses without number, a wretched hummum, and upwards of forty mosques, of which one only is worthy of the name; and this, with the palace of the governor, and the English factory, which are all contiguous to one another, are the only decent buildings in the place. The population is a heterogeneous mixture of all the nations in the East, and consists of Turks, Arabs, Indians, Persians, Armenians, Jacobites, and Jews. The Arabs constitute the principal class; and the Turks, though they are masters of the town, are almost the least numerous.

Bussora is a great emporium of Indian commerce. Six or eight English ships arrive in the course of a year from India; but the chief part of the traffic is carried on in Arabian bottoms; and the merchants of Muscat possess some of the finest vessels that navigate the Indian seas. From various parts of Hindustan, Bussora receives silk, muslin, linen, white and blue cloths for the clothing of the Arabians, gold and silver stuffs, various metals, sandal-wood, and indigo; pearls from Bahrein, and coffee from Mocha; shawls, fruit, and the precious metals from Persia; spices from Java; and European commodities, which are scarce and dear, from different parts. The trade with the interior is conducted by means of caravans to Aleppo and Baghdad, whence the goods are conveyed to Constantinople. The returns are made in Indian goods, bullion, pearls, dates, copper, raw silk, gall-nuts; and the horses, which are very strong and beautiful, are exported in large numbers by the English.

The situation of the town is unhealthy, owing to the inundations of the river, from which noxious exhalations arise; and strangers are commonly attacked by fever after a short residence. The adjoining country is fertile, producing, besides rice, wheat, barley, and dates of different species, a variety of fruits and vegetables, such as apricots, apples, figs, olives, pomegranates, and grapes; and cabbages, broccoli, lettuce, onions, peas, beans, and truffles, in vast quantities. There are whole fields of roses, which the inhabitants cultivate for the purpose of making attar. The liquorice plant also grows amidst the palm groves on the borders of the river.

The city of Bussora was originally founded by Omar, A.D. 636, on a canal eight miles S.W. from its present site, where the town of Zobeir now stands; and its situation was so favourable for commerce that in a few years it became a large and flourishing city. The canal, however, soon be-

came useless, and the city was abandoned. The present city was conquered by the Turks in 1668, and since that period has been the scene of many revolutions. It was taken in 1777, after a siege of eight months, by the Persians under Sadick Khan. In about a year it fell again into the hands of the Turks; who were again deprived of it by the scheik of the Montefik Arabs. The town was in October following recovered by Solyman Pasha, who encountered the scheik on the banks of the Euphrates, and put him to flight; and it has since remained in the hands of the Turks. The population is estimated at 60,000. Long. 47. 34. E. Lat. 30. 32. N.

BUST (Italian *busto*), in *Sculpture*, the head, breast, and shoulders of the human figure.

Felibien observes, that though in painting one may say a figure appears in busto, yet it is not properly called a *bust*, that word being confined to figures in relievo.

The Italians use the word for the trunk of the body from the neck to the hips.

BUSTARD. See Ornithology, *Index*.

BUSTUARII, in *Roman Antiquity*, gladiators who fought about the bustum or funeral pile of a person of distinction, in order that the blood which was spilt might propitiate the infernal gods. This custom was introduced in the room of the more inhuman practice of sacrificing captives at the bustum, or on the tombs of warriors.

BUSTUM, in *Antiquity*, denotes a pyramid or pile of wood whereon the bodies of the deceased were placed in order to be burnt.

The Romans borrowed the custom of burning their dead from the Greeks. The deceased, crowned with flowers, and dressed in the richest habits, was laid on the bustum. Some authors say it was only called *bustum* after the burning, *quasi bene ustum vel combustum:* before the burning it was more properly called *pyra*, during it *rogus*, and afterwards *bustum*. When the body was only burnt there, and buried elsewhere, the place was not properly called *bustum*, but *ustrina*, or *ustrinum*.

Bustum was also figuratively used to denote any tomb; hence *facere bustum, violare bustum, &c.*

BUTCHER, one who slaughters cattle for the use of the table, or who cuts up and retails the same. Among the ancient Romans there were three kinds of established butchers, viz., the *suarii*, who provided hogs; the *pecuarii* or *boarii*, who furnished oxen, &c.; and the *lanii* or *carnifices*, who slaughtered the animals.

Butcher-Bird. See Ornithology, *Index*.

BUTE, John Stuart, third earl of, a British statesman of the time of the second and third Georges, was born in Scotland in 1713. He was educated at Eton, and in his youth was better known as a voluptuary than as a student. He entered parliament as one of the representative peers of Scotland in 1737, and signalized himself by his determined opposition to every measure of the existing government. Soon after he attracted the favourable notice of Frederic Prince of Wales, by whom, in 1738, he was made a knight of the Thistle, and one of the lords of the bedchamber. After the death of that prince he gained a great ascendency over the mind of his son, afterwards George III. For the undue use which he was supposed to have made of his influence, he was bitterly attacked by Junius. On the accession of George III., he was sworn a member of the privy council, and made groom of the stole. In 1762, he became first lord of the treasury, an office which he only retained till the 10th of April of the following year. On that day he suddenly resigned; and the cause of his resignation is not yet clearly ascertained. (For the details of his political life, see Great Britain.) He retired to his mansion near St Albans, where he spent the remainder of his days in literary pursuits. He collected a splendid library, and formed one of the best galleries of Dutch and Flemish pictures in the kingdom. It was to him that Dr Johnson was indebted for his pension; and by his influence a place was secured for Home, the author of Douglas. He died March 10, 1792.

BUTESHIRE, a county on the west coast of Scotland, in the Firth of Clyde, is composed of seven islands, viz. Bute, Arran, Great Cumbrae, Little Cumbrae, Inchmarnock, Holy Island, and Pladda.

Bute, from which the county derives its name, is situated between Long. 4. 51. and 5. 2. W., and Lat. 55. 41. and 55. 43. N., and is 16 miles west from Greenock, 38 miles from Glasgow, and 83 from Edinburgh; but the usual route to these places is about 4 or 5 miles longer. It is about 15 miles long, in a straight line from N.N.W. to S.S.E., and the average breadth is $3\frac{1}{2}$ miles, although it is much indented with bays: in some places it is not above half that breadth, but in other places it is at least a mile broader. It is separated on the north from the district of Cowal in Argyleshire by the Kyles of Bute, which for a considerable distance along the shore are not above half a mile broad. The more southerly part of the island is separated from Ayrshire by the Firth of Clyde, which at that point is from 5 to 7 miles broad; but the channel is much narrowed by the islands of Cumbraes, situated between Bute and Ayrshire, and distant from Bute about 3 miles, but much nearer Ayrshire. Arran lies off the south point of Bute, distant about 6 miles; and Skipness in Argyleshire bounds it on the west at a distance considerably greater. There is considerable uncertainty as to the origin of the name of Bute. Some contend that it is derived from Both, signifying in the Irish tongue a cell; and they ground this on the fact, that it has been so written by ancient authors, and that St Brendan, an Irish abbot, caused a cell to be erected on it in the sixth century. It has been written Both, Bote, Boot, and Botis; but Mr Blain, some time commissary of the isles, and sheriff-substitute of Buteshire, in his manuscript history of Bute, endeavours to show, with considerable ingenuity, that it has been derived from the old British word Ey Budh, or Gaelic word Ey Bhiod, signifying the Island of Corn or Island of Food, from its being more fertile than the adjacent highland countries; and this opinion appears to be still further supported by the fact, that at the time of valuing the teinds, the grain in the island amounted to about 34,700 bolls. The Butemen were anciently called Brandanes, and looking upon themselves as a distinct people, refused to identify themselves either with the highlanders or lowlanders. The island has an area of about 30,000 English acres, of which about two-thirds may be considered as arable; the remainder consists of woods, muirs, mosses, and lakes. There are six lakes in the island. The largest, Loch Fad, extended originally to 138 acres, but is now considerably enlarged by the embankments of the cotton spinning company, whose works are placed on the water flowing from this lake. Ascog Loch is 72 acres in extent. The water flowing from this loch has also an excellent fall for a mill or other public work; but nothing has yet been erected on it except a dye-work, and a carding and wauking mill. It is hoped, however, that it will soon be made more available. Quien Loch covers 54 acres; Greenan Loch, 12 acres; Loch Dhu, or Black Loch, 9 acres; and Lochantarbh, 5 acres. The climate is more mild, genial, and healthy, than in any other part of the west of Scotland. It is frequently compared to that of Devonshire, to which it is in some respects considered as superior. The lofty mountains of Arran and Argyle skirt it on the west and south, and break the clouds coming from the Western Ocean, so that they pass over Bute with a discharge of comparatively but little of their contents, and less rain falls here than on the rest of the west coast of Scotland. In summer the air is kept cool by the sea breeze, and in winter the same cause prevents intense frost; while snow seldom falls to the depth of twelve inches, and very rarely remains above two or three days on the ground. The winds most prevalent blow from the south and west.

Agriculture, under the fostering care of the late Marquis of Bute, has of late years made considerable progress in the island, especially in the middle and southern divisions. The soil in the southern half of the island is light and sandy; in the more northern it is of a clayey nature. The land is generally well subdivided with ditches and white-thorn hedges. Crops of all kinds common in the lowlands are produced in Bute.

Freestone and coal are both found in the island, but neither to any great extent. Several attempts have been made to discover a good working vein of coals, but hitherto without success. Slate and lime, however, abound. The slate has been principally wrought on the estate of Kames, formerly the seat of the deceased Sir William M'Leod Bannatyne, one of the lords of session, but now possessed by James Hamilton, Esq. The lime has been chiefly wrought in the south end of the island, in the parish of Kingarth; and that manufactured there is considered as equal, if not superior, in point of adhesiveness, to the far-famed Arden lime of Lanarkshire, when properly wrought; and it is much cheaper, though not so white in the colour. Inexhaustible beds of shells are found on the west side of the island, and considerable quantities of sea-weed are driven in upon the shores. The rocks in the north end are chiefly mica, clay, and chlorite slate, intersected with quartz and trap. Whinstone is chiefly found near the town of Rothesay, and sandstone stretches along from thence to the south.

Excellent banks for fishing are found round the island; and the herring fishery is prosecuted vigorously by the inhabitants, especially by residents in Rothesay.

The Marquis of Bute is the chief proprietor of the island. His seat, Mountstuart, is beautifully situated on the east side of the island, about four miles from Rothesay. The real rent of his property in the island is about L.9000, including L.440 of feu-duty for ground feued chiefly within the burgh of Rothesay. The other proprietors of any extent are James Hamilton, Esq. of Kames, rent L.1500; Robert Thom, Esq. of Ascog, L.700; M'Conechy of Ambrisbeg, L.70; James M'Kay of Garrachty, L.70; and George Campbell, Esq. of Dunoon, whose lands of Ardbeg, let on long building leases, are now nearly covered with villas, and form substantially a part of the town of Rothesay.

The burgh of Rothesay, the capital of the island and shire, is beautifully situated at the head of a deep bay on the N.E. side of the island, where there is safe anchorage-ground for vessels of any size, in any wind, and room enough to contain a very large fleet. The territory of the burgh is about nine miles in circumference, extending fully a mile beyond the town on the east, south, and west sides. The burgh has an extensive harbour built in 1822 at an expense of L.6000, and on which large sums have been since expended. It is now in an excellent state. The shipping belonging to the port was at one time upwards of 4000 tons, but it has decreased of late, owing to the decline of the herring trade. There is a large spinning factory, consisting of two mills, in Rothesay, driven by water from Loch Fad; and it may be worthy of notice, that the second mill erected in Scotland for the spinning of cotton was upon this water only about fifty-five years ago, when the business was carried on with the strictest secrecy. The house then used was a thatched building, which is still standing. There are three power-loom factories in Rothesay, in one of which cotton is also spun. Numerous steam-boats ply daily to and from Glasgow and the intermediate ports. These convey the mail; and in the summer season there are generally two mails in the day.

The town has of late been rapidly increasing, and handsome new streets are building. The places of worship in Rothesay are the parish church, situated on a gentle eminence about a quarter of a mile from the town; another Established church close to the town; three Free churches (the predominant denomination), one being Gaelic; one Reformed Presbyterian, one United Presbyterian; one Episcopalian; one Baptist; and about two miles from Rothesay there is a Roman Catholic chapel. The County Buildings are situated in Rothesay, and contain a large and handsome courtroom with the requisite offices attached. The prison is under the same roof, and affords good accommodation for proper classification of the prisoners. The courts are held in Rothesay. The sheriff court is held every Tuesday and Friday, and the burgh court every Thursday. There is a local police act, under which the burgh magistrates act as judges and try petty delinquencies. The ruins of an ancient castle, which was once the residence of the kings of Scotland, are situated in the middle of the town. The castle originally consisted of a circular court, 138 feet in diameter, surrounded by a wall eight feet thick and seventeen feet high, with battlements. It had four towers and was surrounded by a wet ditch. It is supposed to have been built about the year 1100, though the precise date is not known. It is first mentioned in history in 1228. Heulbec, king of the Isles, was killed in besieging this castle in 1263. It was taken possession of by the English during the reign of John Baliol, but surrendered to Robert the Bruce in 1311. King Robert the Second built a palace adjoining the castle, and frequently took up his residence in it betwixt 1376 and 1398, when he created his eldest son Prince David Duke of Rothesay, a title which the king's eldest son still bears. This was the first dukedom conferred in Scotland. On the 12th January 1400 Robert granted the charter of erection of the burgh of Rothesay. He died in the castle of Rothesay on 4th April 1406, and was buried in the abbey of Paisley. This castle was burned by the Earl of Argyll's brother in 1685, and has since remained in ruins. The population of the burgh of Rothesay in 1851 was 7014, besides upwards of 300 seamen belonging to registered vessels, not included in the census.

The island is divided into three parishes, Rothesay, Kingarth, and North Bute; the first containing a population (1851) of 7354, including the burgh; the second a population of 1007, and the third a population of 1025, making the whole population of the island 9386, exclusive of seamen absent when the census was taken. In Kingarth parish there is, besides the parish church, a Free church at Ascog, and in the parish of North Bute there is a Free church at Port Bannatyne. Lord Bute is the patron of all of the parish churches.

The island is highly esteemed, and is much resorted to as sea-bathing quarters in the summer season; and many invalids are induced, by the mildness of the climate, to reside there during the winter.

There are several remains of druidical monuments on the island, but the chief or most entire is at Langalchorid, in the parish of Kingarth. At Dunagoil, in this parish, there is a vitrified fort, and the remains of an old church, and burying-ground, where, until after the Reformation, the two sexes were not allowed to intermingle. Near this church there is a circular inclosure called the Devil's Cauldron, where penance was wont to be performed. As this rite of superstition is somewhat singular, we shall describe it. Transgressors were imprisoned in this terrene purgatory for a given time, which, it may be readily conceived, was proportioned to the magnitude of the offences committed, being sometimes for several days and nights together. The priest threatened eternal punishment to the whole party if but one of their number fell asleep. To provide against this, the penitents were furnished with a sharp instrument, with which they pricked each other when inclined to somnolency.

There are three villages in the island; Port Bannatyne, situated at the head of Kames Bay, about two and a half miles from Rothesay, which is of some extent, has a good quay, and a pretty numerous fishing population; Ker-

rycroy, near Mountstuart, the seat of the Marquis of Bute; and Kilcatten Bay, situated on the south side of the island. The natives formerly spoke the English and Gaelic languages indifferently, but English is now chiefly spoken.

Arran is situated about six miles south of Bute. It is very mountainous. Goatfell, a mountain situated about the centre of the island, is upwards of 2945 feet high; and some others approach to that height. There is a remarkably fine view from this mountain on all sides, whence is seen part of the Atlantic Ocean, Ireland, the counties of Ayr, Renfrew, Argyle, and Bute, the Firth of Clyde, Loch Fine, and other scenery both beautiful and picturesque. There are many druidical remains and monumental stones on the island. Fingal's Cave is still pointed out; and tradition says that Ossian died on this island. The island is about twenty miles long and eleven broad, and contains about 106,000 English acres, of which only 15,000 are arable. Abundance of game and some wild deer are found on the mountains, which are either bare rocks, or only covered with heath and fern, but including magnificent glens. There is comparatively little wood in the island, except near Brodick Castle, where there are fine old woods and thriving young plantations. A large addition has but lately been made to Brodick Castle, and improvements are in progress which, when completed, will, combined with the mixed grand and beautiful scenery, make Brodick Castle one of the most attractive seats in Scotland. The climate in winter is mild, but generally moist. The whole island, except a small estate, belongs to the Duke of Hamilton, in which family it has been for several centuries. The other proprietor is Captain Fullarton, of Kilmichael, descended of a very ancient family formerly bearing the name of MacLoy. The roads are for the most part very good, having been chiefly made by the parliamentary commissioners several years ago; and the expense of repairs is defrayed partly by the exchequer, and partly by the proprietors, in terms of the act 59th Geo. III. cap. 135. The herring fishery is prosecuted to a considerable extent, but this is almost wholly done by means of boats and other small vessels. There are two excellent harbours in the island, Lamlash and Loch Ranza, but without piers of any extent. There is a small pier at Brodick, but the bay is not well sheltered for anchorage. An extensive pier was commenced at Lamlash in the reign of Queen Anne, and a considerable part erected, but it was afterwards neglected; and all the stones above the water have from time to time been removed for building or other purposes, so that now the foundation can scarcely be traced; and the only landing place is a small jetty recently built. The island produces barley, bear, oats, peas, beans, potatoes, and turnips. The islanders were long addicted to illicit distillation, a practice which has been given up, owing chiefly, it is believed, to the strong laws enacted against it, and the firmness with which they are executed. Agriculture was at one time neglected, every farm being occupied by a society of tenants, among whom the arable part of the farm was divided in small lots, while the pasturage grounds and moors were a common under one herd. The farms are now well subdivided, and some of them are large and well cultivated by tenants of enterprise and skill. There was many years ago a great emigration from this island to America, although the inhabitants were strongly attached to their native soil. The language chiefly spoken by the natives is Gaelic, but they are advancing in the knowledge of English. The islanders are all Protestants, and strongly attached to the Free Church of Scotland, about 9-10ths of them belonging to that denomination. Christianity is said to have been introduced here by St Molios, a disciple of St Columba. The island is divided into two parishes, Kilbride and Kilmory, and has also two chapels. There are three places of worship belonging to the Free Church of Scotland. The largest parish is named Kilmory, and contained (1851) 3414 inhabitants; the other parish named Kilbride, contains 2533 inhabitants, making the population of the island 5947, besides a few seamen belonging to registered vessels, being a decrease from 6427 (census 1831), attributed to emigration. Arran is highly celebrated for its mineralogy. (See Jameson's *Mineralogy of the Scottish Isles*, Headrich's *Survey of Arran*, and Dr M'Culloch's works.) Granite, rock crystal, quartz, and small-grained granite, are abundant in the northern division of the island. Mica slate and granite unite at Catacoal. Gneiss, micaceous schist, and pudding-stone, are abundant at Glenrosa. Quartz is found in all kinds of crystallization, in beds of clay slate and in other situations. Greenstone, sandstone resting on clay slate, basalt, trap, and limestone, are abundant. Pitchstone is found on the south, with pearlstone, ironstone, and porphyry; also flint, agate, siliceous spar, jaspar, and various beautiful crystals.

Great Cumbrae is situated in the Firth of Clyde betwixt Ayrshire and the Island of Bute. It is the property of the Marquis of Bute and the Earl of Glasgow. It is about two and a half miles long, and one and a half broad, and measures about 2500 acres, one-half of which is arable. It has a gentle ascent of about 400 feet from the sea to the centre of the island. The village of Millport is situated on the S.W. side of the island, opposite to which there is safe anchorage-ground (which, however, is not easily reached), and a small harbour is formed with a stone pier. Millport is increasing very fast, both in extent and population. Many neat villas have lately been built, and it has become a favourite watering place, as the bathing ground is excellent. There is a college belonging to the Scotch Episcopal Church. It is a handsome Gothic building with a chapel and spire, and attached to it are an excellent garden and pleasure grounds, which are open to the public at certain hours. There are a provost, dean, and choristers, and the necessary establishment for education. The college was erected and endowed, it is understood, chiefly at the expense of the Honourable Mr Boyle, the brother of Lord Glasgow. There is in Millport a residence of the Earl of Glasgow called The Garrison. It is occupied by the countess-dowager, and is a neat Gothic building, with pleasure grounds. The great defect in Cumbrae is the absence of roads: there is only one made road, and it is a bad one. The farms are of some size, and the agriculture is good. The climate is mild and healthy. The island abounds with lime and freestone. Considerable quantities of the freestone are exported, but the lime is seldom wrought. There are two basaltic rocks on the east side of the island, called Reppel Walls. It forms one parish, and has one Established church and a Free church. The population in 1851 was 1266, besides seamen belonging to registered vessels.

Little Cumbrae lies about half a mile south of Great Cumbrae. It is the property of the Earl of Eglinton. It is about a mile in length, and half a mile in breadth. Ecclesiastically Little Cumbrae is attached to the parish of Killin in Ayrshire, while civilly and politically it is in Buteshire. Rabbits are very plentiful on this island. A lighthouse was erected in 1750 on the highest point of the island, but it was found that the fogs obscured the light; it was therefore removed to a lower situation. Three or four families live on it. The ruins of a castle are situated on the south side. The ascent from the shore is over rocks, which rise one above another like steps of stairs. There are several caves in the island, two of them very large. The extent of one of these is not known, but the other is thirty-two feet square, and six feet in height.

Inchmarnoch is a low-lying, small, beautiful island, situated about a mile west from Bute. It takes its name from a chapel built on it, dedicated to St Marnoch, and which had a burying-ground attached. The ruins were visible till very lately, when they were removed by the rude hands

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of a farmer. It is about a mile long and half a mile broad, and is divided into three farms, and nearly one-half is arable. It is the property of the Marquis of Bute, and abounds in sea shell or marl. The inhabitants acknowledge the spiritual jurisdiction of the parish of Rothesay, although it was long considered as belonging to Saddel in Argyleshire, from the monks of St Marnoch being attached to the convent of Saddel; and still the minister of Kerry in Argyleshire derives a portion of his stipend from this island.

Pladda is a small island, which lies about a mile S.E. from Arran, on which there is a lighthouse, which directs the mariner to the Cumbrae light.

Holy Island is a small island situated in the mouth of Lamlash Bay, in Arran, and helps to form that safe and capacious harbour. There is one house upon it, and the island forms a farm of some value.

The valued rent of the county in Scots money is L.15,042, 13s. 10d. The lands belong to ten proprietors. The valuation Scots of the Marquis of Bute's land is L.8066, 5s. 4¼d.; that of the Duke of Hamilton is L.4955, 11s. Nearly one-fourth of the lands in the county is entailed. The real rent of the county in 1849, was L.40,570 including house property. Of the thirty-three shires of Scotland, Bute was the twelfth in point of precedency in the Scottish parliament rolls and all public processions, though not entitled to that rank in point of valuation. It sent two members to parliament before the union; from that time till the passing of the Reform bill, Bute and Caithness returned a member alternately; now Bute returns a member for itself. The burgh of Rothesay is included in the county constituency, having a separate constitution for municipal purposes. The county constituency is about 483. The family of Bute were hereditary sheriffs of the county for upwards of 360 years, until the jurisdictions were taken away in 1748. They were also lords of the regality of Bute. The Marquis of Bute is heritable coroner of the island of Bute, and keeper of the castle of Rothesay. By a recent statute the counties of Dumbarton and Bute are combined as one sheriffdom, under the jurisdiction of the same sheriff, but each county has a sheriff-substitute and other officials. Lord James Stuart, the uncle of the Marquis of Bute, is the lord-lieutenant. Criminals usually tried before the justiciary court are sent to the circuit court at Inveraray. Buteshire sends ten assizers to that circuit court. The islands of Bute and Cumbrae were granted by the sovereign of Scotland, at an early period, to the lord high steward; and when they fell under the power of Norway, the monarch of that country gave Bute and certain other islands to Reginald, king of Man. After the marriage of Alexander VI., lord high steward, with Jean, daughter and heiress of Angus, one of the grandsons of the king of Man, the islands of Bute, Arran, and Cumbrae became a favoured part of the patrimony of the lord high steward, between whom and the people a strong attachment subsisted; and they were, by way of distinction, called the Lord High Steward's Brandanes. It is probable that this name was derived from St Brandane, who flourished in the eleventh century. Sir John Stuart of Bute, from whom the family of Bute descended, was son to King Robert II., and received from his father the office of heritable sheriff, as well as an estate of lands in Bute and Arran. In the year 1544 the English burned the greater part of Bute and Arran. The shire of Bute contains 171 English square miles, or 109,375 English acres; and the population in 1851 amounted to 16,608, besides seamen belonging to registered vessels.

BUTLER (French *bouteillier*, from *bouteille*, a bottle, *i. e.* the *bottler*), a servant or officer in the houses of the wealthy, whose chief business is to take charge of the wine, plate, &c. The title was anciently applied in the court of France to an officer corresponding to the grand échanson or great cup-bearer of later times.

Butler.

Butler, *Charles*, an ingenious and learned writer, born in 1559, at High Wycomb in Buckinghamshire. He entered of Magdalen Hall, Oxford, whence, after taking a degree in arts, he was translated to Magdalen College. He afterwards became master of the free school at Basingstoke, and curate of a neighbouring parish. He was promoted about the year 1600 to the vicarage of Lawrence-Wotton, in the same county, and there he died in 1647. He published a book entitled "The Principles of Music in singing and setting; with the twofold use thereof, ecclesiastical and civil;" 4to, London, 1636. This very learned and entertaining book is highly praised by Dr Burney in his *History of Music*. His various works are enumerated by Wood in the *Athenæ Oxonienses*. Among these is a curious English Grammar, published in 1633, in which he proposes a scheme of regular orthography, and makes use of peculiar characters, some borrowed from the Saxon, and others of his own invention; and of this imagined improvement he has made use in all his tracts.

Butler, *James*, Duke of Ormond, was born at London in 1610. To the personal interest which King James took in his early education may be attributed that devotion to the Stuart dynasty, and to the principles of the Protestant faith, that distinguished him through life. In his 20th year he entered the army, and two years later, on the death of his grandfather, he succeeded to the earldom of Ormond. His talents attracted the notice of Strafford, at that time lord-lieutenant of Ireland; and by the influence of this nobleman he was appointed to the command of the army intended for the suppression of the Irish rebellion. Though he checked the progress of the insurgents, and gained many advantages over them, his efforts were so much impeded by the jealous interference of Strafford, that Charles granted him an independent commission under the Great Seal, and raised him to a marquisate. In 1644, three years after the death of Strafford, he was appointed lord-lieutenant of Ireland, a situation rendered doubly difficult by the insubordination of the Irish themselves, and by the intrigues of the English parliament. In 1647 he returned to England; and though his administration was publicly approved of by Charles, the state of affairs was such that he resolved to secure his safety by a temporary residence in France. After the king's death he returned to Ireland, and availing himself of the reaction that had taken place in consequence of that event, he caused Charles II. to be proclaimed. Cromwell, however, soon after landed in Ireland, and Ormond once more retired to France and joined the exiled family of the late king. At the Restoration he not only recovered his estates, but was rewarded for his many services with the title of duke. In 1662 he was again appointed lord-lieutenant of Ireland, and retained this office for seven years. In 1670 he narrowly escaped assassination at the hands of the notorious Colonel Blood. At the request of the king, however, he forgave his intended assassin, upon whom no punishment was ever inflicted. In 1667 he was once more appointed lord-lieutenant of Ireland, and governed that country with marked ability and success till 1685, when he resigned his office and returned to England. He died at his seat in Dorsetshire in 1688, and was buried in Westminster Abbey. His son, "the gallant" Ossory, had predeceased him by eight years. Many details of his personal history, together with an admirable delineation of his character, will be found in Sir Walter Scott's *Peveril of the Peak*.

Butler, *Joseph*, Bishop of Durham—one of the most profound and original thinkers this or any country ever produced—well deserves a place among the *dii majores* of English philosophy; with Bacon, Newton, and Locke.

The following brief sketch will comprise an outline of his life and character, some remarks on the peculiarities of his genius, and an estimate of his principal writings.

He was born at Wantage, in Berkshire, May 18, 1692

His father, Thomas Butler, had been a linen-draper in that town, but before the birth of Joseph, who was the youngest of a family of eight, had relinquished business. He continued to reside at Wantage, however, at a house called the Priory, which is still shown to the curious visitor.

Young Butler received his first instructions from the Rev. Philip Barton, a clergyman, and master of the grammar-school at Wantage. The father, who was a Presbyterian, was anxious that his son, who early gave indications of capacity, should dedicate himself to the ministry in his own communion, and sent him to a Dissenting academy at Gloucester, then kept by Mr Samuel Jones. "Jones," says Professor Fitzgerald, with equal truth and justice, "was a man of no mean ability or erudition;" and adds, with honourable liberality, "could number among his scholars many names that might confer honour on any university in Christendom."[1] He instances among others Jeremiah Jones, the author of the excellent work on the *Canon;* Secker, afterwards Archbishop of Canterbury; and two of the most learned, acute, and candid apologists for Christianity England has produced—Nathaniel Lardner and Samuel Chandler.

The academy was shortly afterwards removed to Tewkesbury. While yet there, Butler first displayed his extraordinary aptitude for metaphysical speculation in the letters he sent to Clarke on two supposed flaws in the reasoning of the recently published *à priori* Demonstration; one respecting the proof of the Divine *omnipresence*, and the other respecting the proof of the *unity* of the "necessarily existent Being." It is but just to Clarke to say that his opponent subsequently surrendered both objections. Whether the capitulation be judged strictly the result of logical necessity, will depend on the estimate formed of the value of Clarke's proof of the truths in question;—truths which are happily capable of being shown to be so, independently of any such *à priori* metaphysical demonstration. In this encounter, Butler showed his modesty not less than his prowess. He was so afraid of being discovered, that he employed his friend Secker to convey his letters to the Gloucester post-office, and to bring back the answers.

About this time he began to entertain doubts of the propriety of adhering to his father's Presbyterian opinions, and consequently, of entering the ministry of that communion; doubts which at length terminated in his joining the Church of England. His father, seeing all opposition vain, at length consented to his repairing to Oxford, where he was entered as a commoner of Oriel College, March 17, 1714. Here he early formed an intimate friendship with Mr Edward Talbot, second son of the Bishop of Durham, a connection to which his future advancement was in a great degree owing.

The exact period at which Butler took orders is not known, but it must have been before 1717, as by that date he was occasionally supplying Talbot's living, at Hendred, near Wantage. In 1718, at the age of twenty-six, he was nominated preacher at the Rolls, on the united recommendation of Talbot and Dr Samuel Clarke.

At this time the country was in a ferment. What is called the "Bangorian Controversy," and which originated in a sermon of Bishop Hoadley, "On the Nature of Christ's Kingdom" (a discourse supposed to imperil "all ecclesiastical authority") was then raging. One pamphlet which that voluminous controversy called forth has been attributed to Butler. "The external evidence, however, is," as Mr Fitzgerald judges, "but slight; and the internal for the negative at least equally so." This writer says, "On the whole, I feel unable to arrive at any positive decision on the subject." Readers curious respecting it may consult Mr Fitzgerald's pages, where they will find a detail of the circumstances which led to the publication of the pamphlet, and the evidence for and against its being attributed to Butler.

In 1721, Bishop Talbot presented Butler with the living of Haughton, near Dorkington, and Secker (who had also relinquished nonconformity, and after some considerable fluctuations in his religious views, had at length entered the church), with that of Haughton-le-Spring. In 1725 the same liberal patron transferred Butler to the more lucrative benefice of Stanhope.

He retained his situation of preacher at the Rolls till the following year (1726); and before quitting it published the celebrated "Fifteen Sermons" delivered there; among the most profound and original discourses which philosophical theologian ever gave to the world. As these could have been but a portion of those he preached at the Rolls, it has often been asked what could have become of the remainder? We agree with Mr Fitzgerald in thinking that the substance of many was afterwards worked into the "Analogy." That many of them were equally important with the "Fifteen" may be inferred from Butler's declaration in the preface,—that the selection of these had been determined by "circumstances in a great measure accidental." At his death, Butler desired his manuscripts to be destroyed; this he would hardly have done, had he not already rifled their chief treasures for his great work. Let us hope so at all events; for it would be provoking to think that discourses of equal value with the "Fifteen" had been wantonly committed to the flames.

After resigning his preachership at the Rolls, he retired to Stanhope, and gave himself up to study and the duties of a parish priest. All that could be gleaned of his habits and mode of life there has been preserved by the present Bishop of Exeter, his successor in the living of Stanhope eighty years after; and it is little enough. Tradition said that "Rector Butler rode a black pony, and always rode very fast; that he was loved and respected by all his parishioners; that he lived very retired, was very kind, and could not resist the importunities of common beggars, who, knowing his infirmity, pursued him so earnestly, as sometimes to drive him back into his house as his only escape." The last fact the bishop reports doubtful; but Butler's extreme benevolence is not so.

In all probability, Butler in this seclusion was meditating and digesting that great work on which his fame, and what is better than fame, his usefulness, principally rests—"The Analogy." "In a similar retirement," says Professor Fitzgerald, "The Ecclesiastical Polity of Hooker, The Intellectual System of Cudworth, and The Divine Legation of Warburton—records of genius 'which posterity will not willingly let die'—were ripened into maturity." Queen Caroline once asked Archbishop Blackburne whether Butler was not "dead?" "No," said he, "but he is *buried.*" It was well for posterity that he was thus, for a while, entombed.

He remained in this meditative seclusion seven years. At the end of this period, his friend Secker, who thought Butler's health and spirits were failing under excess of solitude and study, succeeded in dragging him from his retreat. Lord Chancellor Talbot, at Secker's solicitation, appointed him his chaplain in 1733; and in 1736 a prebendary of Rochester. In the same year, Queen Caroline, who thought her court derived as much lustre from philosophers and divines as from statesmen and courtiers—who had been the delighted spectator of the argumentative contests of Clarke and Berkeley, Hoadley and Sherlock—appointed Butler clerk of the closet, and commanded "his attendance every evening from seven till nine."

It was in 1736 that the celebrated "Analogy" was published, and its great merits immediately attracted public

[1] *Life of Butler*, prefixed to Professor Fitzgerald's very valuable edition of the *Analogy*, Dublin, 1849. The memoir is derived chiefly from Mr Bartlett's more copious "Life;" it is very carefully compiled, and is frequently cited in the present article.

attention. It was perpetually in the hands of his royal patroness, and passed through several editions before the author's death. Its greatest praise is that it has been almost universally read, and never answered. "I am not aware," says Mr Fitzgerald, "that any of those whom it would have immediately concerned, have ever attempted a regular reply to the 'Analogy;' but particular parts of it have met with answers, and the whole, as a whole, has been sometimes unfavourably criticised." Of its merits, and precise position in relation "to those whom it immediately concerns," we shall speak presently.

Some strange criticisms on its general character in Tholuck's *Vermischte Schriften*, showing a singular infelicity in missing Butler's true "*standpunkt*," as Tholuck's own countrymen would say, and rather unreasonably complaining of obscurity, considering the quality of German theologico-philosophical style in general, are well disposed of by Professor Fitzgerald (Pp. xlvii.–l.)

About this time Butler had some correspondence with Lord Kaimes on the *Evidences of Natural and Revealed Religion.* Kaimes requested a personal interview, which Butler declined in a manner very characteristic of his modesty and caution. It was "on the score of his natural diffidence and reserve, his being unaccustomed to oral controversy, and his fear that the cause of truth might thence suffer from the unskilfulness of its advocate."

Hume was a kinsman of Lord Kaimes, and when preparing his treatise of *Human Nature* for the press, was recommended by Lord Kaimes to get Butler's judgment on it. "Your thoughts and mine," says Hume, "agree with respect to Dr Butler, and I should be glad to be introduced to him." The interview, however, never took place, nor was Butler's judgment obtained. One cannot help speculating on the possible consequences. Would it have made any difference?

In the year 1737, Queen Caroline died, but on her deathbed recommended her favourite divine to her husband's care. In 1738 Butler was accordingly made Bishop of Bristol, in place of Dr Gooch, who was translated to Norwich. This seems to have been a politic stroke of Walpole, who "probably thought," says Fitzgerald, "that the ascetic rector of Stanhope was too unworldly a person to care for the poverty of his preferment, or perceive the slight which it implied." In the reply, however, in which Butler expresses his sense of the honour conferred, he shows that he understood the position of matters very clearly. The hint he gave seems to have had its effect, for in 1740 the King nominated him to the vacant Deanery of St Paul's, whereupon he resigned Stanhope, which he had hitherto held *in commendam.* The revenues of Bristol, the poorest see, did not exceed L.400.

A curious anecdote of Butler has been preserved by his domestic chaplain, Dr Tucker, afterwards Dean of Gloucester. He says;—"His custom was, when at Bristol, to walk for hours in his garden in the darkest night which the time of the year could afford, and I had frequently the honour to attend him. After walking some time, he would stop suddenly and ask the question, 'What security is there against the insanity of individuals? The physicians know of none; and as to divines, we have no data, either from Scripture or from reason, to go upon relative to this affair.' 'True, my Lord, no man has a lease of his understanding any more than of his life; they are both in the hands of the Sovereign Disposer of all things.' He would then take another turn, and again stop short—'Why might not whole communities and public bodies be seized with fits of insanity, as well as individuals.' 'My Lord, I have never considered the case, and can give no opinion concerning it.' 'Nothing but this principle, that they are liable to insanity, equally at least with private persons, can account for the major part of those transactions of which we read in history.' I thought little of that odd conceit of the bishop at that juncture; but I own I could not avoid thinking of it a great deal since, and applying it to many cases."

In 1747, on the death of Archbishop Potter, it is said that the primacy was offered to Butler, who declined it with the remark that "it was too late for him to try to support a falling church." If he really said so, it must have been in a moment of despondency, to which his constitutional melancholy often disposed him. No such feeling, at all events, prevented his accepting the bishopric of Durham in 1750, on the death of Dr Edward Chandler. About the time of his promotion to this dignity, he was engaged in a design for consolidating and extending the Church of England in the American colonies. With this object he drew up a plan marked by his characteristic moderation and liberality; the project, however, came to nothing.

Soon after his translation to the see of Durham, Butler delivered and published his charge on the Use and Importance of External Religion, which gave rise, in conjunction with his erection of a "white marble cross" over the communion table in his chapel at Bristol, and one or two other slight circumstances, to the ridiculous and malignant charge of popery;—a charge, as Mr Fitzgerald observes, "destitute of a shadow of positive evidence, and contradicted by the whole tenor of Butler's character, life, and writings."

The revenues from his see were lavishly expended in the support of public and private charities,[1] while his own mode of life was most simple and unostentatious. Of the frugality of his table, the following anecdote is proof:—"A friend of mine, since deceased, told me," says the Rev. John Newton, "that when he was a young man, he once dined with the late Dr Butler, at that time Bishop of Durham; and, though the guest was a man of fortune, and the interview by appointment, the provision was no more than a joint of meat and a pudding. The bishop apologized for his plain fare, by saying, that it was his way of living; 'that he had been long disgusted with the fashionable expense of time and money in entertainments, and was determined that it should receive no countenance from his example.'" No prelate ever owed less to politics for his elevation, or took less part in them. If he was not "wafted to his see of Durham," as Horace Walpole ludicrously said, "on a cloud of metaphysics," he certainly was not carried there by political intrigue or party manœuvres. He was never known to speak in the House of Peers, though constant in his attendance there.

He had not long enjoyed his new dignity before symptoms of decay disclosed themselves. He repaired to Bath in 1752, in hope of recovering his health, where he died, June 16, in the 60th year of his age.

His face was thin, and pale, but singularly expressive of placidity and benevolence. "His white hair," says Hutchinson,[2] "hung gracefully on his shoulders, and his whole figure was patriarchal." He was buried in the cathedral of Bristol, where two monuments have been erected to his memory. They record in suitable inscriptions (one in Latin by his chaplain, Dr Foster, and the other in English by the late Dr Southey) his virtues and genius. Though epitaphs, they speak no more than simple truth.

[1] Butler must have been of a naturally munificent as well as benevolent disposition. He was extremely fond, it appears, of *planning* and *building;* a passion not always very prudently indulged, or without danger, in early days, of involving him in difficulties; from which, indeed, on one occasion Secker's intervention saved him. He spent large sums in improving his various residences. It was probably in the indulgence of the love of ornamentation to which this passion led, that the "marble cross" and other imprudent symbols which were so ridiculously adduced to support the charge of popery, originated.

[2] *History of Durham,* vol. i. p. 578; cited in Fitzgerald's "Life."

A singular anecdote is recorded of his last moments. As Mr Fitzgerald observes, "it wants direct testimony," but is in itself neither uninstructive nor incredible, for a dying hour has often given strange vividness and intensity to truths neither previously unknown nor uninfluential. It is generally given thus:—"When Bishop Butler lay on his death-bed, he called for his chaplain, and said, 'Though I have endeavoured to avoid sin, and to please God, to the utmost of my power; yet, from the consciousness of perpetual infirmities, I am still afraid to die.' 'My Lord,' said the chaplain, 'you have forgotten that Jesus Christ is a Saviour.' 'True,' was the answer, 'but how shall I know that he is a Saviour for me?' 'My Lord, it is written, Him that cometh unto me, I will in no wise cast out.' 'True,' said the bishop, 'and I am surprised, that though I have read that scripture a thousand times over, I never felt its virtue till this moment; and now I die happy.'"

The genius of Butler was almost equally distinguished by subtilty and comprehensiveness, though the latter quality was perhaps the most characteristic. In his *juvenile* correspondence with Clarke—already referred to—he displays an acuteness which, as Sir James Mackintosh observes, "neither himself nor any other ever surpassed;" an analytic skill, which, in earlier ages, might easily have gained him a rank with the most renowned of the schoolmen. But in his mature works, though they are everywhere characterized by subtle thought, he manifests in combination with it qualities yet more valuable;—patient comprehensiveness in the survey of complex evidence, a profound judgment and a most judicial calmness in computing its several elements, and a singular constructive skill in combining the materials of argument into a consistent logical fabric. This "architectural power" of mind may be wholly or nearly wanting, where the mere analytic faculty may exist in much vigour. The latter may even be possessed in vicious excess, resulting in little more than the disintegration of the subjects presented to its ingenuity. Synthetically to reconstruct the complex unity, when the task of analysis is completed, to assign the reciprocal relations and law of subordination of its various parts, requires something more. Many can take a watch to pieces, who would be sorely puzzled to put it together again.

Butler possessed these powers of analysis and synthesis in remarkable equipoise. What is more, he could not only recombine, and present in symmetrical harmony, the elements of a complex unity when capable of being subjected to an exact previous analysis,—as in his remarkable sketch of the Moral Constitution of Man,—but he had a wonderfully keen eye for detecting remote analogies and subtle relations where the elements are presented intermingled or in isolation, and insusceptible of being presented as a single object of contemplation previous to the attempt to combine them. This is the case with the celebrated "Analogy." In the Sermons on Human Nature, he comprehensively surveys that nature as a *system* or *constitution;* and after a careful analysis of its principles, affections, and passions, views these elements in combination, endeavours to reduce each of these to its place, assigns to them their relative importance, and deduces from the whole the law of subordination—which he finds in the Moral Supremacy of Conscience, as the key-stone of the arch—the ruling principle of the "Constitution." In the Analogy, he gathers up and combines from a wide survey of scattered and disjointed facts, those resemblances and relations on which the argument is founded, and works them into one of the most original and symmetrical logical creations to which human genius ever gave birth. The latter task was by far the more gigantic of the two. To recur to our previous illustration, Butler is here like one who puts a watch together without having been permitted to take it to pieces—from the mere presentation of its disjointed fragments. In the former case he resembled the physiologist who has an entire animal to study and dissect; in the latter he resembled Cuvier, constructing out of *disjecta membra*—a bone scattered here and there—an organized unity which man had never seen except in isolated fragments.

All Butler's productions—even his briefest—display much of this "architectonic" quality of mind; in all he not only evinces a keen analytic power in discerning the "differences" (one phase of the philosophic genius, according to Bacon, and hardly the brightest), but a still higher power of detecting the "analogies" and "resemblances of things," and thus of showing their relations and subordination. These peculiarities make his writings difficult, but it makes them profound, and it gives them singular completeness.

It is not difficult to assign the precise sphere in which Butler, with eminent gifts for abstract science in general, felt most at home. Facts show us, not only that there are peculiarities of mental structure which prompt men to the pursuit of some of the great objects of thought and speculation rather than others—peculiarities which circumstances may determine and education modify, but which neither circumstances nor education can do *more* than determine or modify; but that even in relation to the very same subject of speculation, there are minute and specific varieties of mind, which prompt men to addict themselves rather to this part of it than to that. This was the case with Butler. Eminently fitted for the prosecution of metaphysical science in general, it is always the *philosophy of the moral nature of man* to which he most naturally attaches himself, and on which he best loves to expatiate. Neither Bacon nor Pascal ever revolved more deeply the phenomena of our moral nature, or contemplated its inconsistencies—its intricacies—its paradoxes—with a keener glance or more comprehensive survey; or drew from such survey reflections more original or instructive. As in reading Locke the young metaphysician is perpetually startled by the palpable apparition, in distinct sharply-defined outline, of facts of consciousness which he recognises as having been partially and dimly present to his mind before—though too fugitive to fix, too vague to receive a name; so in reading Butler, he is continually surprised by the statement of moral facts and laws, which he then first adequately recognises as true, and sees in distinct vision face to face. It is not without reason that Sir James Mackintosh says of the sermons preached at the Rolls, "that in them Butler has taught truths more capable of being exactly distinguished from the doctrines of his predecessors, more satisfactorily established by him, more comprehensively applied to particulars, more rationally connected with each other, and therefore more worthy of the name of *discovery*, than any with which we are acquainted."

His special predilections for the sphere of speculation we have mentioned are strikingly indicated in his choice of the *ground* from which he proposes to survey the questions of morals. "There are two ways," says he in the preface to his three celebrated sermons on Human Nature, "in which the subject of morals may be treated. One begins from inquiring into the abstract relations of things; the other, from a matter of fact, namely, what the particular nature of man is, its several parts, their economy or constitution; from whence it proceeds to determine what course of life it is, which is correspondent to this whole nature." As might be expected, from the tendencies of his mind, he selects the *latter* course.

The powers of *observation* in Butler must have been, in spite of his studious life and his remarkable habits of abstraction, not much inferior to his keen faculty of introspection, though this last was undoubtedly the main instrument by which he traced so profoundly the mysteries of our nature. There have doubtless been other men, far less pro-

found, who have had a more quick or more vivid perception of the peculiarities of character which discriminate individuals, or small classes of men (evincing, after all, however, not so much a knowledge of *man*, as a knowledge of *men*); still, the masterly manner in which Butler often sketches even these, shows that he must have been a very sagacious observer of those phenomena of human nature which presented themselves from *without*, as well as of those which revealed themselves from *within*. In general, however, it is the characteristics of *man*, the generic phenomena of our nature, in all their complexity and subtilty, that he best loves to investigate and exhibit. The spirit of his profound philosophy is meantime worthy both of the Christian character and the ample intellect of him who excogitated it. It is the very reverse of that of the philosophical satirist or caricaturist; however severely just to the foibles, the inconsistencies, the corruptions of our nature, it is a philosophy everywhere compassionate, magnanimous, and philanthropic. Its tone, indeed, like that of the philosophy of Pascal (though not shaded with the same deep melancholy), is entirely modulated by a profound conviction of the frailty and ignorance of man, of the little we know compared with what is to be known,—and of the duty of humility, modesty, and caution in relation, to all those great problems of the universe, which tempt and exercise man's ambitious speculations. His constant feeling, amidst the beautiful and original reasonings of the "Analogy," is identical with that of Newton, when, reverting at the close of life to his sublime discoveries, he declared that he seemed only like a child who had been amusing himself with picking up a few shells on the margin of the ocean of universal truth, while the infinite still lay unexplored before him. In a word, it is the feeling, not only of Pascal and of Newton, but of all the profoundest speculators of our race, whose grandest lesson from all they learned, was the vanishing ratio of man's knowledge to man's ignorance. Hence the immense value (if only as a discipline) of a careful study of Butler's writings, to every youthful mind. They cannot but powerfully tend to check presumption, and teach modesty and self-distrust.

The feebleness of Butler's imagination was singularly contrasted with the *inventive* and *constructive* qualities of his intellect, and the facility with which he detected and employed "analogies" in the way of argument. He is, indeed, almost unique in this respect. Other philosophic minds (Bacon and Burke are illustrious examples), which have possessed similar aptitudes for "analogical" reasoning, have usually had quite sufficient of the kindred activity of imagination to employ "analogies" for the purpose of poetical illustration. If Butler possessed this faculty by nature in any tolerable measure, it must (as has been the case with some other great thinkers) have been repressed and absorbed by his habits of abstraction. His defect in this respect is, in some respects, to be regretted, since unquestionably the illustrations which imagination would have supplied to argument, and the graces it would have imparted to style, would have made his writings both more intelligible and more attractive. It is said that once, and once only, he "courted the muses," having indited a solitary "acrostic to a fair cousin," who for the first, and as it seems, the only time, inspired him with the tender passion. But, as one of his biographers says, we have probably no great reason to lament the loss of this fragment of his poetry.

Butler's composition is almost as destitute of the vivacity of wit as of the graces of imagination. Yet is he by no means without that dry sort of humour which often accompanies very vigorous logic, and, indeed, is in some sense inseparable from it; for the neat detection of a sophism, or the sudden and unexpected explosion of a fallacy, produces much the same effect as wit on those who are capable of enjoying close and cogent reasoning. There is also a kind of simple, grave, satirical pleasantry, with which he sometimes states and refutes an objection, by no means without its piquancy.

As to the complaint of obscurity, which has been so often charged on Butler's style, it is difficult to see its justice in the sense in which it has been usually preferred. He is a *difficult* author, no doubt, but he is so from the close packing of his thoughts, and their immense generality and comprehensiveness; as also from what may be called the *breadth* of his march, and from occasional lateral excursions for the purpose of disposing of some objection which he does not formally mention, but which might harass his flank; it certainly is not from indeterminate language or (ordinarily) involved construction. All that is really required in the reader, *capable* of understanding him at all, is to do just what he does with lyrical poetry (if we may employ an odd, and yet in this one point, not inapt comparison); he must read sufficiently often to make all the transitions of thought familiar, he must let the mind dwell with patience on each argument till its entire scope and bearing are properly appreciated. Nothing certainly is wanting in the method or arrangement of the thoughts; and the diction seems to us selected with the utmost care and precision. Indeed, as Professor Fitzgerald justly observes, a collation of the first with the subsequent editions of the "Analogy" (the variations are given in Mr Fitzgerald's edition) will show, by the nature of the alterations, what pains Butler bestowed on a point on which he is erroneously supposed to have been negligent. In subjects so abstruse, and involving so much generality of expression, the utmost difficulty must always be experienced in selecting language which conveys *neither more nor less* than what is intended; and this point Butler must have laboured immensely; it may be added, successfully, since he has at least produced works which have seldom given rise to disputes as to his meaning. Though he may be difficult to be understood, few people complain of his being liable to be *mis*understood. In short, it may be doubted whether any man of so comprehensive a mind, and dealing with such abstract subjects, ever condensed the results of twenty years' meditations into so small a compass, with so little obscurity. No doubt greater amplification would have made him more pleasing, but it may be questioned whether the perusal of his writings would have been so useful a discipline; and whether the truths he has delivered would have fixed themselves so indelibly as they now generally do in the minds of all who diligently study him. It is the result of the very activity of mind his writings stimulate and demand. But, at any rate, if precision in the use of language, and method and consecutiveness in the thoughts, are sufficient to rebut the charge of obscurity, Butler is not chargeable with the fault in the ordinary sense. We must never forget what Whately in his rhetoric has so well illustrated; that perspicuity is a "relative quality." To the intelligent, or those who are willing to take sufficient pains to understand, Butler will not seem chargeable with obscurity. The diction is plain, downright Saxon-English, and the style, however homely, has, as the writer just mentioned observes, the great charm of transparent simplicity of purpose and unaffected earnestness.

The immortal "Analogy" has probably done more to silence the objections of infidelity than any other ever written from the earliest "apologies" downwards. It not only most critically met the spirit of unbelief in the author's own day, but is equally adapted to meet that which *chiefly* prevails in all time. In every age, some of the principal, perhaps *the* principal, objections to the Christian Revelation, have been those which men's *preconceptions* of the Divine character and administration—of what God *must* be, and of what God *must* do—have suggested against certain facts in the sacred history, or certain doctrines it reveals. To show

the objector then (supposing him to be a theist, as nine-tenths of all such objectors have been), that the very same or similar difficulties are found in the structure of the universe and the divine administration of it, is to wrest every *such* weapon completely from his hands, if he be a fair reasoner and remain a theist at all. He is bound by strict logical obligation either to show that the parallel difficulties do *not* exist, or to show how he can solve them, while he *cannot* solve those of the Bible. In default of doing either of these things, he ought either to renounce all *such* objections to Christianity, or abandon theism altogether. It is true, therefore, that though Butler leaves the alternative of atheism open, he hardly leaves any other alternative to nine-tenths of the theists who have objected to Christianity.

It has been sometimes said by way of reproach, that Butler *does* leave that door open; that his work does not confute the atheist. The answer is, that it is not its object to confute atheism; but it is equally true, that it does not diminish by one grain any of the arguments against it. It leaves the evidence for theism—every particle of it—just where it was. Butler merely avails himself of facts which exist, undeniably exist (whether men be atheists or theists), to neutralize a certain class of objections against Christianity. And as the exhibition of such facts as form the pivot on which Butler's argument turns, does not impugn the truth of theism, but leaves its conclusions, and the immense preponderance and convergence of evidence which establish them just as they were, so it is equally true that Butler has sufficiently guarded his argument from any perversion; for example, in Part I. chap. vi., and Part II. chap. viii. He has also with his accustomed acuteness and judgment shown that, even on the principles of atheism itself, its confident assumption that, *if* its principles be granted, a future life—future happiness—future misery—is a dream,—cannot be depended on; for since men have existed, they may again; and if in a bad condition now, in a worse hereafter. It is not, on such an hypothesis, a whit more unaccountable that man's life should be renewed or preserved, or perpetuated for ever, than that it should have been originated at all. On this point, he truly says, "That we are to live hereafter, is just as reconcileable with the scheme of atheism, and as well to be accounted for by it, as that we are now alive, is; and therefore nothing can be more absurd than to argue from that scheme, that there can be no future state."

It has been also alleged that the analogy only "*shifts* the difficulty from revealed to natural religion," and that "atheists might make use of the arguments and have done so." The answer is, not only (as just said) that the arguments of Butler leave every particle of the evidence for theism just where it was, and that he has sufficiently guarded against all abuse of them; but that the *facts*, of which it is so foolishly said that the atheist *might* make ill use, had always been the very arguments which he *had* used, and of which Butler only made a new and beneficial application. The objections with which he perplexes and baffles the deist, *he* did not give to the atheist's armoury; he took them from thence, merely to make an unexpected and more legitimate use of them. The atheist had never neglected such weapons, nor was likely to do so, previous to Butler's adroit application of them. The charge is ridiculous; as well might a man, who had wrested a stiletto from an assassin to defend himself, be accused of having put the weapon into the assassin's hands! It was there before; he merely wrested it thence. It is just so with Butler.

Further: we cannot but think that the conclusiveness of Butler's work as against its true object *The Deist*, has often been underrated, by many even of its genuine admirers. Thus Dr Chalmers, for instance, who gives such glowing proofs of his admiration of the work, and expatiates in a congenial spirit on its merits, affirms that "those overrate the power of analogy who look to it for any very distinct or positive contribution to the Christian argument. To repel objections, in fact, is the great service which analogy has rendered to the cause of Revelation, and it is the *only service* which we seek for at its hands."[1] This, abstractedly, is true; but, *in fact*, considering the *position* of the bulk of the objectors, that they have been invincibly persuaded of the truth of theism, and that their objections to Christianity have been exclusively or chiefly of the kind dealt with in the "Analogy," the work is much more than an *argumentum ad hominem;* it is not simply of negative value. To such *objectors* it logically establishes the truth of Christianity, or it forces them to recede from theism, which the bulk will not do. If a man says, "I am invincibly persuaded of the truth of proposition A, but I cannot receive proposition B, because objections α, β, γ are opposed to it; if these were removed, my objections would cease;" then, if you can show that α, β, γ equally apply to the proposition A, his reception of which, he says, is based on invincible evidence, you do really compel such a man to believe that not only B *may* be true, but that it *is* true, unless he be willing (which few in the parallel case are) to abandon proposition A as well as B. This is precisely the condition in which the majority of deists have ever been, if we may judge from their writings. It is usually the *à priori* assumption, that certain facts in the history of the Bible, or some portions of its doctrine, are unworthy of the Deity, and incompatible with his character or administration, that has chiefly excited the incredulity of the deist; far more than any dissatisfaction with the positive evidence which substantiates the Divine origin of Christianity. Neutralize these objections by showing that they are *equally* applicable to what he declares he cannot relinquish—the doctrines of theism; and you show him, if he has a particle of logical sagacity, not only that Christianity may be true, but that it is so; and his only escape is by relapsing into atheism, or resting his opposition on other objections of a very feeble character in comparison, and which, probably, few would ever have been contented with alone; for *apart* from those objections which Butler repels, the historical evidence for Christianity,—the evidence on behalf of the integrity of its records, and the honesty and sincerity of its founders,—showing that they *could* not have constructed such a system if they *would*, and *would* not, supposing them impostors, if they *could*,—is stronger than that for any fact in history.

In consequence of this position of the argument, Butler's book, to large classes of objectors, though practically an *argumentum ad hominem*, not only proves Christianity *may* be true, but in all logical fairness proves it *is* so. This he himself, with his usual judgment, points out. He says: "And objections, which are equally applicable to both natural and revealed religion, are, properly speaking, answered by its being shown that they are so, *provided the former be admitted to be true.*"

The praise which Mackintosh bestows on this great work, is alike worthy of it and himself. "Butler's great work, though only a commentary on the singularly original and pregnant passage of Origen, which is so honestly prefixed to it as a motto, is, notwithstanding, the most original and profound work extant in any language, on the *Philosophy of Religion.*[2] The favourite topics of the "Sermons" are, of course, largely insisted on in the "Analogy;" such as the

[1] *Prelections on Butler*, &c., p. 7.

[2] A far different and utterly inconsistent judgment in all respects is reported, in his "Life," to have fallen from him. But as Professor Fitzgerald shows, it is so strangely, and, indeed, amusingly contrary to the above, that it must have been founded on some mistake of something that had been said in conversation.

"ignorance of man;" the restrictions which the limitations of his nature and his position in the universe should impose on his speculations; his subjection to "probability as the guide of life;" the folly and presumption of pronouncing, *à priori*, on the character and conduct of the Divine Ruler from our contracted point of view, and our glimpses of but a very small segment of his universal plan. These topics Butler enforces with a power not less admirable than the sagacity with which he traces the analogies between the "Constitution and Course of Nature" and the disclosures of "Divine Revelation." These last, of course, form the staple of the argument; but to enforce the proper deductions from them, the above favourite topics are absolutely essential.

It has been sometimes, though erroneously, surmised, that Butler was considerably indebted to preceding writers. That in the progress of the long deistical controversy many theologians should have caught glimpses of the same line of argument, is not wonderful. The constant iteration by the English deists of that same class of difficulties to which the "Analogy" replies, could not fail to lead to a partial perception of the powerful instrument it was reserved for Butler effectually to wield. It has been here as with almost every other great intellectual achievement of man; many minds have been simultaneously engaged by the natural progress of events *about* the same subject of thought; there have been "coming shadows" and "vague anticipations," perhaps even simultaneous inventions or discoveries; and then ensues much debate as to the *true* claimants. Thus it was in relation to the calculus, the analysis of water, the invention of the steam-engine, and the discovery of Neptune.

In the present case, however, there can be no doubt that the merit of the systematic construction of the entire argument rests with Butler. Nor would it have much detracted from his merit, even if he had derived far larger fragments of the fabric from his contemporaries than we have any reason to believe he did. They would have been but single stones; the architectural genius which brought them from their distant quarries and polished them, and wrought them into a massive edifice, was his alone.

Professor Fitzgerald has truly remarked, that the work of Dr James Foster against Tindal (an author Butler evidently has constantly in his eye), presents some curious parallelisms with certain passages of the "Analogy;" we have ourselves noted in Conybeare's reply to the same infidel writer (published six years before the "Analogy"), other parallelisms not less striking. But it seems quite improbable that Butler should have derived aid from any such sources, since his work was being excogitated for many years before it was published; nay, as we have seen, it may be conjectured that he largely transfused into it portions of the Sermons delivered so long before at the Rolls, and of which a far greater number must have been preached than the fifteen he published; so that, perhaps, it is more near the truth to say, that contemporary writers had been indebted to him than he to them.

The "pregnant sentence" from Origen, however, is not the only thing which may have suggested to Butler his great work. Berkeley, in a long passage of the "Minute Philosopher," cited by Mr Fitzgerald, clearly lays down the *principle* on which such a work as the "Analogy" might be constructed.

The spirit of the "Analogy" is admirable. Though eminently controversial in its origin and purpose; and though the author must constantly have had the deistical writers of the day in his eye, his work is calm and dignified, and divested of every trace of the controversial spirit. He does not even mention the names of the men whose opinions he is refuting; and if their systems had been merely some new minerals, or aerolites dropped upon the world from some unknown sphere, he could not have analysed them with less of passion.

Of Butler's ethical philosophy, as expounded especially in the "Sermons on Human Nature," Sir James Mackintosh's remarks prefixed to this Encyclopædia supersede further notice in the present brief article. But it may be remarked in general of the Sermons preached at the Rolls, that though not so much read (if we except, perhaps, the three just mentioned) as the Analogy, they are to the full as worthy of being read; they deserve all that is so strikingly said of them in the Preliminary Dissertation. Some of them fill one with wonder at the sagacity with which the moral paradoxes in human nature are investigated and reconciled. Take, for example, the sermon on Balaam. The first feeling in many a mind on reading the history in the Old Testament is, that man *could* not so act in the given circumstances. We doubt if ever any man deeply pondered the sermon of Butler, in which he dwells on the equally unaccountable phenomena of human conduct, less observed, indeed, only because more observable—and questioned any longer man's powers of self-deception, even to such feats of folly and wickedness as are recorded of the prophet.

The editions of Butler's writings, separately or altogether, have been numerous, and it is impossible within the limits of this article to specify them; still less to do justice to the *literature* which they have produced. His commentators have been many and most illustrious; seldom has a man who wrote so little, engaged so many great minds to do him homage, by becoming his exponents and annotators. It may be permitted, however, to mention with deserved honour the Remarks of Sir James Mackintosh prefixed to this Encyclopædia; the "Prelections" of Dr Chalmers on the "Analogy;" the valuable "Essay" of Dr Hampden "On the Philosophical Evidence of Christianity;" some beautiful applications of Butler's principle in Whately's "Essays on the Peculiarities of Christianity;" and the admirable edition of the "Analogy" by Professor Fitzgerald, which is enriched by many very acute and judicious notes, and by a copious and valuable index.

A very neat and convenient edition of Butler's entire works, in two volumes, 8vo, has been issued from the Clarendon press. (H. R.)

Butler, *Samuel*, the author of *Hudibras*, was the son of a respectable Worcestershire farmer, and was born at Strensham in that county, February 13, 1612. He passed some time at Cambridge, but was never matriculated in that university. Returning to his native county, he lived some years as clerk to a justice of peace, and also applied himself to history, poetry, and painting. Being recommended to Elizabeth, Countess of Kent, he enjoyed in her house not only the use of all kinds of books, but the conversation of the illustrious Selden, who often employed Butler to write letters and translate for him. He lived also some time with Sir Samuel Luke, a gentleman of an ancient family in Bedfordshire, and a famous commander under Oliver Cromwell; and he is supposed at this time to have written, or at least to have planned, his celebrated *Hudibras*, and under that character to have ridiculed the knight. The poem itself furnishes this key in the first canto, where Hudibras says—

> "'Tis sung, there is a valiant Mameluke
> In foreign land yclep'd —— ——
> To whom we oft have been compar'd
> For person, parts, address, and beard."

After the Restoration, Butler was appointed secretary to the Earl of Carbury, lord-president of Wales, who appointed him steward of Ludlow Castle when the court was revived there. No one proved a more generous friend to him than the Earl of Dorset and Middlesex, to whom it was owing that the court relished his *Hudibras*. He had promises of a good place from the Earl of Clarendon, but they were never accomplished; though the king was so much pleased with the poem as often to quote it pleasantly in conversation. It is indeed said that Charles ordered him the

sum of L.3000; but the sum being expressed in figures, somebody through whose hands the order passed reduced it, by cutting off a cypher, to L.300, and though it passed the offices without fees, it proved not sufficient to pay what he then owed; so that Butler benefited but little by the king's bounty. During the latter years of his life he was reduced to almost absolute want, and his fate might have been that of the ill-starred Otway, had not the kind interference of Mr Longueville, a bencher of the Inner Temple, prevented such a catastrophe. This gentleman likewise erected a monument in memory of Butler, after his death, which took place in 1680. Granger observes, that Butler "stands without a rival in burlesque poetry. His *Hudibras*," he adds, "is in its kind almost as great an effort of genius as the *Paradise Lost* itself. It abounds with uncommon learning, new rhymes, and original thoughts. Its images are truly and naturally ridiculous. There are many strokes of temporary satire, and some characters and allusions which cannot be discovered at this distance of time."

BUTRINTO (the ancient *Buthrotum*), a fortified maritime town of European Turkey in Albania, immediately opposite the island of Corfu. It stands at the mouth of a stream three or four miles in length, connecting the lake of Vatzindro (the ancient *Pelodes*), with the bay. It is said to have been founded by Helenus, the son of Priam; and on the conquest of Epirus by the Romans, it became a Roman colony. The Roman walls, which still exist, are about a mile in circumference, and are mixed up with remains both of later and of Hellenic work. Pop. about 2000.

BUTT, a measure of wine, containing two hogsheads, or 126 wine gallons. See Pipe.

BUTTER, the unctuous substance obtained from milk by churning. It was not till a late period that the Greeks became acquainted with butter. The Romans used it as a medicine, but not as food. According to Beckmann, the discovery of butter belongs neither to the Greeks nor to the Romans. The former, he thinks, derived their knowledge of butter from the Scythians, the Thracians, and Phrygians; and the latter from the people of Germany. For the process of butter-making, see Dairy.

The ancient Christians of Egypt burnt butter in their lamps instead of oil; and in the Roman churches it was anciently allowed, during Christmas time, to burn butter instead of oil, on account of the great consumption of the latter at that season.

Butter, in the old chemistry, was the term applied to various preparations; as butter of antimony (sesquichloride of antimony); butter of arsenic (sublimated muriate of arsenic); butter of bismuth (sublimated muriate of bismuth); butter of tin (sublimated muriate of tin); butter of zinc (sublimated muriate of zinc).

Butterfly. See Entomology, *Index*.

Buttermilk, milk from which the butter has been separated by churning.

Butter-Tree, a species of *Bassia*, found in Africa. It yields a substance like butter, which is called by Park *Shea butter*.

BUTTERIS, an instrument of steel set in a handle, for paring the hoof of a horse.

BUTTEVANT, a market-town of Ireland, county of Cork, on the Awbeg, 137 miles from Dublin by the Great Southern and Western railway. It was formerly a walled town of some importance, and has remains of two castles and an abbey, founded about the end of the thirteenth century. Buttevant has extensive infantry barracks. Pop. (1851) 1531.

BUTTON, a knob, or small ball; or a similar article used for fastening or ornamenting different parts of dress. These latter are formed of a great variety of materials and shapes. The method of making solid metal buttons is as follows:—The metal with which the moulds are intended to be covered is first cast into small ingots, and then flatted into thin plates by the flattening mill; these are cut into small round pieces proportional to the size of the mould they are intended to cover, by means of proper punches, on a block of wood covered with a thick plate of lead. Each piece of metal thus cut out of the plate is reduced into the form of a button by beating it successively in several concave moulds, with a convex puncheon of iron, always beginning with the shallowest cavity of the mould, and proceeding to the deeper, till the plate has acquired the intended form; and the better to manage so thin a plate, ten, twelve, and sometimes even twenty-four, are formed to the cavities, or concave moulds, at once; often annealing the metal during the operation, to make it more ductile. This plate is generally called by workmen the *cap of the button*.

The form being thus given to the plates or caps, the intended impression is struck on the convex side, by means of a similar iron puncheon, in a kind of mould engraven *en creux*, either by the hammer or a press, similar to that used in coining. The mould in which the impression is to be made is of a diameter and depth suitable to the sort of button intended to be struck in it; each kind requiring a particular mould. Between the puncheon and the plate is placed a thin piece of lead, called by workmen a *hob*, which greatly contributes to take off all the strokes of the engraving; the lead, by reason of its softness, easily giving way to the parts which have relief, and as easily insinuating itself into the traces or indentures.

The plate thus prepared makes the cap or shell of the button. The lower part is formed of another plate, in the same manner, but much flatter, and without any impression. To the last or under plate is soldered a small eye, made of wire, by which the button is to be fastened.

The two plates being thus finished, they are soldered together with soft solder, and then turned in a lathe. Generally indeed a wooden mould is used instead of the under plate; and in order to fasten it, a thread or gut is passed across through the middle of the mould, and the cavity between the mould and the cap is filled with cement, in order to render the button firm and solid; for the cement entering all the cavities formed by the relief of the other side, sustains it, prevents its flattening, and preserves its boss or design.

BUTTRESS, a kind of abutment built archwise, or a mass of stone or brick, serving to support the side of a building or wall externally, when very high or loaded with a heavy superstructure. Buttresses are chiefly used against the angles of steeples and on the outside of such buildings as have heavy roofs, which would be apt to thrust out the walls if unsupported in this manner. They are sometimes placed for a support and abutment against the feet of arches that are turned across great halls in old palaces, abbeys, &c.

Flying buttresses are such as are carried across by an arch from one wall to another. See Architecture.

BUTZOW, a city in the duchy of Mecklenburg-Schwerin, on the Warnow, 16 miles from Rostock. It was formerly the seat of the bishops of Schwerin; and in 1760 a university was founded here, which, however, in 1789, was united with that of Rostock. It manufactures paper, playing-cards, linen, and brandy. Pop. 4050.

BUXAR, a town of Hindustan, in the province of Bahar, district of Shahabad, situated on the south bank of the Ganges. The fort, though of small size, commanded the Ganges, but is now dismantled. This place is distinguished by a celebrated victory gained there on the 23d October 1764 by the British forces under Major (afterwards Sir Hector) Munro, over the united armies of Sujah ud Dowlah and Cossim Ali Khan. The action raged from nine o'clock till noon, when the enemy gave way. Pursuit was, however, frustrated by Sujah ud Dowlah sacrificing a part of his army to the safety of the remainder. A bridge of boats had

been constructed over a stream about two miles distant from the field of battle, and this the enemy destroyed before their rear had passed over. Through this act two thousand troops were drowned, or otherwise lost; but destructive as was this proceeding, it was, says Major Munro, "the best piece of generalship Sujah ud Dowlah showed that day, because if I had crossed the rivulet with the army, I should either have taken or drowned his whole army in the Caramnassa, and come up with his treasure and jewels, and Cossim Ali Khan's jewels, which I was informed amounted to between two and three millions." Lat. 25. 32., Long. 84. 3.

BUXTON, a market-town and fashionable watering-place of Derbyshire, in the parish of Bakewell, and hundred of High Peak, 31 miles N.W. of Derby, and 160 miles from London. It is situated in a deep valley surrounded by hills of considerable elevation, except on the side where the Wye, which rises near this, has its exit. It consist of an old and new town, the former more elevated than the latter, and consisting of one wide street with some good inns and lodging-houses; but most of the buildings are low and mean. In the centre of the market-place is an old cross. The new town is much more elegant, and contains many handsome buildings. Among these is the crescent, a noble range of buildings in the Grecian style, erected by the late Duke of Devonshire in 1779–86, at a cost of L.120,000, and containing hotels, ball-room, lodging-houses, bank, library, arcade, promenade, and an extensive range of stables with riding gallery behind. At the west end of the crescent is the old hall, built by the Earl of Shrewsbury in the reign of Queen Elizabeth, once the residence of Mary Queen of Scots. The church is a handsome edifice, built in 1812 by the Duke of Devonshire. There are numerous public and private baths. The springs, which were known to the Romans, are inclosed in a small Grecian building, and supply hot and cold water within a few inches of each other. They are saline, sulphurous, and charged with nitrogen, and flow at the rate of 60 gallons a minute. They are found useful in cutaneous and nervous complaints, indigestion, gout, and rheumatism. Besides these there is a chalybeate spring behind the crescent, the water of which when mixed with that of the other springs, proves purgative. The "Bath Charity," supported by subscription, is for the maintenance for one month of poor invalids who may require to use the waters. The season extends from June to October, and from 12,000 to 14,000 visitors arrive annually. The public walks are numerous and tastefully laid out. In the vicinity are Pool's Hole (a vast stalactitic cavern), and the Diamond Hill, so called from the profusion of crystals dispersed through the soil. Pop. (1851) 1235, mostly engaged in the manufacture of alabaster, spar, and other ornaments, and in lime-burning.

BUXTON, *Jedediah*, a prodigy of skill in numbers, was born in 1704, at Elmton, near Chesterfield, in Derbyshire. Although his father was schoolmaster of the parish, and his grandfather had been the vicar, his education had been so neglected that he could not write; and with respect to any other knowledge but that of numbers, he seemed always as ignorant as a child. How he came first to know the relative proportions of numbers, and their progressive denominations, he did not remember; but on such matters, his attention was so constantly rivetted, that he frequently took no cognizance of external objects, and when he did, it was only with reference to their numbers. If any space of time was mentioned, he would soon afterwards reduce it to minutes; and if any distance, he would assign the number of hair-breadths, without any question being asked or any calculation expected by the company. He worked out every question after his own method, without any external aid, or even understanding the common rules of arithmetic as taught in the schools. He would stride over a piece of land or a field, and tell the contents of it almost as exactly as if it had been measured by the chain. In this manner he measured the whole lordship of Elmton, consisting of some thousand acres, and gave the contents not only in acres, roods, and perches, but even in square inches. After this, for his own amusement, he reduced them into square hair-breadths, computing forty-eight to each side of the inch. His memory was so great, that in resolving a question he could leave off and resume the operation again at the same point after the elapse of a week, or even of several months. His perpetual application to figures prevented the smallest acquisition of any other knowledge. On his return from church, it never appeared that he had brought away one sentence, his mind, having been busied in his favourite occupation. His wonderful faculty was tested in 1754 by the Royal Society of London, who acknowledged their satisfaction by presenting him with a handsome gratuity. In this visit to the metropolis, the great object of his curiosity was to see the king and royal family; but in this he was disappointed by their recent removal to Kensington. He was taken to see the tragedy of Richard III. performed at Drury Lane theatre; but his mind was solely employed in his usual occupation. He attended to Garrick only to count the words he uttered. During the dance, he fixed his attention upon the number of steps; and he declared that the innumerable sounds produced by the musical instruments had perplexed him beyond measure. Jedediah returned to the place of his birth, where he died about the age of seventy.

BUXTORF, JOHN, a famous Hebrew scholar, was born at Camen in Westphalia, Dec. 25, 1564. He became professor of the Hebrew and Chaldee languages at Basle, where he was settled as a Calvinist minister. He died of the plague, Sept. 13, 1629. His principal works are—his *Rabbinical Bible*, 4 vols. fol.; *Talmudical Lexicon; Hebrew Concordance;* a small but excellent *Hebrew Grammar*, the best edition of which is that of Leyden, 1701, revised by Leusden; *A Treatise of the Hebrew Grammar; Institutio epistolaris Hebraica; De Abbreviaturis Hebraeorum;* &c.

BUXTORF, *John*, the son of the preceding, and a learned professor of the oriental languages at Basle, distinguished himself, like his father, by his knowledge of the Hebrew language, and his rabbinical learning. He died at Basle in 1664, aged sixty-five. His principal works are, his translation of the *More Nevochim* of Maimonides, and the *Liber Cosri;* A Chaldee and Syriac Lexicon; An Anti-critique against Capellus; A treatise on the Hebrew Points and Accents, also against Capellus. See CAPELLUS.

BUYING, the act of making a purchase, or of acquiring the property of a thing for a certain price.

Buying the Refusal is giving money for the right of purchasing at a fixed price at a stated time; chiefly used in dealing for shares in stock. This is sometimes called by the cant phrase of *buying the bear*.

BUZOT, a town of the province of Valencia, in Spain, about ten miles from Alicant, in a most romantic situation. It is celebrated for its warm baths, and for the kermes collected from the *quercus coccifera*.

BUZZARD. See ORNITHOLOGY, *Index*.

BYNG, GEORGE, Lord Viscount Torrington, a distinguished English admiral, was born in 1663. At the age of fifteen he went to sea as a volunteer with the king's warrant. After being several times advanced, he was in 1702 raised to the command of the Nassau, a third rate, and was at the taking and burning of the French fleet at Vigo; and the next year he was made rear-admiral of the red. In 1704 he served in the grand fleet sent to the Mediterranean under Sir Cloudsley Shovel as rear-admiral of the red; and reduced Gibraltar. He was in the battle of Malaga, which followed soon afterwards; and for his gallantry in that action received the honour of knighthood. In 1718 he was made admiral and commander-in-chief of the fleet, and was

Bynkershoek || Byron.

sent with a squadron into the Mediterranean for the protection of Italy. This commission he executed so well, that the king made him a handsome present, and sent him full powers to negotiate with the princes and states of Italy, as there should be occasion. He procured the emperor's troops free access into the fortresses which still held out in Sicily, sailed afterwards to Malta, and brought out the Sicilian galleys, and a ship belonging to the Turkey company. Soon afterwards he received an autograph letter from the Emperor Charles VI., accompanied with his portrait, set round with large diamonds, as a mark of his grateful sense of his services. It was entirely owing to his advice and assistance that the Germans retook the city of Messina in 1719, and destroyed the ships which lay in the basin; an achievement which completed the ruin of the naval power of Spain. The Spaniards being much distressed, offered to quit Sicily; but the admiral declared that the troops should never be suffered to depart from the island till the king of Spain had acceded to the quadruple alliance. And to his conduct it was entirely owing that Sicily was subdued, and his Catholic Majesty forced to accept the terms prescribed him by the quadruple alliance. After performing so many signal services, he was received by the king with the most gracious expressions of favour and satisfaction; and made rear-admiral of England and treasurer of the navy, a member of the privy-council, Baron Byng of Southill, in the county of Bedford, Viscount Torrington in Devonshire, and one of the knights companions of the bath upon the revival of that order. In 1727 George II., on his accession to the crown, placed him at the head of naval affairs, as first lord of the admiralty. He died January 15, 1733, in the seventieth year of his age, and was buried at Southill, in Bedfordshire. For the trial and judicial murder of his son, the Hon. John Byng, see BRITAIN.

BYNKERSHOEK, CORNELIUS VAN, a distinguished Dutch jurist, was born at Middleburg in Zealand, in 1673. In the prosecution of his legal studies he found the common law of his country so defective, as to be nearly useless for practical purposes. This abuse he resolved to reform, and took as the basis of a new system the principles of the ancient Roman law. His works are very voluminous. Of these the most important are the *Observationes Juris Romani*, published in 1710, of which a continuation in four books appeared in 1733; his treatise *De Dominio Maris*, published in 1721; and his *Quæstiones Juris Publici*, published in 1737. Complete editions of his works were published after his death; one in folio at Geneva in 1761, and another in two volumes folio at Leyden in 1766.

BYROM, JOHN, an ingenious poet born at Kersall, near Manchester in 1691, and educated at Trinity College, Cambridge. His first poetical essay appeared in the Spectator, No. 603, beginning, "My time, O ye Muses, was happily spent;" which, with two humorous letters on dreams, are to be found in the eighth volume. He was elected a member of the Royal Society in 1723; and having originally entertained thoughts of practising physic, he used to be styled doctor by his friends, though he had never obtained a diploma. Having reduced himself to narrow circumstances by a precipitate marriage, he supported himself by teaching a new method of writing short-hand, of his own invention, until an estate devolved to him by the death of an elder brother. He was a man of lively wit; of which, whenever a favourable opportunity tempted him to indulge it, he gave many specimens. He died in 1763; and a collection of his miscellaneous poems was printed at Manchester, in two vols. 8vo, 1773, and reprinted at Leeds in 1814, with a Life of Byrom by an anonymous writer.

BYRON, LORD GEORGE GORDON, the only son of Captain Byron, and Catharine, sole child and heiress of George Gordon, Esq. of Gight, in Scotland, was born on the 22d January 1788, in Holles Street, London. His father, a man of dissolute and extravagant habits, died in 1791, at Valenciennes, leaving his widow, who was then residing at Aberdeen, to support herself and her son on a pittance of L.135 per annum. In 1794 his cousin, the grandson of the fifth Lord Byron, died in Corsica, and he became the presumptive heir to the peerage. The fifth Lord Byron died in 1798, and he succeeded to the title; and in the autumn of that year removed with his mother from Aberdeen to Newstead Abbey, in Nottinghamshire, which since the reign of Henry VIII. had been in the possession of the ancient family of Byron. Lord Byron had received the first rudiments of education at a grammar-school in Aberdeen. He was next sent in 1799 to the school of Dr Glennie at Dulwich, and in 1801 to Harrow, which he quitted in 1805. He is described by the head master of the latter school, the Rev. Dr Drury, as sensitive in disposition, intractable except by gentle means, shy, defectively educated, and ill prepared for a public school; but exhibiting the germs of considerable talent, though it does not appear to have been then foreseen in what mode his talents would display themselves. He excelled in declamation; and oratory, rather than poetry, was thought to be the prevailing bent of his genius. He seems to have been an active and spirited boy, at first unpopular, but finally a favourite; ardent in his school friendships, and jealous of the attachment of those whom he preferred. Among these the most learned were Lords Clare and Delawarr, the Duke of Dorset, Mr Harness, and Mr Wingfield. He was on friendly but less intimate terms with the most distinguished of his school-fellows, the late Sir Robert Peel. In classical scholarship Lord Byron acknowledged himself very inferior to Peel; but he was thought superior to him and to most others in general information. This was indeed extensive to a very unusual degree; and he has left on record an almost incredible list of works, in many various departments of literature, which he had read before the age of fifteen.

In October 1805 he was removed to Trinity College, Cambridge. He slighted the university, neglected its studies, and rebelled against its authority. Meanwhile he had commenced his poetical career, but at first feebly and with faint promise of future excellence. He first attempted poetry as early as 1800, under the inspiration of a boyish attachment to his young cousin, a daughter of Admiral Parker. In November 1806 he caused to be printed by Ridge, a bookseller at Norwich, for private circulation, a small volume of poems, among which one, written at the age of fifteen, is remarkable as containing a presage of his future fame. Some of the poems in this collection were of too licentious a character; and, on the advice of Mr Becker, a gentleman to whom the first copy had been presented, it was with praiseworthy promptitude suppressed, and replaced by a purified edition. In 1807 appeared his first published work, *The Hours of Idleness*; a collection of poems little worthy of his talent, and chiefly remembered through the castigation which it received from the *Edinburgh Review*. To this critique, which galled but did not depress him, we owe the first spirited outbreak of his talent, the satire entitled *English Bards and Scotch Reviewers*, which was published in March 1809. The length of this poem was increased, and many changes made in it, during its progress through the press. Censures of individuals were turned into praises, and praises into censures, with all the fickleness and precipitance of his age and character. It contained many harsh judgments, of which he afterwards repented; and able and vigorous as the satire was, and creditable to his talents, the time soon arrived when he was laudably anxious to suppress it. A few days previous to the publication of this

satire, on the 17th of March 1809, he took his seat in the House of Lords. He seems on that occasion to have keenly felt the loneliness of his position. He was almost unknown to society at large; there was no peer to introduce him; and his mortification led him to receive with ungracious coldness the welcome of the lord chancellor. His unfriended situation inspired him with disgust, and chilled his incipient longing for parliamentary distinction; and even a few days after taking his seat he retired to Newstead Abbey, and engaged with his friend Mr (now Sir J. C.) Hobhouse to travel together on the Continent. About the end of June the friends sailed together from Falmouth to Lisbon; travelled through part of Portugal and the south of Spain to Gibraltar; sailed thence to Malta and afterwards to Albania, in which country they landed on the 29th of September. From this time till the middle of the spring 1811, Lord Byron was engaged in visiting many parts of Greece, Turkey, and Asia Minor; staying long at Athens, Constantinople, and Smyrna. He touched again, on his return, at Malta, quitted it on the 2d of June, and early in July, after two years absence, landed in England. His affairs during this period had fallen into disorder, and it became advisable to sell either Rochdale or Newstead. The latter he was then most anxious to retain, and professed that it was his " only tie" to England, " and if he parted with that, he should remain abroad." In a letter to a friend, written during his homeward voyage, he thus expresses his melancholy sense of his condition: " Embarrassed in my private affairs, indifferent to public,—solitary without the wish to be social,—with a body a little enfeebled by a succession of fevers, but a spirit I trust yet unbroken,—I am returning home without a hope, and almost without a desire." This gloom was still deepened by numerous afflictions. His mother died on the 1st of August, without his having seen her again since his return to England; and he was deprived by death of five other relatives and friends between that and the end of August. " In the short space of one month," he says, " I have lost her who gave me being, and most of those who made that being tolerable." Amongst the latter were Wingfield, and Matthews, the brother of the author of the *Diary of an Invalid*. At this period of distress he was approaching unsuspectingly a remarkable epoch of his fame. He had composed while abroad two poems very different in character, and which he regarded with strangely misplaced feelings; the one called *Hints from Horace*, a weak imitation of his former satire; the other the first two cantos of *Childe Harold*. The former he intended to publish immediately; but the latter he thought of so disparagingly (owing probably to the injudicious comments of the single friend who had hitherto seen it), that it might probably have never become known to the public but for the wise advice of Mr Dallas. In compliance with the request of that gentleman, he withheld the *Hints from Horace*, which would have been injurious rather than beneficial to his fame, and allowed *Childe Harold* to be offered for publication. He received from his publisher, Mr Murray, L.600 for the copyright, which he gave to Mr Dallas. The publication was long delayed; for though placed in the publisher's hands in August, it did not appear till the beginning of March 1812. It, however, received during this interval considerable improvements; and the fears of the author were allayed by the approbation of Mr Gifford, the translator of Juvenal, and then editor of the *Quarterly Review*. The success of the poem exceeded even the anticipation of this able critic; and Lord Byron emerged at once from a state of loneliness and neglect, unusual for one in his sphere of life, to be the magnet and idol of society. As he tersely says in his memoranda, " I awoke one morning and found myself famous." A few days before the publication of *Childe Harold*, he attracted attention, but in a minor degree, by his first speech in the House of Lords on the subject of the house-breaking bill. He opposed it, and with ability; and his first oratorical effort was much commended by Sheridan, Sir F. Burdett, and Lords Grenville and Holland. He had prepared himself, by having committed the whole of this speech to writing. It was well received, and he was extremely gratified by its success. He might perhaps have been incited by the praises it received to seek political distinction; but the greater success which attended his poem turned his ambitious feelings into a different channel. He nevertheless spoke again about six weeks afterwards, on a motion of Lord Donoughmore, in favour of the claims of the Roman Catholics, but less successfully than before. Less clearness was displayed in the matter of his speech, and his delivery was considered as theatrical. In the autumn of this year he wrote an address at the request of the Drury-lane Committee, to be spoken at the re-opening of the theatre; and not long afterwards he became a member of that committee. The same autumn he engaged to sell Newstead for L.140,000, of which L.60,000 was to remain in mortgage on the estate for three years; but this purchase was never completed. In May 1813 appeared his *Giaour*, a wildly poetical fragment, of which the story was founded on an event that had occurred at Athens while he was there, and in which he was personally concerned. It was written rapidly, and with such additions during the course of printing as to be more than trebled in length, and swelled from about four hundred lines to upwards of fourteen hundred. On the 2d of June in this year he spoke for the last time in the House of Lords, on presenting a petition from Major Cartwright. He had now apparently ceased to regard parliamentary distinction as a primary object of ambition.

In his journal of November 1813 is the following entry: " I have declined presenting the debtors' petition, being sick of parliamentary mummeries. I have spoken thrice, but I doubt my ever becoming an orator; my first was liked, my second and third, I don't know whether they succeeded or not; I have never set to it *con amore*." In November he had finished the *Bride of Abydos* (written in a week), and it was published the following month. The *Corsair*, a poem of still higher merit and popularity, appeared in less than three months afterwards: it was written in the astonishingly short space of ten days. During the year 1813 he appears to have first entertained a serious intention of marriage, and became a suitor to Miss Millbanke, only daughter and heiress of Sir Ralph Millbanke. His first proposal was rejected; but the parties continued on the footing of friendship, and maintained a correspondence, of which, and of that lady, he thus speaks, and it may be presumed with the most perfect sincerity, in his private journal: " Yesterday a very pretty letter from Annabella, which I answered. What an odd situation and friendship is ours! without one spark of love on either side, and produced by circumstances which in general lead to coldness on one side, and aversion on the other. She is a very superior woman, and very little spoiled, which is strange in an heiress—a girl of twenty—a peeress that is to be in her own right—an only child, and a *savante*, who has always had her own way. She is a poetess, a mathematician, a metaphysician, and yet withal very kind, generous, and gentle, with very little pretension: any other head would be turned with half her acquisitions and a tenth of her advantages." In September 1814 he made a second proposal by letter, which was accepted; and on the 2d of January 1815 he was married to Miss Millbanke, at Seaham, the country seat of her father. The only is-

sue of this marriage, Augusta Ada, was born on the 10th of December of that year. We cannot lift the veil of their domestic life; we can only state the unfortunate results. On the 15th of January 1816, Lady Byron left London for Kirkby Mallory, the residence of her parents, whither Lord Byron was to follow her. She had, with the concurrence of some of Lord Byron's relatives, previously consulted Dr Baillie respecting the supposed insanity of her husband, and by the advice of that gentleman had written to him in a kind and soothing tone. Lady Byron's impressions of the insanity of Lord Byron were soon removed, but were followed by a resolution on her part to obtain a separation. Conformably with this resolution, Sir Ralph Millbanke wrote to Lord Byron on the 2d of February, proposing such a measure. This proposal Lord Byron at first rejected, but afterwards consented to sign a deed to that effect. Dr Lushington, the legal adviser of Lady Byron, has stated in a published letter, that *he* "considered reconciliation impossible." Of the circumstances which led to such an event, and on which Dr Lushington founded such an opinion, the public is at present uninformed. We are therefore, in absence of full and satisfactory evidence, bound to suspend our judgment on the merits of this melancholy case, and dismiss it with the foregoing statement of the leading facts. In the course of the spring he published the *Siege of Corinth* and *Parisina.* He also wrote two copies of verses, which appeared in the public papers, *Fare thee well*, and *A Sketch from Private Life;* of which his separation from his wife, and the instrumentality which he imputes to an humble individual in conducing to that separation, were the themes. This private circumstance had become the subject of general comment. The majority of those who filled the circles in which Lord Byron had lately lived declared against him, and society withdrew its countenance. Lord Byron, deeply stung by its verdict, hastily resolved to leave the country; and on the 25th of April 1816 he quitted England for the last time. His course was through Flanders and along the Rhine to Switzerland, where, at a villa called Deodati, in the neighbourhood of Geneva, he resided during the summer. From thence he made two excursions, one in the central part of Switzerland, in company with Mr Hobhouse, and another shorter excursion with a celebrated poetical compeer Mr Shelley, with whom he became acquainted soon after his arrival at Geneva. He remained in Switzerland till October, during which time he had composed some of his most powerful works; the third canto of *Childe Harold*, the *Prisoner of Chillon*, *Darkness*, the *Dream*, part of *Manfred*, and a few minor poems. In October he quitted Switzerland in company with Mr Hobhouse, and proceeded by Milan and Verona to Venice. Here he resided from the middle of November 1816 to the middle of April 1817. During this period his principal literary occupation was the completion of *Manfred*, of which he re-wrote the third act. He visited Rome for about a month in the spring, and then returned to Venice, at which city, or at La Mira, in its immediate vicinity, he resided almost uninterruptedly from this time till 1819. He wrote during this period the *Lament of Tasso*, *Beppo*, the fourth canto of *Childe Harold*, *Marino Faliero*, the *Foscari*, *Mazeppa*, and part of *Don Juan*. The licentious character of his life while at Venice corresponded but too well with the tone of that production. His able biographer and friend Mr Moore, after adverting to his *liaison* with a married Italian woman, says: "Highly censurable in point of morality and decorum as was his course of life while under the roof of Madame * * it was (with pain I am forced to confess) venial in comparison with the strange headlong career of license to which, when weaned from that connection, he so unrestrainedly, and, it may be added, defyingly, abandoned himself." This course of unbridled libertinism received its first check from the growth of attachment which, as it was still unhallowed, not even the good which it may seem to have done in the substitution of a purer sentiment, will enable us to regard with satisfaction. In April 1819 he first became acquainted with the Countess Guiccioli, the young and newly-married wife of an elderly Italian nobleman. A mutual attachment, which appears to have commenced on the part of the lady, soon arose between Lord Byron and the Countess Guiccioli. Their passion was augmented by occasional separation, the interest excited by her severe illness during one of their forced absences, and the imprudent complaisance of the husband in leaving them much in the society of each other. They long lived together in a half-permitted state of intimacy, the lady appearing with the consent of her husband to share his protection with that of Lord Byron. But this equivocal position soon terminated in the separation of the Count and Countess Guiccioli. The lady then went to reside with her father; and under his sanction, during the next three or four years, she and Lord Byron enjoyed the intimate possession of each other's society. In December 1819 Lord Byron quitted Venice for Ravenna, where he remained till the end of October 1821. During this period he wrote part of *Don Juan*, the *Prophecy of Dante*, *Sardanapalus*, a translation of the first canto of *Pulci's Morgante Maggiore*, and the mysteries, *Heaven and Earth*, and *Cain;* the latter of which may be justly considered as among the most faulty in principle, and powerful in execution, of the productions of his genius. He also wrote a letter on Mr Bowles's strictures on Pope, dated 7th February 1821, in which he defends the poet against his commentator; and an answer to an article in Blackwood's Magazine, entitled "Remarks on Don Juan," but this was never published.

During this period an insurrectionary spirit broke out in Italy; the Carbonari appeared; and secret societies began to be formed. The brother of the Countess Guiccioli, Count Pietro Gamba, espoused the cause of the insurgents, and through his means Lord Byron became implicated in the proceedings of that party. In his private journal of 16th February 1821, Lord Byron complains of the conduct of that gentleman and others, in sending to his house, without apprising him, arms with which he had a short time previously furnished them at their request, and thereby endangering his safety, and exposing him to the vengeance of the government, which had lately issued a severe ordinance against all persons having arms concealed. In July 1821, the father and brother of Madame Guiccioli were ordered to quit Ravenna, and repaired with that lady, first to Florence, and afterwards to Pisa, where they were joined in October by Lord Byron. He remained at Pisa till September 1822, Madame Guiccioli still living with him under the sanction of her father, who, in consequence of one of the conditions of her separation from her husband, was always to reside with her under the same roof. While here he lost his illegitimate daughter Allegra, and his friend Shelley, who was drowned in July 1822 in the Bay of Spezia. The body was burned, and Lord Byron assisted at this singular rite. His principal associates during this time had been the Gambas, Shelley, Captain Medwyn, and Mr Trelawney. He had also become associated with the brothers John and Leigh Hunt, in a periodical paper called the *Liberal;* a transaction certainly disinterested, inasmuch as it does not appear that he expected either profit or fame to accrue to himself from the undertaking; and he seems to have allowed his name to be connected with it from a desire to serve the Hunts, of whom Leigh Hunt, with his wife and family,

received an asylum in his house. An affray with a serjeant-major at Pisa rendered his residence in that city less agreeable; and his removal from it was at length determined by an order from the Tuscan government to the Gambas to quit the territory. Accordingly, in September 1822, he removed with them to Genoa. While at Pisa he had written, besides his contributions to the *Liberal*, *Werner*, the *Deformed Transformed*, and the remainder of *Don Juan*.

In April 1823 he commenced a correspondence with the Greek committee, through Messrs Blaquiere and Bowring, and began to interest himself warmly in the cause of the Greeks. In May he decided to go to Greece; and in July he sailed from Genoa in an English brig, taking with him Count Gamba, Mr Trelawney, Dr Burns, an Italian physician, and eight domestics; five horses, arms, ammunition, and medicine. The money which he had raised for this expedition was 50,000 crowns; 10,000 in specie, and the rest in bills of exchange. In August he arrived at Argostoli, the chief port of Cephalonia, in which island he established his residence till the end of December. His first feelings of exaggerated enthusiasm appear to have been soon cooled. Even as early as October he uses, in letters to Madame Guiccioli, such expressions as, "I was a fool to come here;" and, "of the Greeks I can't say much good hitherto; and I do not like to speak ill of them, though they do of one another." During the latter part of this year we find him endeavouring to compose the dissensions of the Greeks among themselves, and assisting them with a loan of L.4000. About the end of December 1823 he sailed from Argostoli in a Greek mistico, and after narrowly escaping capture by a Turkish frigate, landed on the 5th of January 1824 at Missolonghi. His reception here was enthusiastic. The whole population came out to welcome him; salutes were fired; and he was met and conducted into the town by Prince Mavrocordato, and all the troops and dignitaries of the place. But the disorganization which reigned in this town soon depressed his spirits, which had been raised by this reception, and filled his mind with reasonable misgivings of the success of the Greek cause. Nevertheless his resolution did not seem to fail, nor did he relax in his devotion to that cause, and in his efforts to advance it. About the end of January 1824 he received his commission from the Greek government as commander of the expedition against Lepanto, with full powers both civil and military. He was to be assisted by a military council, with Bozzari at its head. Great difficulties attended the arrangement of this expedition, arising principally from the dissensions and jealousies of the native leaders, and the mutinous spirit of the Suliote troops; with which latter, on the 14th of February, Lord Byron came to a rupture, in consequence of their demand, that about a third part of their number should be raised from common soldiers to the rank of officers. Lord Byron was firm, and they submitted on the following day. Difficulties in the civil department harassed him at the same time, aggravated by a difference of opinion between himself and Colonel Stanhope, on the subject of a free press, which the latter was anxious to introduce, and for which, on the other hand, Lord Byron considered that Greece was not yet ripe. On the 15th of February, the day of the professed submission of the Suliotes, he was seized with a convulsive fit, and for many days was seriously ill. While he was on a sick bed, the mutinous Suliotes burst into his room, demanding what they called their rights; and though his firmness then controlled them, it soon afterwards became necessary to get rid of these lawless soldiers, by the bribe of a month's pay in advance,—and with their dismissal vanished the hopes of the expedition against Lepanto. After this he turned his mind chiefly to the fortification of Missolonghi, the formation of a brigade, and the composition of the differences among the Greek chieftains. Since his attack in February he had never been entirely well. Early in April he caught a severe cold through exposure to rain. His fever increased, and in consequence of his prejudice against bleeding, that remedy was delayed till it was too late to be effectual. On the 17th (the second day after he had been bled) appearances of inflammation in the brain presented themselves. The following day he became insensible, and about twenty-four hours afterwards, at a quarter past six in the evening of the 19th of April 1824, Lord Byron breathed his last. Public honours were decreed to his memory by the authorities of Greece, where his loss was deeply lamented. The body was conveyed to England, and on the 16th of July was deposited in the family vault, in the parish church of Hucknell, near Newstead, in the county of Notts. By his will, dated 29th July 1815, Lord Byron bequeathed to his half-sister, Mrs Leigh, during her life, and after her death to her children, the monies arising from the sale of all such property, real and personal, as was not settled upon Lady Byron and his issue by her. The executors were Mr Hobhouse, and Mr Hanson, Lord Byron's solicitor.

The personal appearance of Lord Byron was prepossessing. His height was five feet eight and a half inches; his head small; his complexion pale; hair dark brown and curly; forehead high; features regular and good, and somewhat Grecian; eyes light grey, but capable of much expression. He was lame in the right foot, owing, it was said, to an accident at his birth; which circumstance seems always to have been to him a source of deep mortification, little warranted by its real importance. It did not prevent him from being active in his habits, and excelling in various manly exercises. He was a very good swimmer; successfully crossed the Hellespont in emulation of Leander; swam across the Tagus, a still greater feat; and, greatest of all, at Venice in 1818, from Lido to the opposite end of the grand canal, having been four hours and twenty minutes in the water without touching ground. In his younger days he was fond of sparring; and pistol-shooting, in which he excelled, was his favourite diversion while in Italy. In riding, for which he professed fondness, he did not equally excel. He was nervous both on horseback and in a carriage, though his conduct in Greece, and at other times, proved his unquestionable courage on great occasions. He had always a fondness for animals, and seemed to have preferred those which were of a ferocious kind. A bear, a wolf, and sundry bull-dogs, were at various times among his pets. The habits of his youth, after the period of boyhood, were not literary and intellectual; nor were his amusements of a refined or poetical character. He was always shy, and fond of solitude; but when in society, lively and animated, gentle, playful, and attractive in manner; and he possessed the power of quickly conciliating the friendship of those with whom he associated. He was very susceptible of attachment to women. The objects of his strongest passions appear to have been Miss Chaworth, afterwards Mrs Musters, and the Countess Guiccioli. His amours were numerous, and there was in his character a too evident proneness to libertinism. His constitution does not seem ever to have been strong, and his health was probably impaired by his modes of life. He was abstemious in eating, sometimes touching neither meat nor fish. Sometimes also he abstained entirely from wine or spirits, which at other times he drank to excess, seldom preserving a wholesome moderation and regularity of system. His temper was irascible, yet placable. He was quickly alive to tender and generous emotions, and performed many acts of disinterested liberality, even to-

wards those whom he could not esteem, and in spite of parsimonious feelings, which latterly gained hold upon him. He was a man of a morbid acuteness of feeling, arising partly from original temperament, and partly from circumstances and habits. He had been ill educated; he had been severely tried; his early attachments, and his first literary efforts, had equally been unfortunate; he had encountered the extremes of neglect and admiration; pecuniary distresses, domestic afflictions, and the unnerving tendency of dissipated habits, had all conspired to aggravate the waywardness of his excitable disposition. It is evident that, in spite of his assumed indifference, he was always keenly alive to the applause and censure of the world; and its capricious treatment of him more than ordinarily encouraged that vanity and egotism which were conspicuous traits of his character.

The religious opinions of Lord Byron appear, by his own account of them, to have been "unfixed;" but he expressly disclaimed being one of those infidels who deny the Scriptures, and wish to remain "in unbelief." In politics he was liberal, but his opinions were much influenced by his feelings; and, though professedly a lover of free institutions, he could not withhold his admiration even from tyranny when his imagination was wrought upon by its grandeur. He would not view Napoleon as the enslaver of France; he viewed him only as the most extraordinary being of his age, and he sincerely deplored his fall.

Lord Byron's prose compositions were so inconsiderable that they may almost be overlooked in the view of his literary character. His letters nevertheless must not pass wholly unnoticed. Careless as they are, and hastily written, they are among the most lively, spirited, and pointed specimens of epistolary writing in our language, and would alone suffice to indicate the possession of superior talent. The critical theories of Lord Byron were remarkably at variance with his practice. The most brilliant supporter of a new school of poetry, he was the professed admirer of a school that was superseded. The most powerful and original poet of the nineteenth century, he was a timid critic of the eighteenth. In theory he preferred polish to originality or vigour. He evidently thought Pope the first of our poets; he defended the unities; praised Shakspeare grudgingly; saw little merit in Spencer; preferred his own *Hints from Horace* to his *Childe Harold's Pilgrimage;* and assigned his eminent contemporaries Coleridge and Wordsworth a place far inferior to that which public opinion has more justly accorded to them.

The poetry of Lord Byron produced an immediate effect unparalleled in our literary annals. Of this influence much may be attributed, not only to the real power of his poetry, but also to the impressive identification of its principal characteristics with that which, whether truly or falsely, the world chose to regard as the character of the author. He seemed to have unbosomed himself to the public, and admitted them to view the full intensity of feelings which had never before been poured forth with such eloquent directness. His poems were as tales of the confessional, portraitures of real passion, not tamely feigned, but fresh and glowing from the breast of the writer. The emotions which he excelled in displaying were those of the most stormy character,—hate, scorn, rage, despair, indomitable pride, and the dark spirit of misanthropy. It was a narrow circle, but in that he stood without a rival.

His descriptive powers were eminently great. His works abound in splendid examples; among which the Venetian night-scene from Lioni's balcony, Terni, the Coliseum viewed by moonlight, and the shipwreck in Don Juan, will probably rise foremost in the memories of many readers. In description he was never too minute. He selected happily, and sketched freely, rapidly, and boldly. He seized the most salient images, and brought them directly and forcibly to the eye at once. There was, however, in his descriptive talent, the same absence of versatility and variety which characterized other departments of his genius. His writings do not reflect nature in all its infinite change of climate, scenery, and season. He portrayed with surpassing truth and force only such objects as were adapted to the sombre colouring of his pencil. The mountain, the cataract, the glacier, the ruin,—objects inspiring awe and melancholy,—seemed more congenial to his poetical disposition than those which led to joy or gratitude.

His genius was not dramatic; vigorously as he portrayed emotions, he was not successful in drawing characters; he was not master of variety; all his most prominent personages are strictly resolvable into one. There were diversities, but they were diversities of age, clime, and circumstances, not of character. They were merely such as would have appeared in the same individual when placed in different situations. Even the lively and the serious moods belonged alike to that one being; but there was a bitter recklessness in the mirth of his lively personages, which seems only the temporary relaxation of that proud misanthropic gloom that is exhibited in his serious heroes; and each might easily become the other. It may also be objected to many of his personages, that, if tried by the standard of nature, they were essentially false. They were sublime monstrosities;—strange combinations of virtue and vice, such as had never really existed. In his representations of corsairs and renegades, he exaggerates the good feelings which may, by a faint possibility, belong to such characters, and suppresses the brutality and faithlessness which would more probably be found in them, and from which it is not possible that they should have been wholly exempt. His plan was highly conducive to poetical effect; but its incorrectness must not be overlooked in an estimate of his delineation of human character. In his tragedies there is much vigour; but their finest passages are either soliloquies or descriptions, and their highest beauties are seldom strictly of a dramatic nature. Many of his dialogues are scarcely more than interrupted soliloquies; many of his arguments such as one mind would hold with itself. In fact, in his characters, there was seldom that degree of variety and contrast which is requisite for dramatic effect. The opposition was rather that of situation than of sentiment; and we feel that the interlocutors, if transposed, might still have uttered the same things.

It is to be deplored that scarcely any moral good is derivable from the splendid poetry of Lord Byron. The tendency of his works is to shake our confidence in virtue, and to diminish our abhorrence of vice;—to palliate crime, and to unsettle our notions of right and wrong. Even many of the virtuous sentiments which occur in his writings are assigned to characters so worthless, or placed in such close juxtaposition with vicious sentiments, as to induce a belief that there exists no real definable boundary; and it may perhaps be said with truth, that it would have been better for the cause of morality, if even those virtuous sentiments had been omitted. Our sympathy is frequently solicited in the behalf of crime. Alp, Conrad, Juan, Parisina, Hugo, Lara, and Manfred, may be cited as examples. They are all interesting and vicious. In the powerful drama of *Cain*, the heroes are Lucifer and the first murderer; and the former is depicted, not like the Satan of Milton, who believes and trembles, but as the compassionate friend of mankind. Resistance to the will of the Creator is represented as dignified and commendable; obedience and faith as mean, slavish, and con-

temptible. It is implied that it was unmerciful to have created us such as we are, and that we owe the Supreme Being neither gratitude nor duty. Such sentiments are clearly deducible from this drama. Whether they were those of Lord Byron is not certain; but he must be held accountable for their promulgation. (T. H. L.)

BYRON, *Hon. John*, the British admiral and circumnavigator, second son of the fourth Lord Byron, and grandfather of the poet, was born November 8th, 1723. He began his naval career in the eighth year of his age, and while still very young accompanied Anson in his voyage of discovery round the world. The dreadful hardships that he endured on this voyage he has recorded in his narrative. On his return home he was raised to the rank of commander, and soon after to that of post-captain. During many successive years he saw a great deal of hard service, and so constantly had he to contend on his various expeditions with adverse gales and dangerous storms, that he was aptly nicknamed by the sailors "Foul-weather Jack." It is to this that Lord Byron alludes in his famous *Epistle to Augusta*:—

> "A strange doom is thy father's son's, and past
> Recalling as it lies beyond redress,
> Reversed for him our grandsire's fate of yore,
> He had no rest at sea, nor I on shore.

In 1769 he was appointed governor of Newfoundland. In 1775 he attained his flag rank, and in the following year became a vice-admiral. In 1778 he was despatched with a fleet to watch the movements of the Count d'Estaing, who was setting out from France with an armament to assist the Americans. With this commander, in the July of the following year, he fought an indecisive engagement off Grenada. He shortly after returned to England, and retired into private life. He died on the 10th of April 1786.

BYSSUS, or BYSSUM, *in Antiquity*, a fine thready cloth produced in India, Egypt, and the vicinity of Elis, of which the richest apparel was made, especially that worn by the Jewish and Egyptian priests. Some interpreters render the Greek βύσσος, which occurs both in the Old and New Testament, by *fine linen*. But other versions, as Calvin's, and the Spanish one printed at Venice in 1556, explain the word by *silk*. M. Simon, who renders the word by fine linen, adds a note to explain it, bearing "that there was a fine kind of linen, very dear, which great lords alone wore in this country as well as in Egypt;" an account which agrees perfectly well with that given by Pliny and by Hesychius, as well as with the observation of Bochart, that the byssus was a finer kind of linen, which was frequently dyed of a crimson or purple colour. Some authors suppose byssus to have been cotton; some the *linum asbestinum;* while others conceive it to have been the bunch of silky hair found adhering to the pinna marina, by which the latter attaches itself to neighbouring bodies. There were two sorts of byssus; that of Elis, and that of Judæa, which was the finest. Bonfrerius remarks, that there must have been two sorts of byssus, one finer than ordinary, inasmuch as there are two Hebrew words used in Scripture to denote byssus; one of which is always used in speaking of the habit of the priests, and the other in alluding to that of the Levites. (See Yates, *Textrinum Antiquorum*, p. 267, &c.)

BYZANTINE HISTORIANS, a series of Greek writers who have given an account of the Eastern or Byzantine empire from the time of Constantine, A.D. 325, to the conquest of Constantinople by the Turks, A.D. 1453. They may be divided into four classes. 1st, Those whose works form a continuous history of the Byzantine empire during the above mentioned period. The works of these authors, who are nearly thirty in number, constitute the chief authority for the history of that eventful period. 2d, The chronographers, a very numerous class, who have given a brief chronological summary of universal history from the Creation down to their own times. 3d, The writers who have treated of particular portions of Byzantine history. 4th, Those who have written on the politics, statistics, manners, antiquities, &c., of the empire. A collection of the Byzantine writers was published at Paris by order of Louis XIV., in 36 vols. fol., 1645–1711. This edition was reprinted with additions at Venice, 1727–1733. Besides these, many of the Byzantine historians were published separately at different places. A new edition of the whole was commenced by Niebuhr, Bonn, 1828, 8vo, under the title of *Corpus Scriptorum Historiæ Byzantinæ, editio emendatior et copiosior*, of which many volumes have already appeared. This important work is still (1853) in course of publication.

BYZANTIUM, an ancient Greek city on the shores of the Bosporus, which occupied the most easterly of the seven hills on which the modern Constantinople has been built. It is said to have been founded by a band of Megarians B.C. 667, but the original settlement having been destroyed in the reign of Darius Hystaspes by the Satrap Otanes, it was recolonized by Pausanias, who wrested it from the hands of the Medes after the battle of Platæa—a circumstance which has led several ancient chroniclers to ascribe its foundation to him. The advantages of its situation as a place of commerce, which are said to have been pointed out to the Megarians by the oracle of Apollo—in the same way that its boundaries were afterwards revealed to Constantine by an invisible guide—quickly gave it pre-eminence over the other Dorian colonies on the coast. Its position on the Bosporus gave it complete control of the extensive corn-trade carried on by the merchants of the west with the northern shores of the Euxine, the absence of tides and the depth of its harbour rendered its quays accessible to vessels of large burden without the intervention of boats, while the pelamys and other fisheries at the mouth of the Lycus were so lucrative as to procure for the deeply curved bay into which that river fell the appellation of the Golden Horn. The greatest hindrance to its continued prosperity consisted in the miscellaneous character of the population, partly Lacedæmonians and partly Athenians, who flocked to it under Pausanias. From this circumstance it was the subject of dispute between both the states, and alternately in the possession of each, till it achieved its independence of both only to fall into the hands of the Macedonians; and from the same cause arose the violent contests of its intestine factions, which ended in the establishment of a rude and turbulent democracy. About seven years after its second colonization, Cimon wrested it from the hands of the Lacedæmonians; but it soon after revolted, and returned to its former allegiance. Alcibiades, after a severe blockade (B.C. 408) gained possession of the city through the treachery of the Athenian party; and it continued an ally of Athens until B.C. 405, when it was retaken by Lysander after the battle of Aigos-potamoi. It was under the Lacedæmonian power when the Ten Thousand were quartered in it after the retreat; when exasperated by the conduct of the governor, they mutinied and made themselves masters of the city, and would have pillaged it had they not been repressed by the firmness and promptitude of Xenophon. In B.C. 390 Thrasybulus, with the assistance of Heracleides and Archebius, succeeded in expelling the Lacedæmonian oligarchy, and in restoring the Athenian interest both in Byzantium and Chalcedon. By his influence also the government was changed into a democracy; and under the new constitution, as under the former oligarchy, the native Bithynians, into whose territories the colonists of Byzantium and Chalcedon had for half a century been making joint inroads, suffered the degradation and misery of Helots. After having withstood an attempt under Epaminondas to restore it to the Lacedæmonians, Byzantium joined with Rhodes, Chios, Cos, and Mausolus King of Caria, in throwing off the Athenian yoke, but soon returned to its allegiance when besieged by Philip of Macedon, after he had overrun Thrace. The succours which were sent by

Byzantium. the Athenians under Chares, on their arrival suffered a severe defeat from Amyntas, the Macedonian admiral; but in the following year they gained a decisive victory under Phocion, and compelled Philip to raise the siege. The wonderful deliverance of the besieged from a surprise, by means of a flash of light which illuminated the northern horizon and revealed the advancing masses of the Macedonian army, has rendered this siege peculiarly memorable. As a memorial of the miraculous interference the Byzantines erected an altar to Torch-bearing Hecate, and stamped a crescent on their coins as a symbol of the portent, a device which is retained by the Turks to this day. In gratitude for the Athenian succours, procured chiefly by the eloquence of Demosthenes, they granted the Athenians the right of isopolity, coupled with extraordinary privileges, and erected a monument in honour of the event in a public part of the city. During the reign of Alexander, Byzantium was compelled to acknowledge the Macedonian supremacy; and after the decay of the Macedonian power, although it regained its independence, it suffered from the repeated incursions of the Scythian hordes which overran the unprotected province. The losses which they sustained by land roused the Byzantines to indemnify themselves on the vessels which still crowded the harbour, and the fleets of merchantmen which cleared the straits; but this had the effect of provoking a war with the neighbouring naval powers. The exchequer being drained by the payment of 10,000 pieces of gold to buy off the Gauls who had invaded their territories about the year 279 B.C., and the subsequent imposition of an annual tribute which was ultimately raised to 80 talents, they were compelled to exact a toll on all the ships which passed the Bosporus; a measure which the Rhodians resented and avenged by a war, in which, though supported by Attalus King of Pergamus, they were defeated, and obliged to sue for peace on very disadvantageous terms. The subsequent retreat of the Gauls to Asia gave Byzantium another opportunity of regaining its independence, and enabled it to render considerable services to Rome in the contests with Philip II. of Macedon, Antiochus, and Mithridates. During the first years of its alliance with Rome it held the rank of a free and confederate city; but having sought the arbitration of the capital on some of its domestic disputes, it was subjected to the imperial jurisdiction, and gradually stripped of its privileges, until reduced to the status of an ordinary Roman colony. In recollection of its former services, the Emperor Claudius remitted the heavy tribute which had been imposed on it; but the last remnant of its independence was taken away by Vespasian, who, in answer to a remonstrance from Apollonius of Tyana, taunted the inhabitants with having "forgotten to be free." During the civil wars, it espoused the party of Pescennius Niger; and though skilfully defended by the engineer Periscus, it was besieged and taken (A.D. 196) by Severus, who destroyed the city, demolished the famous wall built of massive stones so closely riveted together as to appear one block, put the principal inhabitants to the sword, and subjected the remainder to the Perinthians. Severus, however, afterwards relented, and rebuilding a large portion of the town, gave it the name of Augusta Antonina. He ornamented the city with baths, and surrounded the hippodrome with porticoes; but it was not till the time of Caracalla that it was restored to its former political privileges. It had scarcely begun to recover its former flourishing position when, from the capricious resentment of Gallienus, the inhabitants were once more put to the sword, and the town given up to be pillaged. From this disaster the inhabitants recovered so far as to be able to give an effectual check to an invasion of the Goths in the reign of Claudius II., and its fortifications were greatly strengthened during the civil wars which followed the abdication of Diocletian. Licinius, after his defeat before Adrianople, retired to Byzantium, where he was besieged by Constantine, and compelled to surrender. To check the inroads of the barbarians on the north of the Black Sea, Diocletian had resolved to transfer his capital to Nicomedia; but Constantine, struck with the advantages which the situation of Byzantium presented, resolved to build a new city there on the site of the old, and transfer the seat of government to it. The design was quickly put into execution, and the new capital was inaugurated with special ceremonies, A.D. 330. See CONSTANTINOPLE.

The ancient historians invariably note the profligacy of the inhabitants of Byzantium. They are described as an idle and depraved people, spending their time for the most part in loitering about the harbour, or carousing over the fine wine of Maronea and the neighbourhood. In war they trembled at the sound of a trumpet, in peace they quaked before the shouting of their own demagogues; and during the assault of Philip II. they could only be prevailed on to man the walls by the savour of the extempore cook-shops distributed along the ramparts.

Bzovius. BZOVIUS or BZOWSKI, ABRAHAM, one of the most voluminous writers of the seventeenth century, was born at Prosovitz in 1567. Losing his parents in early life, he was brought up by his grandmother, who sent him to study at Cracow, where he entered the order of Dominicans. From Cracow he went to Milan, where he taught philosophy, and afterwards to Bologna, where he read lectures on theological subjects. He soon afterwards returned to Poland, and was appointed principal of a Dominican college. A mandate of the pope, Paul V., summoned him to Rome, where he found apartments prepared for him in the Vatican, and the office of librarian of the *Virginio dei Ursini* at his disposal. While living in the papal palace, he was robbed, and his attendant murdered; and he soon after retired to the convent of Minerva, and there devoted himself entirely to literature for the remainder of his days. His death took place in 1637. Though he wrote an astonishing number of books, he is now chiefly remembered for his continuation of the Annals of Baronius. This work he took up from the year 1198—where Baronius left off. Nine volumes of it have been published; the first eight of which appeared at Cologne, 1616–1641, the last at Rome in 1672.

C.

C, THE third letter and second consonant of the alphabet, is pronounced like *k* before the vowels *a*, *o*, and *u*, and like *s* before *e*, *i*, and *y*. C is formed, according to Scaliger, from the κ of the Greeks, by retrenching the stem or upright line; though others derive it from the כ of the Hebrews, which has in effect the same form; only, that as the Hebrews read towards the left, and the Latins and other western nations towards the right, each turned the letter their own way. However, the C not being the same as to sound with the Hebrew *caph*, כ, and it being certain that the Romans did not borrow their letters immediately from the Hebrews or other orientals, but from the Greeks, the derivation from the Greek κ is upon the whole the more probable. Indeed Montfaucon, in his *Palæographia*, gives some forms of the Greek κ which approach very near to that of our C; and Suidas calls the C the Roman *kappa*. Before the first Punic war C held the place which is now occupied by G, as appears from the Duilian Column, where we meet with *acnam* for *agnam*, *lecionem* for *legionem*, and *exfociont* for *effugiunt*. The second sound of C resembles that of the Greek Σ; and many instances occur of ancient inscriptions in which Σ has the same form with our C. Grammarians are pretty generally agreed that the Romans pronounced their Q like our C, and their C like our K. Mabillon informs us that Charles the Great was the first who wrote his name with a C; whereas all his predecessors of the same name wrote it with a K; and the same difference is observable in their coins. As an abbreviature, C stands for Caius, Carolus, Cæsar, *condemno*, &c., and CC represent *consulibus*. As a numeral, C signifies 100, CC 200, and so on. C, in *Music*, placed after the cleff, intimates that the music is in common time, which is either quick or slow as it is joined with allegro or adagio; but if alone, it is usually adagio. If the C be crossed or turned, the first requires the air to be played quick, and the last very quick.

CAABA, or KAABA, properly signifies a square stone building, but is particularly applied to the temple of Mekka, built, as the Mahommedans pretend, by Abraham and his son Ishmael. This temple enjoys the privilege of an asylum for all sorts of criminals; but it is most remarkable for the pilgrimages made to it by the devout Moslemins, who pay it so great a veneration that they account the mere sight of its sacred walls, without any particular act of devotion, as meritorious in the sight of God as the most careful discharge of their duty for the space of a whole year in any other temple. See MEKKA.

CAB, a Hebrew measure, mentioned in 2 Kings vi. 25. The Rabbins make it the sixth part of a *seah* or *satum*, and the eighteenth part of an ephah. A cab would hence contain $3\frac{1}{3}$ pints of our wine measure, or $2\frac{5}{6}$ pints of our old corn measure.

CABAL (Italian *cabala*, knowledge of secret things; Spanish *cabala*, secret science), a number of persons united in some close design, usually for the purpose of promoting their private views by intrigue.

This name was given to one ministry of Charles II., consisting of Clifford, Ashley, Buckingham, Arlington, and Lauderdale, the initials of whose names compose the word cabal.

CABALLARIA, in middle-age writers, lands held by the tenure of furnishing a horseman with suitable equipage during war, or when the lord had occasion for him.

CABALLINE, pertaining to a horse; as *caballine aloes*, so called from being chiefly used as a purge for horses.

CABANIS, PIERRE JEAN GEORGE, a distinguished writer and physician at Paris, was born at Conac in 1757. His father, Jean Baptiste Cabanis, was a lawyer of eminence, and chief magistrate of a district in the Lower Limousin, highly respected for his great acquirements and integrity, and entitled to the gratitude of his country for the many improvements he has introduced in agriculture and farming. Young Cabanis was sent at ten years of age to the college of Brives; and he afterwards studied at Paris, where he devoted himself to the acquisition of classical knowledge. At first he paid no attention to the lectures of his professors; but afterwards, of his own accord, he resumed those branches of his education in which he had remained deficient, and devoted himself entirely to the cultivation of his mind.

Thus constantly occupied, two years had passed away, when he received the offer of the place of secretary to a Polish nobleman. This offer he embraced without hesitation, and, though only sixteen, committed himself into the hands of strangers, in a distant country, which was represented to him as in a state of barbarism. This was in 1773, the year during which that diet was sitting which was to deliberate upon giving its sanction to the first partition of Poland. The corrupt intrigues and compulsory measures which were practised on that occasion, inspired him with a contempt for mankind, and a degree of misanthropic gloom, which are generally the fruits of a later experience of human depravity. He returned to Paris two years afterwards, when Turgot, the friend of his father, was minister of finance. On being presented to this statesman he was received with kindness, and would soon have been placed in a situation perfectly conformable to his tastes and wishes, had not a court intrigue caused the sudden downfall of the minister.

He now felt the necessity of making up for the time he had lost, and again applied to his studies with his former ardour. He had contracted a friendship with the poet Roucher, who enjoyed some celebrity. This connection rekindled his taste for poetry; and the French Academy having proposed as a prize subject the translation of a passage in the *Iliad*, he not only ventured to appear as a competitor, but set about translating the entire poem. The two specimens which he sent to the Academy did not obtain any public notice, but they were judged of favourably by several persons of taste. He was soon, however, sensible of the emptiness of these applauses; and, urged by his father to choose a useful profession, he at length decided for that of medicine. Dubreuil offered to be his guide in the new and arduous career which he was commencing; and Cabanis continued for six years the pupil of this able master. In 1789 he published *Observations sur les Hôpitaux*, a work which procured him the appointment of administrator of hospitals at Paris.

His state of health requiring occasional relaxation, he fixed upon Auteuil, in the immediate vicinity of Paris, as his place of residence. He continued his intercourse with Turgot; was on terms of intimacy with Condillac, Thomas, and D'Alembert; and acquired the friendship of Holbach, Franklin, and Jefferson. During the last visit which Voltaire made to Paris, Cabanis was presented to him by Turgot, and read to him part of his translation of the *Iliad*, which that acute critic, though old, infirm, and fatigued with his journey, listened to with great interest, and bestowed much commendation on the talents of the author. Cabanis had now, however, long ceased to occupy himself with that work; and, even bade a formal adieu to poetry in his *Serment d'un Médecin*, which appeared in 1789. In the political struggle which now began to engross the general attention, Cabanis espoused with enthusiasm the cause of the revolution, to which he was attached from principle, and

Cabanis.

of which the opening prospects were thoroughly congenial to his active and ardent mind.

During the two last years of Mirabeau's life he was intimately connected with that extraordinary man, who had the singular art of pressing into his service the pens of all his literary friends. Cabanis united himself with this disinterested association of labourers, and contributed the *Travail sur l'Education Publique;* a tract which was found among the papers of Mirabeau at his death, and was edited by the real author soon afterwards in 1791. During the illness which terminated his life, Mirabeau confided himself entirely to the professional skill of Cabanis. Of the progress of the malady, and the circumstances attending the death of Mirabeau, Cabanis has drawn up a very detailed narrative, which is not calculated, however, to impress us with any high idea of his skill in the treatment of an acute inflammatory disease.

Condorcet was another distinguished character with whom Cabanis was intimate, and whom he endeavoured, though without success, to save from the destiny in which he afterwards became involved by the calamitous events of the revolution. Shortly after this he married Charlotte Grouchy, sister to Madame Condorcet and to General Grouchy; a union which was a great source of happiness to him during the remainder of his life.

After the subversion of the government of the terrorists, Cabanis, on the establishment of central schools, was named professor of *Hygiène* in the medical schools of the metropolis. Next year he was chosen member of the National Institute, and was subsequently appointed clinical professor. He was afterwards member of the Council of Five Hundred, and then of the Conservative Senate. The dissolution of the Directory was the result of a motion which he made to that effect. But his political career was not of long continuance. A foe to tyranny in every shape, he was decidedly hostile to the policy of Bonaparte, and constantly rejected every solicitation to accept a place under his government.

For some years before his death, his health became gradually more impaired, and he retired from the laborious duties of his profession, spending the greatest part of his time at the chateau of his father-in-law at Meulan. Here he solaced himself with reading his favourite poets, and even had it in contemplation to resume that translation of the *Iliad* which had been the first effort of his youthful muse. The rest of his time was devoted to kindness and beneficence, especially towards the poor, who flocked from all parts to consult him on their complaints. Cabanis died May 5, 1808, leaving a widow and a daughter.

Besides the tracts already mentioned, Cabanis was author of *Mélanges de Littérature Allemande, ou Choix de Traductions de l'Allemande,* &c., Paris, 8vo, 1797; *Du Degré de Certitude de la Médecine,* 1797 and 1803, containing a republication of his *Observations sur les Hôpitaux,* and his *Journal de la Maladie et de la Mort de Mirabeau l'ainé;* together with a short tract on the punishment of the guillotine, in which he combats the opinion of Soemmerring, Œlsuer, and Sue, that sensibility remains for some time after decapitation. This tract had already appeared in the *Magazin Encyclopédique,* and in the first volume of the *Mémoires de la Société Médicale d'Emulation.* This new edition also contains his *Rapport fait au Conseil des Cinq-cents sur l'Organisation des Ecoles de Médecine;* and a long dissertation entitled *Quelques Principes et quelques Vues sur les Secours Publiques. Quelques Considérations sur l'Organisation sociale en général, et particulièrement sur la nouvelle Constitution,* 12mo, 1799. His principal work, however, is that entitled *Des Rapports du Physique et du Morale de l'Homme,* 1803, in two volumes 8vo. This work was reprinted in the following year, with the addition of a copious analytical table of its contents by M. Destutt-Tracy, and alphabetical indexes by M. Sue. His *Coup d'Œil sur les Révolutions et les Réformes de la Médecine* appeared in 1803. Of this work we possess an excellent English translation, with notes by Dr Henderson. His only practical work on medicine is the *Observations sur les Affections Catarrhales en général, et particulièrement sur celles connues sous le nom de Rhumes de Cerveau, et Rhumes de Poitrine,* 8vo, 1807. He also wrote many interesting articles in the *Magazin Encyclopédique.*

Cabbage || Cabenda.

CABBAGE. See Horticulture.

CABBALA, or Kabbalah according to the Hebrew style, has a very distinct signification from that in which we understand it in our language. The word is an abstract, and means *reception,* a doctrine received by oral transmission. The rabbis who are called cabbalists study principally the combination of particular words, letters, and numbers, by which means they pretend to discover what is to come, and to see clearly into the sense of many difficult passages of Scripture. There are no sure principles of this knowledge, which in fact depends upon some particular traditions of the ancients; for which reason it is termed *cabbala.* The cabbalists have abundance of names which they call *sacred,* and not only make use of in invoking spirits, but imagine that they derive great light from them. They tell us that the secrets of the cabbala were discovered to Moses on Mount Sinai; and that these have been delivered down to them from father to son without interruption, and without any use of letters; for to write them down is what they are by no means permitted to do. This is likewise termed the oral law, as passing from father to son, in order to distinguish it from the written law. There is another cabbala, called *artificial,* which consists in searching for abstruse and mysterious significations of a word in Scripture, from which are borrowed certain explanations, by combining the letters which compose it. This cabbala is divided into three species, viz., the Gematria, the Notaricon, and the Temurah. The first, or Gematric, consists in, taking the letters of a Hebrew word for ciphers or arithmetical numbers, and explaining every word by the arithmetical value of the letters of which it is composed; the second, called Notaricon, consists in taking every particular letter of a word for an entire diction; and the third, called Temurah, or change, consists in making different transpositions or changes of letters, placing one for the other, or one before the other. Among the Christians, likewise, a certain sort of magic is, by mistake, called *cabbala,* and consists in using improperly certain passages of Scripture for magical operations, or in forming magical characters or figures with stars and talismans. Some visionaries among the Jews believe that our Saviour wrought his miracles by virtue of the ridiculous mysteries of the cabbala.

Wolfius has given an extended account of the cabbala, and of the numerous manuscripts and printed Jewish works in which its principles are contained, as well as abundant references to Christian authors who have treated of it. (*Biblioth. Hebr.* ii. 1191, *sq*) See also Beer, *Geschichte der Lehren aller Secten der Juden, und der Cabbala,* Brünn, 1822, 2 vols. 8vo.

CABBALISTS, or Kabbalists, the Jewish doctors who profess the study of the cabbala. In the opinion of these men, there is not a word, letter, nor accent in the law, without some mystery in it. The Jews are divided into two general sects; the Karaites, who refuse to receive either tradition or the Talmud, or anything but the pure texts of Scripture; and the Rabbinists, or Talmudists, who besides this receive the traditions of the ancients, and follow the Talmud. The latter are again divided into two other sects; pure rabbinists, who explain the Scripture in its natural sense, by grammar, history, and tradition; and cabbalists, who, to discover hidden and mystical senses, which they suppose to have been couched therein by God, make use of the cabbala and the mystical methods above mentioned.

CABENDA, a seaport town of Western Africa, in Lower Guinea, 40 miles north of the mouth of the Zaire, Lat. 5. 33. S. Long. 15. 40. E. From the great beauty of its situation, and the fertility of the adjacent country, it has been called the paradise of the coast. The harbour is well sheltered and commodious, and the trade is considerable.

CABEZA DEL BUEY, a town of Spain, province of Badajos, 86 miles E.S.E. from the city of that name. It contains 850 houses, 4 schools, and several manufactories of coarse frieze, linen, and cloth. Pop. 5395.

CABIN, an apartment in a ship for officers and passengers. There are many of these in a large ship, the principal of which is occupied by the captain. In small vessels there is one cabin in the stern, for the accommodation of the officers and passengers. The sleeping apartments in ships are also called cabins.

CABINET, a closet, small room, or retired apartment.

It is also the name of a piece of furniture, consisting of a chest with drawers and doors.

Cabinet, a word of daily use in modern politics, applies specifically to those heads of ministerial departments in Britain whose co-operative action marks the policy of the administration. It has a similar meaning in the United States, and is applied by analogy to the chief organs or advisers of the government in other countries. The word was first used in France, where it meant the inner apartment of a house, and when employed as a general term, that of the palace. To have the entrée of the cabinet meant to have influence with the sovereign, and at an early period the term was thus applied to the secret council of the king. It is singular that a body so great in its power and influence, and so well suited, according to all practice and experience, for conducting the business of a great constitutional state, should have arisen as it were by stealth, should possess no settled constitutional rights and functions, and should be subject to no specific responsibilities. By the older constitutional authorities it has always been held, that those sworn advisers of the monarch who form his privy-council are the responsible officers for conducting the government. A habit of listening to one or two favourite advisers, instead of laying matters before the privy-council, was frequently referred to as one of the innovations made by Charles I. in the direction of arbitrary government. The practice of consulting only a small committee was in full force in the reign of Charles II., whose cabinet at one time received the name of the "Cabal," from the initial letters of the names of its members. The practice became even more systematic after the Revolution, and was the object of an interesting debate in the year 1692, on the occasion of the king seeking the advice of the House of Commons on the crisis in the foreign relations of the nation. Mr Goodwin Wharton, referring to the divided and imperfect responsibility of the existing system, said, "The method is this:—Things are concerted in the cabinet and then brought to the council; such a thing resolved in the council and brought and put upon them for their assent without showing any reason. This has not been the method of England. I am credibly informed that it has been complained of in council, and not much backed there. If this method be, you will never know who gives advice." On the same occasion it was said by Mr Waller, "'cabinet council' is not a word to be found in our law books. We knew it not before; we took it for a nickname. Nothing can fall out more unhappily than to have a distinction made of the 'cabinet' and 'privy-council.' It has this effect in the country, and must have, that the justices of peace and deputy lieutenants will be afraid to act; they will say they cannot go on—and why? Because several of them have been misrepresented and are not willing to act; they know not who will stand by them, and are loth to make discoveries unless seconded. If some of the privy-council must be trusted and some not, to whom must any gentleman apply? Must he ask who is a cabinet-councillor? This creates mistrust in the people. I am sure these distinctions of some being more trusted than others have given great dissatisfaction."—(*Parl. Hist.*, v. 731–3.)

The continued prevalence of such views is apparent in the clause of the Act of Settlement of 1705, requiring all acts of state to be transacted in the privy-council, and signed by the members; a provision which, probably as inconsistent with a settled practice, was repealed two years afterwards. The last time when a privy-councillor entered a cabinet-council without invitation, was that memorable occasion of the last illness of Queen Anne, when the Dukes of Somerset and Argyle, believing that there was a plot to defeat the Hanover succession, entered the council-room and dictated measures for the safety of the kingdom and the proclamation of King George. The privy-council, from whom the cabinet is selected, now forms a considerable body, many of whom hold the membership as a mere mark of distinction. It has often been asked how the system of governing by a cabinet is consistent with personal responsibility, since there is no such executive body known to the law, it passes no specific acts, and the votes and opinions of its individual members are unrecorded. From this last feature, however, there seems to arise an effective collective responsibility, since every member of the cabinet is held to support and be compromised by the leading acts of the government. Certain great officers of state are invariably members of the cabinet; as the first lord of the treasury, the lord chancellor, the three principal secretaries of state, and the chancellor of the exchequer. Sometimes the post-master-general, the commander-in-chief, the chief secretary for Ireland, the president of the board of trade, and on one or two occasions the chief justice of the Queen's Bench, have been members. At the commencement of the year 1854, besides the invariable members, the cabinet included the lord president of the council, the lord privy-seal, the first lord of the admiralty, the president of the board of control, the secretary-at-war, and the first commissioner of public-buildings, while Lord Lansdowne and Lord John Russell were members without office. (J. H. B.)

CABIRI (Κάβειροι), mystic deities of antiquity whose names and rites were widely diffused, but whose special functions have not been determined. Even among the ancients themselves great diversity of opinion prevailed on this point. They are first mentioned as inhabiting the island of Lemnos, where they presided over the fruits of the earth, and vineyards in particular. Herodotus mentions that they were worshipped at Memphis in Egypt as the children of Vulcan; Stesimbrotus endeavours to identify them with the Corybantes and Curetes. Though the worship of these divinities spread gradually over the whole of Greece and Italy, it was nowhere performed with greater solemnity than in Lemnos, Imbros, and Samothrace. The mystic rites which accompanied the worship of these great and powerful deities, as celebrated in those islands, were only inferior in solemnity to the Eleusinian mysteries of the goddess Demeter (Ceres).

CABIRIA (Καβείρια), festivals in honour of the Cabiri, celebrated in Thebes and Lemnos, but especially in Samothracia, an island consecrated to the Cabiri. All persons initiated in the mysteries of these gods were thought to be thereby secure against storms at sea, and all other dangers. The ceremony of initiation was performed by placing the candidate, crowned with olive branches, and girded about the loins with a purple riband, on a kind of throne, about which danced the priests and persons previously initiated. (See Guthberlet, *De Mysteriis Deorum Cabirorum*; E. G. Haupt, *De Religione Cabiriaca*.)

CABLE, a large strong rope, or iron chain, made fast to the anchor, by which a ship is secured. It is usually 120 fathoms; hence the expression *a cable's length*. See Rope-making.

The *Sheet Anchor Cable* is the greatest cable belonging to a ship.

The *Stream Cable* is a hawser or rope used to moor the ship in a river or haven sheltered from the wind and sea.

Cabot.

CABOT, Sebastian, the celebrated navigator, and re-discoverer[1] of the American continent, was the son of John Cabot, a Venetian merchant resident in England, and was born about the year 1477. Although long the subject of much dispute, it is now certain that England was the place of his nativity. In an ancient collection of voyages and travels by Richard Eden, a learned writer and contemporary of Sebastian, the author in a marginal note says, "Sebastian Cabote tould me, that he was borne in Brystowe (Bristol), and that at iiii yeare ould he was carried with his father to Venice, and so returned agayne into England with his father after certayne years, whereby he was thought to have been born in Venice." (*Decades of the New World*, fol. 255.) It also appears that he returned, while still young (*pæne infans*), to England, and remained there till he grew up to manhood.

The brilliant discoveries of Columbus having awakened a spirit of enterprise throughout the enlightened nations of Europe, Henry VII. of England was not slow in perceiving the advantages to be gained by promoting adventure in the new career opened up to human ambition. The all-important and engrossing object was to discover a route to India; and an expedition in a north-westerly direction, ostensibly to reach what was called Cathay, or the Land of Spice, was projected by Sebastian Cabot, and fitted out under the auspices of the English government. The first patent, which bears date March 5, 1496 (Rymer, *Fœdera*, vol. xii. p. 595), was given to John Cabot and his three sons, Lewis, Sebastian, and Saucius. The patentees were empowered to set up the royal banner, and occupy and possess all the "newly found" lands in the name of the king, who reserved a fifth of the profits. It was also stipulated that the vessels should return to Bristol, and that the privilege of exclusive resort and traffic should belong to the patentees.

Although the patent was conferred on John Cabot and his three sons, there can be no doubt, even if the father did accompany the expedition, that its success was entirely owing to the genius of Sebastian.

It is now undoubted, that to Sebastian alone belongs the glory of the re-discovery of the *terra firma* of the Western World. The expedition, consisting of the ship commanded by Sebastian, and three or four smaller vessels, sailed from Bristol in the beginning of May 1497; and an ancient Bristol manuscript records the fact, that, "in the year 1497, the 24th June, on St John's day, was Newfoundland found, by Bristol men, in a ship called the Mathew." On the authority of Peter Martyr, we learn, that after quitting the north, where he reached latitude sixty-seven and a half, Cabot proceeded along the coast of the continent, to a latitude corresponding probably with that of the Straits of Gibraltar. Indeed he is said to have gone so far southward, "ut Cubam Insulam a læva longitudine graduum pene parem habuerit." A failure of provisions at this point compelled him to desist from further pursuit, and the expedition returned to England.

The second patent is dated 3d February 1498, and gives authority to "John Kabotto or his deputies," to take at pleasure six English ships, and "them convey and lede to the londe and isles of late found." Shortly after the date of this patent John Cabot died; and it is said that his sons Lewis and Saucius went to settle in Italy. Sebastian, however, did not abandon the enterprise in which he had embarked; and a second voyage was zealously undertaken under his superintendence. A ship equipped at the king's expense, along with four small vessels, sailed from Bristol in the spring of the year 1498. The result of the expedition is unfortunately wrapt in much obscurity. Gomara alone furnishes us with what may be a correct account. According to this author, Cabot "directed his course by the tracte of islande, uppon the Cape of Labrador, at lviii. degrees; affirmynge that, in the monethe of July, there was such could, and heapes of ise, that he durst passe no further; also, that the dayes were very longe, and in maner without nyght, and the nyghtes very clear. Certayne it is, that at the lx. degrees, the longest day is of xviii. houres. But consyderynge the coulde, and the straungeness of the unknowen lande, he turned his course from thense to the west, folowynge the coast of the lande of Baccalaos unto the xxxviii. degrees, from whense he returned to Englande." (Eden's *Decades*, fol. 318).

Cabot.

The results of this second voyage were not sufficiently important to induce Henry to equip another expedition. We have good authority for believing, however, that Cabot, in 1499, "with no extraordinary preparations sett forth from Bristoll, and made greate discoveries." (Seyer's *Memoirs of Bristol.*) But the narrative of Cabot's life for the fifteen years subsequent to the departure of his second expedition is meagre and unsatisfactory. One circumstance deserves notice, that during that period Amerigo Vespucci, in company with Hojeda, crossed the Atlantic for the *first time*, whilst Sebastian was prosecuting his third voyage.

After the death of Henry VII., upon the invitation of Ferdinand, Sebastian Cabot went to Spain; and Vespucci, who held the office of pilot-major, having died, he was appointed his successor. He was soon employed in a general revision of maps and charts; and his public and private character endeared him to most of the learned and good men in Spain. The death of Ferdinand put an end to an expedition then in contemplation. The ignoble commencement of the reign of Charles V. frustrated all further hopes of its prosecution; and Cabot returned to England, where, under Henry VIII. he got honourable employment, and performed another westwardly voyage in 1517, which, however, proved unsuccessful.

In 1518 we find Cabot in Spain, and again reinstated in the appointment of pilot-major. The dispute between Spain and Portugal in regard to their respective rights to the Moluccas having been decided at the congress of Badajos in 1524 in favour of Spain, a company was formed at Seville to open a commercial intercourse with those islands; and Cabot, with the title of Captain-general, after many delays, set sail with a fleet in April 1526. The squadron was ill assorted, and a mutiny broke out; in consequence of which he diverted his course from the Moluccas to the mouth of the Rio de la Plata, up which he penetrated about three hundred and fifty leagues. He erected a fort at St Salvador; and afterwards sailing up the Parana, he built other two forts. He subsequently entered the Paraguay, where he was drawn into a sanguinary contest with the natives. From the report then made by him to Charles V. it is probable, had he been supplied with means and ammunition, he would have made the conquest of Peru, which Pizarro afterwards accomplished with his own private resources. After tarrying in the hopes of receiving supplies, Cabot was forced to return to Spain, where he resumed his functions of pilot-major.

He finally settled in England, where he appears to have exercised a general supervision over the maritime concerns of the country, and enjoyed a pension of two hundred and fifty merks. It was then that he disclosed to Edward VI. his discovery of the phenomenon of the variation of the needle;—a discovery for which alone his name deserves to be immortalized. It was also at his instigation that the important expedition was undertaken which resulted in the opening of the trade with Russia; and in the charter of the company of merchant adventurers he was nominated governor for life, as "the chiefest setter forth" of the enterprise. Cabot lived to a very advanced age, and died about 1557,

[1] The continent of North America had been seen, and even repeatedly visited about five centuries before by the Icelanders.

probably in London; but neither the date of his death nor the place of his interment is properly authenticated.

Sebastian Cabot may be justly regarded as one of the most illustrious navigators the world has ever seen; and England owes him a debt of imperishable gratitude. "He ended," says the author of the Memoir which has rescued so much of his life from obscurity, "he ended, as he had begun, his career in the service of his native country; infusing into her marine a spirit of lofty enterprise, a high moral tone, and a system of mild but inflexible discipline, of which the results were not long after so conspicuously displayed. Finally, he is seen to open new sources of commerce, of which the influence may be distinctly traced on her present greatness and prosperity." (See *Memoir of Sebastian Cabot, with a Review of the History of Maritime Discovery, illustrated by documents from the Rolls, now first published.* 8vo. London, 1831.)

CABRA, a town of Spain, in the province of Cordova, about 28 miles S.E. of that city. It is situated in a fertile valley near the source of the river of the same name, and contains about 1346 houses. It has a college with classes for the study of philosophy, mathematics, languages, and design, and several public and private schools. The fields of clay in the neighbourhood afford materials for a considerable trade in bricks and pottery; and there is an abundant supply of wine, vinegar, oil, and flour, from the surrounding agricultural districts. The manufacture of coarse linen, woollen, and hempen stuffs is considerable. There are some interesting Moorish remains to be seen in the town and suburbs. Pop. 9576.

CABRERA, (called by the ancients *Capraria* from the number of goats upon it), a rocky and almost uninhabited islet in the Mediterranean, belonging to the Balearic group, about 10 miles south of Cape Salinas in Majorca. In the peninsular war it was used by the English as a depot for French prisoners.

CABUL, or Caubul, a province of Afghanistan, which still retains the name by which the whole Durani kingdom was formerly known. The events which resulted in the dismemberment of the empire, will be found detailed in the article Afghanistan. Cabul proper lies between the 33d and 36th degrees of N. Lat. Its length from east to west is about 250 miles, and its breadth 150. In 1818, upon the revolution which deprived Mahmood the brother of Shah Shooja of his throne, Cabul was seized by Dost Mahomed Khan, its present ruler. Cabul, the capital of the province, and during the integrity of the empire the seat of its government, is situate on the Cabul river immediately above its confluence with that of the Logurh. The immediate vicinity of the town is highly picturesque, well watered, and fertile. It is especially productive of the finest fruits; and the beautiful gardens, orchards, and groves are a source of great delight to the citizens during the fine season. A recent traveller who had often joined their festive parties, thus describes the environs of the beautiful site of the tomb inclosing the remains of the illustrious emperor Baber:[1]— "Baber Badshah, so the interesting spot is called, is distinguished by the abundance, variety, and beauty of its trees and shrubs. Besides the imposing masses of plane-trees, its lines of tall, tapering, and sombre cypresses, and its multitudes of mulberry trees, there are wildernesses of white and yellow rose-bushes, of jasmines and other fragrant shrubs. The place is peculiarly fitted for social enjoyment, and nothing can surpass the beauty of the landscape, and the purity of the atmosphere." The river of Cabul, though giving name to the great body of water which is poured into the Indus at Attock, adds nothing to the charms of the landscape, being here a small and dirty stream. The city, about three miles in circuit, is not wholly surrounded by a wall, being defended on the western side merely by a line of weak ramparts running from one hill to another, and of course affording no defence if turned. It stands at the western extremity of a plain of considerable extent, and in a recess formed by the junction of two ranges of hills. The houses are in general two or three stories high, built of sun-dried bricks with a large admixture of wood, as a security against the shocks of earthquakes. Four spacious bazaars were erected here in the centre of the city, by Ali Murdan Khan, a celebrated Persian nobleman, who for many years governed the western provinces; but these were demolished by the British in retribution of the murderous treachery of the inhabitants. The citadel called Bala-Hissar, or upper Fort, is situate on a rising ground in the eastern quarter of the city, and contains the palace. The mosques and other public buildings have nothing to recommend them in an architectural point of view. There is but one college, and it has been allowed to fall into decay. The serais, or public buildings for lodging and entertaining strangers, are about fifteen in number, and are remarkable neither for elegance nor convenience. There are several public baths, repulsive alike from want of cleanliness and from offensive smell, originating in the nature of the fuel used for heating them. Water is sufficiently supplied, both for the irrigation of the adjacent country and for domestic purposes, by the Cabul river.

This river is crossed by three bridges. One, the Pul Kuhto, is in the middle of the city, and is substantially built of brick and stone; another, the Pul Noe, is a frail fabric of wood, trembling under the weight of foot-passengers, who alone can cross it; a third, to the west of the town, is a fortified bridge, crossing the river where it passes through the gorge between the hills which bound the city on that side, and by this means the lines are continued across the stream. The climate, from the vicinity of the great central range of the Hindu Koh mountains, covered with perpetual snow, and from the great elevation of the town, which is situate 6396 feet above the level of the sea, is severe, the winter setting in at the beginning of October and continuing to the end of March. During this season the more opulent inhabitants rarely stir out, spending their time in such sedentary indulgences as they can command. Cabul is a place of considerable trade. The city is mentioned by the Arabian historians of the seventh century as a residence of a Hindu prince. It was for some time the capital of the emperor Baber, and in the year 1739 was taken by Nadir Shah, who annexed it with the province to his Persian dominions. On his death Ahmed Shah Abdally, the founder of the Durani empire, took possession of it, and in the year 1774 it was constituted the capital of Afghanistan by his son Timour Shah, and so remained till the downfall of the short-lived dynasty, when, as above noticed, it was seized by Dost Mahomed Khan, who for some time maintained an unquiet and precarious rule.

In 1839, a British army marched into Afghanistan, to restore to the throne Shah Shooja, who took possession of the city of Cabul and retained it until the commencement of 1842, when a dreadful outbreak of native fury and perfidy deprived them of it. The chief civil officer, Sir William Macnaghten, was basely assassinated, the troops cut off from their magazines and stores, and compelled to attempt a retreat under circumstances which rendered its successful accomplishment hopeless. Of 3849 soldiers and about 12,000 camp-followers, only one European, severely wounded, and four or five natives, escaped. In the same year a British army took the town, recovered some prisoners, including the heroic Lady Sale, wife of Sir Robert Sale, and having destroyed the principal bazaar and some other public buildings, returned leaving the place to its fate. The po-

[1] *Narrative of various Journeys in Beluchistan, Afghanistan, and the Punjaub*, by Charles Masson. London, 1842.

pulation of Cabul is about 60,000. Lat. 34. 30. Long. 69. 6.

CACAO or COCOA, the substance prepared from the seeds of the *Theobromia cacao*. When the bruised seeds are flavoured with the *Epidendrum vanilla*, mixed with a little sugar, they form the agreeable confection well known under the name of *chocolate*.

CACERES, a province of Spain, forming, by the division of 1833, the northern half of the old province of Estremadura. It is bounded north by Salamanca and Arvila, east by Toledo and Ciudad-Real, south by Badajos, and west by Portugal, embracing an area of 615 Spanish square leagues. It contains 13 *partidos*, 226 *ayuntamientos*, 3 cities, 122 towns, and 100 villages. Pop. (1849) 264,988. See ESTREMADURA.

CACERES, the capital of the above province, on the left bank of the Tagus, on a ridge of hills which stretch from east to west, 24 miles west of Truxillo. It is the residence of the Bishop of Coria, and contains a handsome episcopal palace. The monastery and college of the Jesuits was one of the finest in the kingdom, but has been secularized and converted into an hospital. It has a public school, a college with professorships of grammar, rhetoric, mathematics, philosophy, moral and scholastic theology, &c., a foundling hospital and several other charitable institutions. In the neighbourhood are large gardens, well cultivated fields, and extensive pasture grounds; while in the town are numerous oil and fulling mills, soap-works, and lime-kilns. It occupies the site of the ancient *Castra Cæcilia*, and was a place of some importance both under the Romans and the Moors. Pop. 12,051.

CACHALOT, the spermaceti or sperm whale (*Physeter macrocephalus*). See index to MAMMALIA.

CACHAO, KACHO, KECHO, or BAK-THIAN, the largest city of Anam, and the capital of the province of Tonquin, in Asia, situated on the west side of the Tonquin river, about eighty miles from the sea. It is of great extent, and has neither walls nor fortifications, being merely surrounded by a bamboo stockade. The principal streets are wide and airy, and for the most part are paved with bricks and small stones; intermediate spaces being, however, left for the passage of elephants and other beasts of burden. The other streets are narrow and ill paved. Most of the houses are constructed of mud and timber, and thatched with leaves, straw, or reeds, and are generally one story in height. The magazines and warehouses belonging to foreigners are the only edifices built of brick; and these, though plain, yet, by reason of their height and more elegant structure, make a considerable show among the rows of wooden huts. The public edifices are very spacious, but particularly the royal palace, which is several miles in circuit, and is surrounded by high walls. It contains many buildings within its precincts, which are devoted to different purposes, and embellished with a variety of carvings and gildings after the Indian manner, all finely varnished. Besides this palace there are to be seen the ruins of one still more magnificent, which is said to have been six miles in circumference. Cachao is a great commercial resort, and its trade is facilitated by the river, which is always crowded with vessels. The imports are long cloths, chintz, arms, pepper, and other articles, which are exchanged for gold and manufactured goods, namely, beautiful silks and lackered ware, which last is generally reckoned superior to any in the East. The English factory, which stood on the banks of the river, north of the city, and that of the Dutch, south of it, have long been withdrawn. Cachao, built chiefly of wooden and brick houses, is peculiarly liable to fires; and to prevent these, or to extinguish them after they have broken out, the city is governed by a very rigid police, and is divided into wards, each subjected to a certain jurisdiction. Fires for domestic use are only permitted during certain hours of the day. About the middle of the eighteenth century the city was nearly burnt to the ground by a conflagration, which was the work of incendiaries, who discharged fire-arrows during the night against the straw-covered roofs, and the whole was in a moment in a blaze. Population estimated at about 100,000. Long. 105. 35. E., Lat. 21. N.

CACHOLONG, a peculiar variety of calcedony commonly of a milk-white colour, and transclucent. It occurs imbedded in the trap rocks of Iceland and Faro, along with calcedony, and is also found in Bukhara, on the borders of the river Cach; whence its designation. See MINERALOGY.

CACHUNDE, a medicine highly celebrated among the Chinese and Indians. It is composed of several aromatic ingredients and perfumes, made into a stiff paste, and shaped in various figures, which are dried for use.

CACOPHONY (κακός and φωνή), in *Rhetoric*, the meeting of two or more letters or syllables which produce a harsh effect.

CACTUS, a genus of endogenous plants, which are now considered as constituting a natural order, the *Cactaceæ*. They are chiefly natives of Central America; but several of them are now naturalized in the south of Spain and warmer parts of Europe, as *C. Opuntia*, which forms hedges round the fields, and produces a fruit that is much used in Spain. See BOTANY.

CACUS, the son of Vulcan, was a giant of prodigious size, who dwelt in a cave on Mount Aventine, whence he issued and plundered the surrounding country. When Hercules was returning to Italy with the oxen he had taken from king Geryon, Cacus stole some of the cattle while the hero slept; and in order to prevent discovery, he drew them backwards by their tails into his cave. Hercules, however, was attracted to the spot by their bellowing, and slew Cacus with his club. According to another tradition, the place where the oxen were confined was revealed by Cacia the sister of the robber. In commemoration of his victory, Hercules erected the *Ara Maxima*. Ovid, *Fast*, i, 554.

CADARI, or KADARI, a sect of Mahommedans, who assert free will, attribute the actions of men to men alone, not to any secret power determining the will, and deny all absolute decrees, and predestination. The author of this sect was Mabeb ben Kaled al Gihoni, who suffered martyrdom for his doctrine. The word comes from the Arabic *cadara*, power.

CADENCE, in *Music*, see MUSIC.

CADENCE, in *Reading*, a falling of the voice below the key-note at the close of a period.

CADET (French *Cadet*), the younger son of a family. In Spain it is usual for one of the cadets in great families to take the mother's name.

CADET, a military term denoting a gentleman who carries arms in a regiment as a private soldier, with a view to acquire military skill, and to obtain a commission. His service is voluntary, but he receives pay, and thus is distinguished from a volunteer. The word cadet also denotes a pupil in a military school.

CADI, or CADHI, a judge in civil affairs in the Turkish empire, usually the judge of a town or village, the judge of a city or a province being called Mollah or Moula.

CADILESCHER, a capital officer of justice among the Turks, answering to a chief justice among us.

CADIZ, one of the three provinces into which the ancient kingdom of Seville has been divided, lying between 36. 2. and 37. 0. N. Lat., and between 5. 6. and 6. 21. W. Long. It is bounded north by Huelva and Seville, east by Malaga, south by the Straits of Gibraltar, and west by the Atlantic. The eastern part, intersected by numerous sierras, which separate it from Malaga, is rocky and sterile; the western part is more level and fertile. The only river of

any importance in the province is the Guadalete, which rises in the Sierra Ronda, and falls into the Bay of Cadiz. The climate is for the most part mild and equable, and epidemics are of less frequent occurrence in this than in most of the provinces of Spain. Its industry is chiefly occupied with agricultural produce, such as grain, fruits, wine, and olives, and with the rearing of horses, asses, mules, and pigs; but in most of the maritime towns there are considerable manufactures of coarse linen and woollen goods. Pop. (1849) 358,446.

Cadiz (Latin *Gades*), the capital of the above province, is built on the extremity of a tongue of land projecting about five miles into the sea, in a direction N.W. from the Isla de Leon, in N. Lat. 36. 31., W. Long. 6. 17.; 70 miles south of Seville, and 60 N.W. of Gibraltar. The city, which is six or seven miles in circumference, is surrounded by a wall with five gates, one of which communicates with the isthmus, and is connected with the mainland by the ancient work the *Puente do Zuazo*. Seen from a distance off the coast, it presents a magnificent display of snow-white turrets rising majestically from the sea; and for the uniformity and elegance of its buildings, it must certainly be ranked one of the finest cities of Spain, although, being hemmed in on all sides by the sea, its streets and squares are necessarily contracted. The most characteristic feature of Cadiz is the marine promenades, fringing the city all round between the ramparts and the sea, especially that called the *Alameda* on the eastern side, commanding a view of the shipping in the bay and the ports which line the opposite shore. The principal square is the *Plaza de San Antonio*, surrounded by handsome houses with elegant façades, the centre pleasantly shaded with trees, and furnished with numerous ornamental seats of marble. Communicating with it is the principal street, in which are the exchange and houses of the nobility. The houses are generally lofty and well-built, with open central courts, surmounted by turrets and flat roofs in the Moorish style; but from the continual decrease of the population, some quarters of the city are falling into disrepair. The principal public buildings are the two cathedrals (one built in 1597, the other begun in 1720, but not completed till 1840); the *Hospicio o Casa de Misericordia*, adorned with a marble portico; and having an interior court with Doric colonnades; the *Plaza del Toros*, or bull-arena, the two theatres, the new prison, and the lighthouse of San Sebastian on the western side, rising 172 feet from the rock on which it stands. Besides the Hospicio already mentioned, which sometimes contains 1000 inmates, there are numerous other charitable institutions, such as the *Hospicio de Mujeres, the Casa de Espositos*, the admirable *Hospicio de San Juan de Dios*, for sick men, &c. Gratuitous instruction is given to upwards of 1000 children; and there are several mathematical and commercial academies, maintained by different commercial corporations. There is also a flourishing medical school, and an *Academia de Nobles Artes*, founded in 1789, principally by the exertions of Governor O'Reilly. There are several public libraries attached to the various educational establishments, but none of any note. Cadiz is the see of a bishop, who is suffragan to the archbishop of Seville; but its chief conventual and monastic institutions of regulars have been suppressed.

It has a museum filled only with wretched copies of ancient masterpieces; but in one of the chapels is an unfinished picture by Murillo, the last effort of his pencil, as he met his death by falling from the scaffold on which he was painting.

Its noble bay, more than 30 miles in circuit, and almost entirely land-locked by the isthmus and the headlands which lie to the N.E., has principally contributed to the importance of Cadiz. The outer bay stretches from the promontory of Rota to the mouth of the Guadalete; and the inner bay, closed by the forts of Matagorda and Puntales, affords generally good anchorage, and contains a harbour formed by a projecting mole, where vessels of small burden may discharge their cargoes. The entrance to the bays is rendered somewhat dangerous by the low shelving rocks (Cochinos and Las Puercas), which encumber the passage, and by the shifting banks of mud deposited by the Guadalete and the Rio del Santi Petri. On the mainland, at the mouth of the Santi Petri, is the Caracca, once a flourishing naval arsenal and dockyard, but now almost deserted.

The commercial greatness of Cadiz has long been on the wane. At one time it was the great focus of commercial intercourse between Spain and the Spanish colonies, and from 1720 to 1765 it enjoyed a monopoly of the traffic with Spanish America. Its prosperity began to decline when the trade of St Domingo, Cuba, Porto Rico, and the other islands was opened up to the greater ports of Spain, and decayed almost entirely in the beginning of the present century, when the colonies achieved their independence. An attempt was made by the Spanish government in 1828 to restore its former greatness, by making it a free warehousing port; but this valuable privilege was withdrawn in 1832, and commerce relapsed into its former depressed condition. By far the greatest obstacle in the way of its future prosperity is the oppressive commercial restrictions imposed by government on all imports—a policy which throws three-fourths of the trade of Spain into the hands of contrabandistas. The principal exports are wine (from Xeres) to the amount of 30,000 pipes annually, quicksilver, brandy, oil, provisions, flour, salt, wool, &c. The imports consist chiefly of sugar and coffee from the Havannah and Porto Rico, cocoa, hemp, flax, linens, dried fish, hides, cotton and woollen manufactures, rice, spices, indigo, staves, and timber. The total value of cargoes entered in 1846 was L.637,396; of cargoes cleared L.973,416, but not more than half of these were in Spanish vessels. The principal manufactures of Cadiz are soap, glass, coarse woollen, cotton and silk stuffs, and hats. There are also some sugar refineries and tanneries. A considerable stimulus to industry is given by the *Sociedad economica de Amigos del pais*, which introduced the cochineal plant, and grants medals for improvements in manufactures.

Cadiz is strongly fortified with ramparts and bastions, crowned by the forts of San Sebastian, Santa Catalina, the Muelle de San Felip, and the Muelle Principale: the isthmus is defended by an intrenchment called the Cortadura; but the fortifications are gradually falling into disrepair.

From its almost insular position, it enjoys a mild and serene climate, the mean annual temperature being about 64° Fahr., while the mean summer and winter temperatures vary only about ten degrees above and below this point. From the same cause it labours under a great deficiency of water, which must either be collected in cisterns from the tops of the houses, or brought at great expense from Santa Maria on the opposite coast. Pop. (1845) 53,922.

Cadiz is identical with the ancient Gadir or Gaddir, which was a flourishing Phœnician colony long before the beginning of classical history, and continued in the hands of the Carthaginians, though somewhat disaffected to them, till after the Punic wars, when Spain became a Roman province. C. Julius Cæsar conferred the *civitas* of Rome on all its citizens; and under Augustus, when it was the residence of no fewer than 500 *equites*, it was made a municipium under the title of Augusta Urbs Gaditana, and its citizens ranked next to those of Rome. After the fall of Rome it was destroyed by the Goths, and remained in obscurity under the Moors, from whom it was retaken by Alonzo el Sabio in 1262, but emerged again when the discovery of America made it valuable as a market for colonial produce. In more recent contests, Cadiz has been subjected to several disasters. It was taken and pillaged in 1596 by the British fleet, under Essex and Howard, in revenge for the Spanish Armada. It was attacked, but without success, by Lord Wimbledon in 1626, and by the Duke of Ormond and Sir George Rooke in 1702. It was bombarded by Nelson in 1800. In 1808, the Spanish patriots in Cadiz brought the French fleet, which lay in the bay blockaded by Admiral Collingwood, to a surrender; and they were in turn subjected to a protracted siege of two years by

Cadizadelites. || Cadmus.

Marshal Victor, from which they were relieved by the successes of Wellington in the Peninsula. It was once more reduced by the Duke D'Angoulême in 1823, and remained in the hands of the French till 1828.

CADIZADELITES, a sect of Mahommedans not unlike the ancient Stoics. They shun feasts and diversions, and affect an extraordinary gravity; they are continually talking of God, and some of them make a jumble of Christianity and Mahommedanism. They drink wine, even in the fast of the Rhamazan; love and protect the Christians; believe that Mahomet is the Holy Ghost; and practise circumcision, justifying it by the example of Jesus Christ.

CADMEAN LETTERS, the sixteen ancient Greek or Ionic characters, such as they were first brought by Cadmus from Phœnicia, whence Herodotus (v. 58, &c.) calls them also Phœnician Letters. These were—α, β, γ, δ, ε, ι, κ, λ, μ, ν, ο, π, ρ, σ, τ, υ. According to some writers, Cadmus was not the inventor, nor even the importer, but only the modeller and reformer, of the Greek letters; and it was from this circumstance they acquired the appellation of Cadmean or Phœnician Letters; whereas they had previously been called Pelasgian Letters.

CADMIUM. This metal has not yet been met with in its native state, but is contained in certain ores of zinc, and especially in the black fibrous blende of Bohemia, which contains about five per cent. of it. It was discovered by M. Stromeyer in 1817, who used the following process for separating it from its ore. He dissolved it in dilute sulphuric or muriatic acid, and, after adding a portion of free acid, transmitted a current of sulphuretted hydrogen gas through the liquid, by which means the cadmium was precipitated as sulphuret, while the zinc remained in solution. The sulphuret of cadmium was then decomposed by nitric acid, and the solution evaporated to dryness; then the dry nitrate of cadmium was dissolved in water, and an excess of carbonate of ammonia added. The white carbonate of cadmium subsided, which, when heated to redness, yielded a pure oxide; and by mixing this oxide with charcoal, and exposing it to a further heat, metallic cadmium was obtained in the form of sublimation. Dr Wollaston's process is somewhat more simple: he placed the solution of the mixed metals in a platinum capsule along with a piece of metallic zinc. If cadmium be present it is reduced, and adheres to the capsule; after which it may be dissolved, either by nitric or dilute muriatic acid.

The cadmium thus obtained has in colour and lustre a strong resemblance to tin, but is somewhat harder and more tenacious. It is very ductile and malleable; melts at about the same temperature as tin; but is nearly as volatile as mercury, condensing like that metal into globules which have a metallic lustre. When heated in the open air it absorbs oxygen, and is converted into an orange-coloured oxide. It is readily dissolved by nitric acid, but is less easily acted upon by sulphuric and muriatic acids. Its specific gravity is 8·62.

Cadmium appears to exist in those ores in the state of a sulphuret. It has since been found in the yellow zinc blendes of Mexico, and was still more recently discovered by Lord Greenock (now Earl Cathcart), in a porphyritic greenstone near Bishoptown in Renfrewshire. This last occurs in detached prismatic crystals of a rich orange-yellow colour. It consists of cadmium 77·6, sulphur 22·4, and has been named *Greenockite* in honour of its discoverer.

CADMUS, in *Fabulous History*, king of Thebes, the son of Agenor king of Phœnicia, and the brother of Phœnix, Cilix, and Europa. According to tradition, he carried into Greece the sixteen simple letters of the Greek alphabet; and there he built Thebes, in Bœotia. The poets relate that Cadmus left his native country in search of his sister Europa, whom Jupiter, in the form of a bull, had carried away; and that, on inquiring of the Delphic oracle for a place to settle in, he was answered that he should follow the direction of a cow. When Cadmus arrived in Phocis, he found the cow described by the oracle; and following her into Bœotia, he built the city of Thebes as he had been directed on the spot where she sank down. Intending to sacrifice his guide to Pallas, he sent two of his company for water to the fountain Dirce, where they were devoured by a serpent or dragon. Cadmus slew the monster, and afterwards, by the advice of Pallas, sowed its teeth, from which sprung up a number of armed men, who prepared to revenge the death of the serpent; but on his casting a stone among them, they turned their weapons against each other with such animosity that only five survived the combat. This remnant assisted Cadmus in founding his new city. Afterwards, to recompense his labours, the gods gave him Harmonia, the daughter of Mars and Venus, for his wife, and honoured his nuptials with presents and peculiar marks of favour. Subsequently Cadmus and Harmonia quitted Thebes, and went to the Euchelians, who made Cadmus their king. Lastly, Cadmus and his wife were transformed into serpents; or, as others say, were translated to the Elysian fields in a chariot drawn by serpents.

Cadmus || Cælius.

CADMUS of Miletus, the earliest Greek historian who wrote in prose. He flourished about B.C. 540. (Plin. *Hist. Nat.* v. 31; Strabo, i., p. 18.)

CADRITES, a sort of Mahommedan friars, who once a-week spend a great part of the night in turning round, holding each other's hands, and repeating incessantly the word *hai*, which signifies *living*, and is one of the attributes of God; during which one of them plays on a flute. They never cut their hair, nor cover their heads, and always go barefooted. They have liberty to quit their convent when they please, and to marry.

CADUCEUS, in *Antiquity*, the rod or sceptre borne by Hermes or Mercury, as the ensign of his quality and office. This rod was entwisted by two serpents, and generally surmounted with a pair of wings. The rod represents power; the serpents, wisdom; and the wings, diligence and activity. Wonderful properties were ascribed to the caduceus by the poets; as laying persons asleep, raising the dead, and such like marvels. See MERCURY.

The staff or mace carried by heralds and ambassadors in time of war was called caduceus (in Greek κηρύκειον or κηρύκιον). It was originally an olive branch, the twigs of which came afterwards to be represented as serpents. Later mythologists invented various tales about these serpents. The ambassador sent to treat of peace was called *caduceator*, from the caduceus or mace which he carried in his hand. The Roman Fetiales, however, on such occasions, did not use the caduceus, but carried the sacred herbs gathered from within the inclosure of the Capitoline hill. The caduceus is frequently represented on medals, &c., as a symbol of good conduct, peace, and prosperity.

CADUS (κάδος), in *Antiquity*, a large vessel, generally of earthenware, used for containing wine and other liquids. As a measure for liquids it was synonymous with the Attic amphora, usually equal to 1½ Roman amphoræ, or about eight gallons and five pints English.

CADUSII, in *Ancient Geography*, a warlike mountain-race of Media Atropatene, inhabiting the hilly country on the S.W. shores of the Caspian Sea; between whom and the Medes a perpetual feud continued down to the time of Cyrus the Elder.

CÆLIUS or CŒLIUS, AURELIANUS, a very celebrated Latin physician, and the only one of the sect of the Methodici of whose works we have any remains. It is supposed that he was a native of Sicca in Numidia, and probably lived in the third century. He had carefully studied the ancient physicians of all sects; and to him we are indebted for a knowledge of many dogmas that are not to be found but in his work on *Acute and Chronic Diseases*. The best edi

tion, perhaps, is that by Amman, Amstel., 1709, 4to. Cælius also wrote several other works, but these have perished.

CAEN, the capital of the arrondissement of the same name, in the department of Calvados in France. It stands in an extensive valley, on the left bank of the Orne, at the influx of the Odon, 9 miles from the English Channel, and 122 west of Paris. Lat. 49. 11. 12. N., Long. 0. 21. 38. W. The town is handsome and well built; the streets are generally wide, straight, and clean; and the houses, being built of freestone, have a very good appearance. The city contains several ancient churches and other edifices, fine specimens of the Norman style of architecture. Among these are the church of St Pierre, which is surmounted by a handsome stone spire, the finest in Normandy, and which is 242 feet in height; the churches of the *Abbayes*, *Aux Hommes*, and *Aux Dames*, both founded in 1066, the former by William the Conqueror, where a plain gray marble slab in the pavement now marks his tomb, which, however, has long since been emptied; and the latter by his queen Matilda, who was interred there. Caen is the seat of a high court of appeal for the departments of Calvados, Manche, and Orne, and has tribunals of primary instance and commerce, a chamber of commerce, a *conseil de prud 'hommes*, a university, a royal college, a school of hydrography, an institution of deaf-mutes, a public library of 45,000 volumes, an extensive botanic garden, and a theatre. Population (1851) 40,569; while that of the arrondissement amounted to 139,922. The commerce and manufactures of Caen are considerable. It exports corn, wine, brandy, fruit, cattle, stones, hardware, &c. Its manufactures consist chiefly of laces, caps, table-linen, cotton fabrics, earthenware, cutlery, &c.; it has also breweries, dye-works, and shipbuilding yards. Several large fairs are annually held here. At high water, vessels of 150 or 160 tons can come up to the town, and a canal to connect it with the sea is in course of construction, which will render it accessible to large vessels.

Though Caen is not a town of great antiquity, yet the date of its foundation is unknown. In the ninth century it existed under the name of Cathem or Catham; and when in 912 Neustria was ceded to the Normans by Charles the Simple, it was a large and important city. Under the Dukes of Normandy, and particularly under William the Conqueror, it rapidly increased. This last prince, with his spouse Matilda, contributed much to its embellishment. It became the capital of Lower Normandy, and in 1346 was besieged and taken by Edward III. of England. It was again taken by the English in 1417, and retained by them till 1459, when it capitulated to the French, in whose possession it has since continued.

CÆRE (Καῖρε), called by the Greeks *Agylla* (Ἄγυλλα), a city of Southern Etruria, near the coast of the Tyrrhenian Sea. Its site is occupied by the modern *Cervetri* (*Cære vetus*). From the inhabitants being admitted to the privilege of Roman citizens, but without the right of suffrage, the *Cærite franchise* came to be a proverbial expression denoting disfranchisement. Interesting Etruscan remains have been found in the tombs of Cære. (See Dennis' *Cities and Cemeteries of Etruria*, vol. ii.)

CAERLEON, a market-town in the parish of Llangattock, and hundred of Usk, Monmouthshire, stands on the right bank of the river Usk, N. Lat. 51. 37., W. Long. 2. 56.; 2 miles N.E. of Newport, and 148 miles west from London. It covers an area of 450 acres, partly on the site of the ancient *Isca Silurum*, the station of the second *legion* (of which *leon* is a contraction), and is thought at one time to have been the capital of Wales. It is an old and irregular town, with an ancient parish church (St Cadoc's), and three other places of worship, besides an endowed, a national, and an infant school. The iron and tin-plate works give employment to a large number of the inhabitants, but otherwise there is little trade of any description in the place. In the neighbourhood are the remains of the Roman city, with outworks, a fortress, and an amphitheatre since called Arthur's Round Table. And a great variety of antiquities, chiefly Roman altars, pavements, tiles, coins, medallions, &c., have been dug up in the vicinity, and are deposited in a museum erected for that purpose in the town. Caerleon was the seat of an ancient archbishopric, afterwards removed to St David's. Pop. (1851) 1281.

CAERMARTHEN, or CAERMARTHENSHIRE (Welsh *Caerfyrddin*), a maritime county in South Wales, is bounded on the north by Cardigan, on the east by Brecon, on the south by Glamorgan and the Bristol Channel, and on the west by Pembroke. Its greatest length is from S.W. to N.E., about 52 miles; its greatest breadth, S.E. to N.W., about 28 miles. It possesses an area of 947 square miles, or 606,331 acres, and is thus the largest of all the Welsh counties. It contains 77 parishes, and is in the diocese of St David's. It derives its name from Merlin (Welsh *Myrddin*) the famous wizard, who was a native of this county.

The whole of the northern, and by far the largest portion of Caermarthenshire, is chiefly occupied by the Silurian geological formation. To the south of this, and crossing the county in a direction from S.W. to N.E., there stretches a belt of the old red sandstone, varying in width from 1½ to 4 or 5 miles. This is succeeded on its southern edge by narrow belts of the carboniferous limestone, and the millstone grit; south of which the whole remaining portion of the county is occupied by the coal measures, forming part of the great South Wales coalfield.

In the S.E. there is a range of bleak and somewhat lofty mountains, called Mynydd du, or the Black Mountains. In the east, adjoining the border of Breconshire, the Caermarthenshire Van, the third highest mountain in South Wales, rears its lofty summit. The rest of the county is thickly studded with rounded green hills; but few of these exceed 1000 feet in height.

The valleys of the Teivy (Welsh *Teifi*) and the Towy (Welsh *Tywi*) present scenes of great beauty and interest. From Grongar hill and the ruins of Dynevor Castle the picturesque beauties of the vale of the Towy are seen to great advantage. The whole of the county is intersected in every direction by narrow valleys and deep glens, from which the hills rise abruptly. The scenery in the neighbourhood of Caermarthen is seen to great advantage from Abergwili, the residence of the bishop of St David's, about two miles from the town.

The principal rivers are the Towy (Welsh *Tywi*), which rises in Cardiganshire, and enters the county at Capel Ystradfin in the N.E.; thence it flows S.W., and in its course passes through the towns of Llandovery, Llangadock, Llandeilofawr, and Caermarthen; and after forming the harbour of the latter place, falls into Caermarthen bay in the Bristol Channel. The Teivy (Welsh *Teifi*) rises in Llyn Teifi in Cardiganshire, and forms the boundary between Caermarthen and Cardigan shires, from Lampeter to Cenarth, near Newcastle Emyln. The Tave (Welsh *Taf*), which rises in Pembrokeshire, near Llanfirnach, enters the county near its western boundary, and flows S. and S.E.; and after forming the harbour of Laugharne, falls into Caermarthen bay. Besides these, there are several smaller streams, as the Cothi, the Dewi, the Feni, the Gynin, the Gwili, the Dulais; the Gwendraeth Fawr, which forms the port of Kidwelly; and the Llwchwr, which separates the county from Glamorganshire for about ten miles, and forms the port of Llanelly.

The bay of Caermarthen is the finest in the Bristol Channel. It is about 18 miles across its mouth, from the Worm's head in Glamorgan on the east to Giltar head in Pembroke on the west. It is about 12 miles in depth, and affords good anchorage and shelter for vessels navigating the channel.

There is an inlet of the sea in this bay on the east, called the Burry river, which leads up to the port of Llanelly. Between the Burry and the mouth of the Towy, there is a somewhat dangerous sand-bank called Cefn Sidan.

The port of Caermarthen is only frequented by small coasters, owing to the difficulties of the navigation, and the bar at the mouth of the Towy; but at Llanelly vessels of 600 or 700 tons can enter, and a vigorous trade in coals, iron, copper, and copper ore is carried on.

The climate is mild, except in the very elevated parts of the county; but the annual fall of rain is very great. Agriculture is generally in a very backward condition; but there is now some progress being made in efficient drainage under the provisions of the drainage acts, and better modes of agricultural practice will no doubt follow. The soil varies very much; but in the southern parts of the county, and in the larger valleys, it is exceedingly fertile. The cultivated crops consist of wheat, oats, barley, turnips, and potatoes. There is a good deal of cultivation on the lower hills; but the more elevated are chiefly in heath or mountain pastures. The breed of horses is celebrated; and these, with cattle, sheep, wool, butter, and pigs, are largely exported to the neighbouring districts. It is calculated that about two-thirds of the lands only are inclosed.

In the S.E. there are extensive and valuable coal and iron mines, and there are also some important lead mines in the county. Limestone is also abundant in the south.

The South Wales railway traverses the county in the S. and S.W.; and there is also a line from Llanelly to Llandeilofawr, with several branches. There are besides numerous canals and tramways for the accommodation of the mines. The principal towns are Caermarthen, Llandeilofawr, Llangadock, Llandovery, Newcastle Emlyn, Laugharne, Llanelly, and Kidwelly. The county has returned two members to parliament since 1832, having only had one from 1536 up to that time. The political influence is chiefly in the hands of Lord Cawdor, although Lord Dynevor has much weight in the county. Constituency in 1852, 4791. The average gross estimated rental of the county is 10s. 1d. per acre. The annual value of real property paying income-tax is L.396,915.

The population of the county at the last census was 110,632, giving an average of 117 persons to a square mile, or 5·5 acres to each person. Of the total number, 53,076 were males and 57,556 females. The number of inhabited houses was 22,465; uninhabited, 1176; and building, 99; giving an average of 24 inhabited houses to a square mile, and 4·9 persons to a house. The following table gives the census returns for the last 50 years:—

YEARS.						Increase of population per cent. in fifty years.
1801.	1811	1821.	1831.	1841.	1851.	
67,317	77,217	90,239	100,740	106,326	110,632	64

It is calculated that about one-fifth of the whole population are in the condition of labourers, servants, &c. About fourteen per cent. live by agriculture, and rather more than eight per cent. by trade, manufactures, &c. Nearly four thousand persons possess independent means, while seven hundred follow professions.

In 1847 the total number of children of the working classes at day schools within the county was 7191. The total number of schools was 179; of which 61 were Church or National, with 3170 scholars; 4 British and Foreign, with 456 scholars; 8 Baptist, with 308 scholars; 15 Independent, with 581 scholars; 5 Calvinistic Methodist, with 133 scholars; 1 Wesleyan, with 10 scholars; 75 Adventure or Private, with 2186 scholars; 5 Workhouse schools, with 138 scholars; 2 Workmen's, with 95 scholars. The average annual income of each school was L.23, 5s., and the average annual income of the teachers from all sources only L.20, 15s. 1d. The total number of scholars attending Sunday-schools was 28,313. The total number of Sunday-schools was 308; of which 48 were Church of England, with 3837 scholars; 78 Calvinistic Methodist, with 7411 scholars; 110 Independent, with 11,962 scholars; 55 Baptist, with 4006 scholars; 14 Wesleyan, with 983 scholars; 3 other denominations, with 114 scholars. In 140 of these schools instruction was given in Welsh only, in 19 in English only, and in 149 in both tongues.

Welsh is the language commonly spoken by the lower orders, and in the northern parts of the county the manners and customs of the people are as purely Welsh as in any part of the principality. It was in this county that the remarkable "Rebecca" insurrection originated in 1843–4. The multiplicity of toll-gates seemed to be the original cause of this singular conspiracy. Parties of five or six hundred men, mostly mounted, armed with pickaxes, sledges, hatchets, and guns, used nightly to traverse the counties of Caermarthen, Pembroke, Cardigan, and Brecon, headed by a tall man dressed in women's clothes, throwing down the toll-gates, and committing other excesses; and so well did the rioters keep counsel, and so secretly did they manage their forays, that despite the exertions of the magistrates, assisted by large bodies of military sent into the districts, no effectual check could be put upon their proceedings for many months. The course usually pursued by them was to assemble quickly and secretly in the neighbourhood of some obnoxious toll-gate; the leader then addressed to them the inquiry, "My children, this gate has no right to be here, has it?" Upon which the attack commenced, and in a few minutes not a vestige of gate or toll-house remained standing. From pulling down toll-gates, the rioters proceeded to redress all other real or imaginary grievances. On one occasion they destroyed a weir in the Teifi, about which there had been a long feud between the proprietor and the fishermen. On another occasion they murdered a poor old woman who kept a toll-gate. The daring and courage with which they executed the commands of their leaders, and the ingenuity they displayed in outwitting those sent against them, form altogether a remarkable episode in the history of the principality. On more than one occasion they destroyed the restored toll-gates within earshot of the military sent to protect them; and having discovered the secret signals agreed on between the magistrates and military, they used to harass the latter by exhibiting them at the most unseasonable hours. Thus a magistrate having arranged that if his house were attacked he was to exhibit three lights, the Rebeccaites, who had discovered this, gave the signal so often in the night, that the patience of both officers and men was fairly exhausted with the false alarms.

Caermarthenshire is rich in antiquities, and possesses the remains of three important Roman roads.

CAERMARTHEN, or CARMARTHEN (Welsh *Caerfyrddn*), the capital of the county of the same name, a market and borough town 183 miles north by west from London, beautifully situated in the vale of the Towy. The river is navigable up to the town, and there is a considerable export trade carried on in tin-plates, cast-iron, slates, timber, and agricultural produce. Owing to the disgracefully neglected state of the river, only vessels of moderate draught can enter; and indeed, masters of vessels have generally an objection to freights for this port. It is now probable, since the South Wales railway has been opened, that the shipping trade of Caermarthen will fall into a state of decay.

The streets are generally narrow, but the houses are well built, and altogether the town has the appearance of a place of considerable importance. The church of St Peter's is a venerable edifice. and contains some curious monuments,

among which is that of the celebrated Sir Rhys ap Thomas and his lady. Sir Richard Steele is also buried here. There is another church belonging to the Establishment called St David's, a plain structure. There are two Baptist, two Wesleyan, two Independent, one Unitarian, and two Calvinistic Methodist chapels. There is a large and well conducted training college here for Welsh teachers; and there are two grammar-schools on public foundations. There are also two infirmaries, and a literary and scientific institution, the lectures at which are well attended. The town also possesses a county-hall and a handsome new music-hall. The county gaol is built on the site of the very ancient castle. There is a granite obelisk erected to the memory of Sir Thomas Picton, and a bronze statue to General Nott, who were both natives of the town.

Caermarthen has figured as an important place from the earliest period. It was the Maridunum of the Romans, and is supposed to have derived its present name from Caer, a fortified place, and Myrddin, the British name of the celebrated wizard Merlin, who was a native of the place. It gives the title of Marquis to the Duke of Leeds.

The corporation consists of a mayor, 6 aldermen, and 18 councillors. It returned a member to parliament for itself from 1536 to the period of the Reform act. Since that time it has been associated with Llanelly in returning one member; constituency in 1832, 684; in 1852, 849. The political influence is chiefly in the hands of Earl Cawdor. The assessed taxes yield annually L.2192, and the annual value of real property paying income-tax is L.55,250. There are markets on Wednesdays and Saturdays, and several fairs in the course of the year. The quarter sessions and assizes are held here. Pop. in 1851 10,524; inhabited houses 1800.

CAERNARVON or CARNARVONSHIRE (Welsh *Caer-yn-arfon*), a maritime county of North Wales, is bounded on the north by Beaumaris Bay; on the east by Denbigh; on the S.E. by part of Merioneth; on the S.W. by Cardigan Bay, and on the west by the Irish Sea and the Menai Straits. There are two small detached portions of the county on the north coast of Denbighshire; one of these forms the Great Ormes Head; and the other is a few miles further east. The greatest length of this county is from N.E. to S.W., and, exclusive of the detached portions, it measures about 53 miles; its greatest breadth from S.W. to N.E. is about 23 miles. Nearly one-half of its whole length forms a peninsula varying from five to nine miles in width, projecting in a S.W. direction into the Irish Sea, and forming Cardigan bay on the south, and Caernarvon bay on the north. This county possesses an area of 579 square miles, or 370,273 acres, and is thus the ninth largest of the Welsh counties. Arfon was the original name of this district, and from this, and Caer—a fortified place—the present name is derived.

The lower Silurian and Cambrian beds may be termed the basis of the geological features of this county; but they are so completely penetrated in every direction by intrusive igneous rocks, that there is hardly a square mile of surface in the whole county free from their presence. These consist chiefly of compact felspar, felspathic traps, greenstone, and quartz prophyries. On the west, along the shore of the Menai Straits, there is a narrow belt of carboniferous limestone; of this the Great Ormes Head is also composed; and on the western side of the peninsular part of the county is a broad band of chlorite and mica schist. Caernarvon is rich in mineral treasures; for besides lead and copper lodes, its numerous slate quarries are amongst the most valuable mineral properties in the united kingdom, and yield princely incomes to the fortunate possessors, besides furnishing employment to many thousands of workmen. It is calculated that the workmen and their families who are supported by the slate quarries of Col Pennant alone number fully 12,000 people.

Caernarvon is the most mountainous of all the Welsh counties, and its mountains are the grandest of any in the British islands south of the Forth. The Snowdon range fills up the whole of the centre of the county; and, with its lofty summits rising to the height of between three and four thousand feet, throws an air of grandeur and sublimity over the scenery, which is of the most romantic and beautiful description. The summit of Snowdon itself is 3571 feet above the level of the sea, and it is surrounded by a phalanx of giants, many of them but little lower than itself. Among the more important of these, within the county, are the Glyder Fawr, 3300 feet; the Glyder Bach, 3000 feet; the Moel Siabod, 2878 feet; Moel Hebog, 2584 feet; Aran, 2473 feet; Craig Goch, 2350 feet; Carnedd Dafydd, 3427 feet; and Carnedd Llewelyn, 2460 feet in height. The upper part of the mountain is generally enveloped in clouds. The rocks of which the Snowdonian range is composed are for the most part of a very bold and rugged description, which adds to the impressiveness of their immense masses.

Some of the valleys are characterized by the extreme of wild and rugged grandeur, being walled in by naked rocks, and traversed by foaming torrents dashing through them with angry roar and race-horse speed; while others are marked by soft and smiling beauty. Among the former may be mentioned the gorge at Pont Aberglaslyn, while Nant Gwynant with its placid lake and verdant meadows will serve as an illustration of the latter. The vales of Beddgelert and Llanberis, the former at the southern, and the latter at the northern base of Snowdon, have a world-wide reputation for beauty; and the vale of the Conway from Llanrwst to Conway is a noble piece of scenery, backed as it is on its southern border by the Snowdon range.

The only river of importance in the county is the Conway (Welsh *Conwy*). It rises in Llyn Conwy, in the S.E. corner of the county; and after separating Caernarvon from Denbigh, in a nearly due north course of about 30 miles, falls into the sea at Conway. It is a tidal river, and navigable for about 10 miles from Conway. The Seoint, a small stream, rises in Snowdon, and falls into the sea at Caernarvon.

The lakes are very numerous, and some of them are of considerable size. The more important are the lakes of Llanberis, to the north of Snowdon; Llyn Ogwen to the north of the Glyder Fawr; Llyn Cwlyd, and Llyn Eigiau, both to the north of Capel Careg; Llyn Llydau on Snowdon; Llyn Cwellyn to the east, and Llyn Gwynant to the west of that mountain; Llyniau Nant y Clef near Llanllyfin; and Llyn Conwy, already referred to.

The climate is cold and severe during the winter, except in the peninsular part of the county and on the sea-coast, where it is very mild. The arable land occupies not more than one-fortieth part of the whole surface; and this is mostly in the vale of Conway, or in the neighbourhood of the sea. A small quantity of wheat is raised; but the principal cultivated crops are barley, oats, and bere. The alluvial deposit in some of the valleys forms a rich and fertile soil, which is chiefly employed as meadow land. Dairy and sheep-farming form the chief employment of the agricultural population; and on the hills great numbers of diminutive ponies are reared, which at two years old find a steady sale in the English market. Agriculture is in a very backward state; and the farmers are a very poor ignorant race of men, without capital or energy, but very industrious and saving; often living more penuriously than the poorest day labourer. The farm buildings and cottages throughout the greater part of the county are of a very wretched description.

A railway has lately been opened from Bangor to Caernarvon along the coast, and there are admirable private railways worked by locomotive power laid down through the

Caernarvon. mountains from the slate quarries to the ports of shipment, at each of which—Bangor, Port Dinorwic, Caernarvon, and Portmadoc—a prodigious amount of shipping is employed, in transporting the slates to different parts of the kingdom, to the continent of Europe, and to America. This county boasts of possessing some of the grandest works of scientific skill in existence—the Menai and Conway suspension bridges, constructed by the celebrated Telford as parts of the Great Holyhead road from London; and the famous tubular bridges constructed by Mr Robert Stephenson for carrying the Chester and Holyhead railway over the estuary of the Conway and the Menai Straits.

The principal towns are Conway (Welsh *Aberconwy*), Bangor, Caernarvon, Pwllheli, Criccieth, and Tremadoc, all on the coast. The county returns one member to parliament, and has done so since 1536. The political influence is chiefly in the hands of the Marquis of Anglesey and Mr Douglas Pennant—the owner of the Bangor slate quarries. Constituency in 1852, 1913. The average gross rental of the county is 8s. 7d. per acre; and the annual value of real property paying income-tax is L.251,044.

The population of the county, by the last census, was 87,870; giving an average of 151 persons to a square mile, or 4·2 acres to each person. Of the total number, 42,978 were males, and 44,892 females. The number of inhabited houses was 18,005; uninhabited, 590; building, 132; giving an average of 31 inhabited houses to a square mile, and 4·9 persons to a house. The following table gives the census returns for the last 50 years:—

YEARS.						Increase of population per cent. in fifty years.
1801.	1811.	1821.	1831.	1841.	1851.	
41,521	39,655	58,099	66,818	81,093	87,870	111

It is calculated that about a fourth part of the whole population are in the condition of labourers, servants, &c. About 12 per cent. live by agriculture, and about 7 per cent. by trade; while upwards of 2000 persons possess independent means, and about 400 follow professions.

In 1847 the total number of the children of the working classes at day-schools within the county was 5867. The total number of schools was 79, of which 47 were Church or National, with 3994 scholars; 5 British and Foreign, with 695 scholars; 5 other denominations, with 378 scholars; 1 Workhouse, with 36 scholars; and 21 Adventure, with 764 scholars. It appears that the average annual income of each teacher from all sources was L.33, 2s. 9d. The total number of Sunday-schools was 236, with 26,763 scholars; of these, 16 were Church of England, with 1455 scholars; 17 Baptist, with 1174 scholars; 131 Calvinistic Methodist, with 18,071 scholars; 49 Independent, with 3998 scholars; and 24 Wesleyan Methodist, with 2065 scholars. In 200 of these schools instruction was given in the Welsh language only; 6 in the English language only; and in 24 in both tongues; in 6 not ascertained. Nearly the whole population use the Welsh language habitually, and their manners and customs are for the most part purely Welsh.

Caernarvon or Carnarvon (*Caerynarfon*), the capital of the county of the above name, a market and borough town, 210 miles N.W. from London, pleasantly situated on the eastern shore of Caernarvon Bay, in the Irish Sea, at the mouth of the Seoint. There are some handsome streets, and many of the houses are large, well-built, and excellent. This town has long been famous for the celebrated castle of Edward I., in which Edward II. was born, as arranged by his astute father, in the hope of attaching the turbulent Welsh chieftains to a prince born in their own land. This splendid pile is situated at the S.W. corner of the town, close on the beach, and although entirely unroofed, possesses a grand and imposing appearance. A considerable portion of the town wall near the castle is still entire. The parish church is nearly half a mile from the town. In the town itself there is a chapel of ease, and several large and commodious dissenting chapels. There are also a town and county hall, a training college for teachers, and handsome schools. The town also possesses assembly rooms and a theatre.

Caerphilly ‖ Caerwys.

The borough has formed part of a district which has returned a member to parliament since 1536. The Reform bill added Bangor to the district, which still returns one member. The contributing boroughs are Caernarvon, Conway, Criccieth, Pwllheli, Bangor, and Nevin. Constituency in 1852, 861. The political influence is in the hands of Colonel Douglas Pennant and Mr Assheton Smith. The assessed taxes yield annually L.2498. The annual value of real property paying income-tax is L.36,503. Pop. in 1851, 8674. Inhabited houses 1723. There is a weekly market on Saturdays, and four fairs in the course of the year. The quarter sessions and assizes are held here. There is a considerable trade carried on in slates. The coasting trade, shipbuilding, and fisheries, also employ a considerable number of the inhabitants.

CAERPHILLY, a town of Wales in the county of Glamorgan, situated between the rivers Rumney and Taf, 7 miles N.W. of Cardiff, and about 165 miles from London. It was formerly a borough and a place of considerable importance, but was disfranchised in the reign of Henry VIII. In the immediate neighbourhood of the town are the ruins of the old castle, which was originally one of the most magnificent baronial strongholds in the kingdom. This fortress was built towards the close of the thirteenth century by Gilbert de Clare, and subsequently passed into the hands of the Mortimers, lords of Glamorgan. From them it was wrested by Hugh Despenser, the favourite of Edward II., who was here besieged by his rebellious barons. The most remarkable portion of the ruins as they now exist, is an old tower called the "mint," which stands ten feet off the perpendicular. Some of the houses of the town itself are very ancient, but the majority of them are comparatively modern. The surrounding scenery is among the finest in South Wales. Considerable manufactures of woollen stuffs are carried on, and occupy a large number of the population, to many of whom also the mines and quarries in the neighbourhood give employment. There is one Episcopal chapel, and three dissenting places of worship. Market-day, Thursday. Pop. (1851) 952.

CAERSWS, a town of North Wales in Montgomeryshire, situated on the Severn, 6 miles N.W. of Newton. During the Roman occupation of Great Britain, it was one of the most important stations which that people had in Wales, and is now chiefly interesting as exhibiting many important Roman remains. One of the camps, that may still be traced in the neighbourhood, covers four acres. Coins, urns, vases, &c. are from time to time turned up in the vicinity. Pop. about 500.

CAERWENT, a town of England in the county of Monmouth, four miles from Chepstow. It was known to the Romans as Venta Silurum, and is situated on the Via Julia or Akeman Street. Like many unimportant towns in this part of the country, it exhibits interesting remains of the Roman occupation. Of these the most important are the ruins of the old wall, nearly 600 yards on one side and 400 on another, from 12 to 20 feet in height, and from 6 to 12 in thickness. Large numbers of Roman coins, statues, and inscriptions, are from time to time dug up in the neighbourhood. Caldecott Castle, the seat of the once powerful family of the Bohuns, is in the immediate vicinity.

CAERWYS, a borough and market-town in the hundred of Rhudd, in Flintshire, North Wales, 204 miles from London. It is situated on a rising ground, and consists chiefly

of four principal streets, which intersect each other at right angles. It is a contributary borough to Flint. Market-day Tuesday. Pop. (1851) 635. The celebrated congress of the Welsh bards used to be held in this town. The last of these meetings took place in May 1798.

CÆSALPINUS, ANDREAS, one of those great and daring geniuses who, contending with the mists of a dark age, elicit the most brilliant truths on the one hand, whilst they sometimes wander into great absurdities on the other, was born at Arezzo in Tuscany in 1519. Of his family nothing is recorded, nor does he appear to have left any progeny, or to have been ever married. Devoted to the studies of physic and natural philosophy, he attained at length the honour of being physician to Pope Clement VIII., during the chief part of whose pontificate, from 1592 till his own death in 1603, at the age of eighty-four, Cæsalpinus lived at Rome, in the highest credit and celebrity; for which, as we trace the circumstances of his history, and inquire into his opinions, it seems at first sight difficult to account. Eminent talents have seldom proved a shield against persecution. On the contrary, by adding fear to its malice, they have generally tended to exasperate its fury. How then could Cæsalpinus, a professed Aristotelian, and an open unbeliever of revealed religion, whose opinions nearly approached those of Spinosa, exist in the holy court of Rome, which was then beginning to persecute the immortal Galileo? This mystery will but too readily unravel itself.

Cæsalpinus seems to have been furnished with two distinct philosophical intellects, which, like a good and evil genius, directed him by turns. Under the influence of the one he discovered the circulation of the blood, the sexes of plants, and the only true principles of botanical classification; under the guidance of the other he became entangled in the metaphysics of the schools, the dreams of Aristotle, and a philosophic contempt for every thing, good or bad, connected with the nonsense he was obliged publicly to respect. It is scarcely necessary to remind the reader, that, however brilliant the reign of literature and taste in the golden age of Leo X. and the times which immediately succeeded, true science and experimental philosophy were as yet in the cradle. In this respect the time of Cæsalpinus was "dark as Erebus," and the light he struck out was altogether his own.

We have no account of this great man till we find him seated in the botanical chair of the University of Pisa, where also he studied, if he did not teach, anatomy and medicine. His first publication was entitled *Speculum Artis Medicæ Hypocraticum*, in which it were too much to expect he should have released himself from the shackles of his venerable guide; but he has left evident proofs, in a passage often quoted, of his having a clear idea of the circulation of the blood, at least through the lungs. In botany his inquiries were conducted on a more original plan, and their result was one of the most philosophical works in that science, which issued from the press at Florence in 1583, in one volume quarto. The title-page runs thus: *De Plantis libri XVI. Andreæ Cæsalpini Aretini, Medici clarissimi doctissimique, atque Philosophi celeberrimi ac subtilissimi;* yet he appears to have been himself the editor of the work, to which is prefixed, in his own name, an elegant and learned epistle dedicatory to Francis de' Medici, grand duke of Tuscany. This book, now rarely to be met with, is not only the unacknowledged source from which various subsequent writers, and especially Morison, derived their ideas of botanical arrangement; but it was a mine of science to which Linnæus himself gratefully avowed his obligations. His own copy evinces the great assiduity with which he studied the book. He has laboured throughout to remedy the defect of which Haller complains, of the want of synonyms; and has subjoined his own generic names to nearly every species. He has particularly indicated those remarkable passages, in pages 13 and 15, where the germination of plants and their sexual distinctions are explained. In the former we trace the first rudiments of a natural classification of plants by the differences in their cotyledons; or, in other words, we find the origin of the natural systems of Linnæus and Jussieu: in the latter passage we detect the fundamental principle of the Linnæan artificial system. Nor were these merely incidental suggestions of the illustrious author. He has pursued his inquiries to a conclusion on which the existence of botany as a science depends, and which the no less eminent Conrad Gesner detected about the same time, though his ideas respecting it were not then made public. The principle to which we allude is the classification of plants by their parts of fructification alone. This was afterwards extended, by the greatest writers on the subject, as Ray and Tournefort, and more completely by Linnæus, to the discrimination of their genera by the same parts, more particularly considered and contrasted. To this more extensive conclusion, indeed, the principle of Cæsalpinus directly and inevitably leads. He pursued it himself to such a length, as to develop some of the most important characters for generic distinctions, such as the flower being superior or inferior with respect to the fruit; the heart of the seed situated at its summit or base; the seeds, or the cells of the seed-vessels, solitary or otherwise; the partitions of certain pericarps parallel or contrary to their valves. Linnæus remarks that this author, though the first systematical botanist, found out as many natural classes, or orders, as any of his followers. He did not indeed define well the philosophical limits of genera in the vegetable kingdom, and therefore his work cannot be regularly quoted throughout for generic synonyms. The want of plates of his own, and of references to other authors, render, as we have already hinted, some of his names and descriptions unintelligible. Yet Linnæus has in manuscript filled up many blanks which he had been obliged to leave in his own *Classes Plantarum*, where the system of Cæsalpinus first assumed a synoptical form. This author might probably have adopted a more clear and methodical mode of arranging and explaining the botanical part of his subject, had he not had in view the vague and desultory manner of Pliny, whom he closely imitates in the materials of his numerous chapters, as well as in his style of description. A small and unimportant *Appendix* to this work, of nineteen pages, appeared at Rome in 1603, which is of very rare occurrence, but may be found reprinted in Boccone's *Museo di Piante Rare*, p. 125.

Cæsalpinus printed at Rome, in 1596, a quarto volume of above two hundred pages, entitled *De Metallicis*, dedicated to Pope Clement VIII. which, like his botanical publications, is now extremely rare. In the philosophy of this work Aristotle is his guide; in its method and composition, Pliny. A prefatory address to the pope declares it to have been undertaken in opposition to a certain treatise on the same subject, which, though written with diligence and elegance, contained many things inconsistent with the principles of philosophy, and subversive of the peripatetic doctrines; and with the author of which, as being excommunicated by the holy church of Rome, no measures were to be kept.

In our author's *Quæstionum Peripateticarum libri quinque*, published at Rome in 1603, it appears that he scrupled not to stand forth as an open defender of the Aristotelian philosophy, without any concealment of his own peculiar opinions and hypotheses derived from thence. By these he incurred the charge of atheism, preferred by a physician

Cæsalpinus.

named Taurel, who, punning on the name of his antagonist, entitled his book *Alpes cæsæ, hoc est, Andreæ Cæsalpini monstrosa dogmata discussa et excussa*. This attack, however, met with little or no countenance; and the learned Aristotelian died in the course of the year, receiving, no doubt, in the very focus of sanctity itself, the funeral honours due to an orthodox physician of his holiness.

Of the medical publications of Cæsalpinus, entitled *Praxis Universæ Medicinæ*, and *De Medicamentorum Facultatibus*, we have had no opportunity of forming an opinion for ourselves. By what is to be gathered from his other writings, his ideas of the medical qualities of plants and fossils seem adopted from ancient writers rather than from any considerable portion of actual experiment. Like other physicians of his time, he was too much occupied in ascertaining the articles of the *materia medica*, to find leisure for doubt, or for practical inquiry, respecting the truth of their reputed virtues. He did, however, promulgate some original ideas relative to the investigation of the properties of plants by their taste and smell. With botany he was not only theoretically but practically conversant. He left behind him a collection of above 760 dried specimens, one of the earliest upon record, which is said to have come into the hands of Micheli, and therefore is doubtless still preserved in the museum of Dr Targioni Tozzetti at Florence. A catalogue of this venerable herbarium is reported to have been prepared for the press, but we do not find that it ever appeared.

Cæsalpinus having been settled at Pisa when the great Galileo first presumed to doubt the infallibility of the Aristotelian philosophy, and, most likely, when that rising character became, at the age of twenty-six, professor of mathematics in the same university, we cannot presume him to have been free from the party-spirit which so disgracefully manifested itself there. He must have concurred in the measures which his own associates, leagued with the ruling powers, thought proper to adopt. The ancient school philosophy, derived from the Peripatetics, whether it was considered as a mere abstract speculation, or whether, as being equally absurd and unintelligible with the orthodox establishment, it did not excite alarm, was, as every body knows, allowed to go on very lovingly with that establishment; nor did it, in general, raise any more suspicion than the heathen mythology, studied and exemplified in the same and other schools. But when a spirit of truth and inquiry arose, when principles and opinions were to be submitted to the tests of reason and experiment, the same fatal results which the preceding age had witnessed in what was called religion, were justly apprehended for what was now with scarcely more propriety denominated philosophy. Hence the papal authority, which had suffered shipwreck in the one case, wanting the wisdom to avoid a similar disgrace in the other, gladly clung for support to any ally. These two celebrated occasions, the divorce of Henry VIII. and the base persecution of Galileo, are almost the only ones in which the authority of the pope has been exerted about any matter that human reason could determine, or that much signified, except to his own immediate dependents, how it might be determined. It is a memorable fact, that his decision was no less just in one case than unjust in the other; yet both proved equally ruinous, the former to his power, the latter to his credit. So hazardous is the exercise of usurped or overstrained authority, and so infallibly, thanks to the Author of all Good, do truth and justice rise, with renovated vigour, from such contests.

By this view of our subject the mystery above alluded to becomes clearly unravelled. Cæsalpinus, though a known heretic and infidel, professing to be an obedient son, and even a champion, of the church, tried to rise by the ruin of equally learned and more honest men than himself. On the side on which he was absurd and censurable, and on that side only, he was unjust and unprincipled; nor is such a character uncommon. Where he exercised his unbiassed judgment, and honestly sought for truth, he, like Galileo, enlarged the bounds of human knowledge, and made discoveries which will for ever claim the gratitude and admiration of mankind. (J. E. S.)

Cæsar.

CÆSAR, C. Julius, the illustrious Roman general and military historian, was the son of C. Julius Cæsar, who held the office of prætor, and of Aurelia, who is conjectured to have been the daughter of M. Aurelius Cotta. He was born July 12 B.C. 100, and was thus six years younger than Cicero and Pompey. His aunt had married the great Marius; and through the influence of this powerful connection, he was raised to the dignity of flamen dialis while still in his thirteenth year. Not long afterwards he married Cossutia, a lady of good family, with whom he received a large fortune; but before he had completed his seventeenth year he divorced her, and took to wife the daughter of Cornelius Cinna, one of the leaders of the popular party. This marriage drew down upon him the anger of Sulla, who ordered him to put away his young wife. Cæsar refused, and was immediately proscribed, losing at the same time his office and his fortune. Though his life was spared, it was not till after the death of Sulla that he began to take a prominent part in public affairs. He first became famous as an orator, and it is agreed that if he had confined himself solely to oratory, he would have taken rank among the best speakers of Rome. His powers of persuasion were always employed in the cause of the people, with whom he spared no effort to ingratiate himself. His popularity soon became unbounded, and from this time till his death his career was uniformly progressive. He obtained in rapid succession the highest civil and military honours that his country had to bestow; and having defeated his rival Pompey on the plains of Pharsalia B.C. 48, he remained undisputed master of the whole Roman empire. He caused himself to be chosen perpetual dictator, and had actually consented to accept the imperial crown, when he was murdered by the remnant of the republican party, who hoped by his death to restore the old constitution. He fell in the senate-house on the 15th of March B.C. 44. Cæsar wrote many works, the majority of which have been lost, but their titles, which have been preserved, are proofs of his great mental activity and varied accomplishments. The purity of his diction and the clearness of his style were acknowledged by the ancients themselves, whose testimony is amply confirmed by the *Commentarii*, which have descended to us entire. In this work is given a detailed history of the first seven years of the Gallic war, and of the first three of the civil war. The best editions of this work are those of Jungermann (with the Greek translation of Planudes), Frankf., 1606 and 1669; of Grævius, Amsterdam, 1697; of Davis, Cambridge, 1706; of Oudendorp, Leyden, 1737; and of Morus, Leipzig, 1780. The history of this illustrious man is given in detail under the head Roman History.

Cæsar, in *Roman Antiquity*, a title borne by all the emperors, from the time of Julius Cæsar till the destruction of the empire. It was also used as a title of distinction for the intended or presumptive heir of the empire; as *King of the Romans* was latterly used for that of the German empire.

This title took its rise from the surname of C. Julius Cæsar, which, by a decree of the senate, all the succeeding emperors were to bear. Under his successor, the appellation of *Augustus* being appropriated to the emperors in compliment to the prince of that name, the title *Cæsar* was given to the second person in the empire, though still it continued to be used by the first; and hence the difference between Cæsar used simply, and Cæsar with the addition of Imperator Augustus.

The title of Cæsar was allotted to the second personage of the empire, till Alexius Comnenus found it necessary, in consequence of having elected Nicephorus Melissenus Cæsar by contract, to confer some higher dignity on his own brother Isaacus. He created him Sebastocrator, with the precedency over Melissenus; ordering that in all proclamations Isaacus Sebastocrator should be named the second, and Melissenus Cæsar the third.

CÆSAR, *Sir Julius*, a learned civilian, was descended by the female line from the Dukes de' Cessarini in Italy, and was born near Tottenham in Middlesex in the year 1557. He was educated at Oxford, and afterwards studied in the university of Paris, where in the year 1581 he was created doctor of the civil law. Two years afterwards he was admitted to the same degree at Oxford, and also became doctor of the canon law. He was advanced to many honourable employments, and for the last twenty years of his life was master of the rolls. Sir Julius was remarkable for his bounty and charity to all persons of worth, so that he seemed to be the almoner-general of the nation. He died in 1639, in the seventy-ninth year of his age. It is worthy of notice that the manuscripts of this lawyer were offered by the executors of some of his descendants to a cheesemonger as waste paper; but their value having accidentally been discovered they were sold by auction in 1757 for upwards of L.500. Many of these MSS. are now in the British Museum.

CÆSAREA, two towns in Palestine. (1.) CÆSAREA PALESTINA, or CÆSAREA, the Roman metropolis of Palestine, lies 35 miles north of Joppa and 55 miles from Jerusalem. It was built about B.C. 22 by Herod, who also adorned it with many splendid buildings, among which was a temple dedicated to Cæsar, a theatre, and an amphitheatre. His most stupendous work, however, was the semicircular mole, constructed of immense blocks of stone brought from a great distance, and sunk to the depth of twenty fathoms in the sea. It protected the port on the south and west, leaving only a sufficient opening for vessels to enter from the north, so that within the inclosed space a fleet might ride at all weathers in perfect security. Its site is now marked by an extensive mass of ruins, among which may be seen those of an old castle, two aqueducts, &c. Its only inhabitants now are snakes, scorpions, lizards, wild boars, and jackals. (2.) CÆSAREA PHILIPPI lay 120 miles north of Jerusalem, and a day and a half's journey from Damascus. It was much enlarged and beautified by Philip the Tetrarch, who named it Cæsarea in honour of Tiberius the emperor, adding the cognomen of Philippi to distinguish it from the preceding. Its site is occupied by the modern Bâniâs, a paltry and insignificant village, with numerous ruins in the vicinity. There were several other places of this name.

CÆSAREAN OPERATION, the extraction of a child from the womb by a surgical operation. It is said that in this way Julius Cæsar was brought into the world.

CÆSONES, a denomination given to those cut out of their mother's wombs. Pliny ranks this as an auspicious kind of birth.

CÆSTUS, or CESTUS, in *Antiquity*, a gauntlet made of thongs of raw hide or leather, which was worn by the pugilists in the public games. The cæstus encompassed the hand, wrist, and part of the arm; and in later times it was loaded with lead or iron, in order to give greater effect to the blows.

CÆSTUS also denoted the girdle of Venus. See CESTUS.

CÆSURA (Latin *cædo*, I cut) is the name given to the division of certain of the longer kinds of verse into two parts, by causing a word in a given position to end in the middle of a foot, as in the pentameter. The term *cæsura* is also applied to a division of words at the termination of each foot, and according to its position in the line is called *triemimeral, penthemimeral, hephthemimeral,* or *ennehemimeral, i. e.* occurring at the 3d, 5th, 7th, or 9th half foot. It seldom happens that all these cæsuras are met with in the same line. In the following verse the first three of them occur—

Una sa-lus vic-tis nul-lam sper-are sa-lutem.

Though the cæsura may happen to be a short syllable, it is frequently lengthened both by the Greek and Latin poets.

CÆSURA, in modern poetry, denotes a rest or pause so introduced as to aid the recital, and render the versification more melodious. It divides a verse or line into equal or unequal parts.

CÆTERIS PARIBUS, a Latin term in frequent use among mathematical and physical writers. The words literally signify *other things being alike or equal.* Thus we say, the heavier the bullet, *cæteris paribus,* the greater the range; that is, by how much the bullet is heavier, if the length and diameter of the piece and strength of the powder be the same, by so much will the utmost range or distance of a piece of ordnance be the greater. Thus also we say, the velocity and quantity circulating in a given time through any section of an artery will, *cæteris paribus,* be according to its diameter, and nearness to or distance from the heart.

CAFFA. See KAFFA.

CAFFEINE, the stimulant principle in coffee, was discovered by Runge in 1820. He obtained it by precipitating a cold infusion of coffee by acetate of lead, and throwing down the lead by sulphuretted hydrogen. It was obtained in colourless acicular crystals. It contains 21·6 per cent. of nitrogen, a larger quantity of that gas than is yielded by any other organic compound except urea and uric acid. Caffeine is identical in composition with *theine.* See CHEMISTRY.

CAFFILA, a kind of caravan or company of merchants. It differs, however, from a caravan, at least in Persia; for the caffila properly belongs to some sovereign, or to some powerful company in Europe; whereas a caravan is a company of particular merchants, each trading upon his own account. Caffilas also cross some parts of the deserts of Africa, particularly that of Sahara.

CAFFRARIA, See AFRICA and KAFFRARIA.

CAFTAN, a Persian and Turkish vest or garment.

CAGANUS, or CACANUS, an appellation anciently given by the Huns to their kings. It appears also to have been formerly applied to the princes of Muscovy, now called *czar.* From the same root also was probably derived the Tartar title *cham* or *khan.*

CAGE, an inclosure made of wire, wicker, or the like, interwoven lattice-wise, for the confinement of birds or wild beasts. The word is French, *cage,* formed from the Italian *gaggia,* of the Latin *cavea,* which has the same signification: *a caveis theatralibus in quibus includebantur feræ.*

In the ancient amphitheatres, the fiercer animals were put in dens under ground, or in iron cages called *caveæ,* ready to be let out for sport.

In some prisons there are iron cages for the closer confinement of prisoners. History affords various instances of persons subjected for a series of years to this cruel species of confinement.

CAGLI (the ancient *Callis*), a walled town of Italy, States of the Church, in the legation and 14 miles south of Urbino, at the confluence of the Cantiana and Busso. It is the seat of a bishop, and has a cathedral with several churches and monasteries. Pop. 5000.

CAGLIARI, a province of Sardinia, embracing the extreme southern part of the island; bounded N. by Isili, N.E. by Lanusci, W. by Iglesias. Pop. (1848) 106,388.

CAGLIARI, the capital of the above province, and of the island of Sardinia, situated in the recess of the bay of Cagliari, on the southern coast of the island, in N. Lat. 39. 33. 14., E. Long. 9. 7. 48. It is built on the slope of a hill, the summit of which is crowned by a noble castle, containing the vice-regal palace, the cathedral, the university, and public seminaries. The intermediate slope between the bay and the district of the castle is occupied by the Marina, a well-built

quarter, where the merchants and consuls reside. Lining the coast are the warehouses, the lazaretto, and the mole. To the west of the castle stands the district of Stampace, to the east that of Villanova,—both consisting of narrow, irregular, and ill-paved streets,—while outside is the spacious suburb of St Avandres, nearly a mile in length. The principal public buildings are those in the castle, including the cathedral already mentioned, built by the Pisans during their occupation of the island, with a handsome front mostly of marble; the vice-regal palace; the mausoleum of Martin, king of Sicily; and the citadel on the northern side, surmounted by three square Pisan towers. The educational and literary establishments of Cagliari include the university (with the four faculties of theology, law, medicine, and philosophy, and enrolling from 200 to 300 students), a private college for the nobility, museums of antiquities and natural history, and a public library containing 15,000 vols. Besides the cathedral, Cagliari contains about 30 churches and 21 convents, to one of which is attached a handsome chapel. It is the see of an archbishop, and the seat of the cortes or states-general for the whole island, and of the audienza or judicial court for the southern division. The bay of Cagliari contributes greatly to its commercial importance. It is formed by the projection of Cape Carbonara on the one side and Pula on the other; having an extreme width of 24 miles, and a depth of 12. The harbour at the south angle of the wall of the Marina quarter, inclosed by a projecting pier, is one of the best and safest in the Mediterranean, being well sheltered from every wind except the south. Cagliari is the chief port of Sardinia, and monopolizes almost all the export trade of the island. The exports consist chiefly of the corn, oil, wine, and manufactures of the country. The principal articles of manufacture are tobacco (which is a royal monopoly), cotton fabrics, soap, chairs, and salt; the last article being procured from numerous salterns in the bay of Cagliari and the neighbourhood.

From the elevation of its site the climate of Cagliari is healthy, notwithstanding its immediate proximity to a stagnant swamp six or seven miles in length. Pop. nearly 28,000.

The modern city stands on the site of the ancient Carales, or Caralis, which was founded by the Carthaginians, but passed into the hands of the Romans after the first Punic war. In the civil wars between Cæsar and Pompey, and during the empire, it was regarded as an important naval station, but was never raised to the status of a Roman colony. After the fall of the Western Empire it continued under the Vandals to be the capital of the island, and retained its importance during the middle ages. The site of the ancient city is still marked by the remains of a large aqueduct, a circular temple, and numerous Roman sepulchres.

Cagliari, *Paolo*, called *Veronese*, a distinguished painter, born at Verona in 1532. His father Gabriele Cagliari, who was a sculptor, perceiving his son's extraordinary predilection for painting, placed him with his uncle Badile, then one of the most eminent artists at Verona. Here he rapidly distinguished himself; and while still a mere youth, was employed by Cardinal Ercole Gonzaga to paint an altarpiece for the cathedral of Mantua. Proceeding afterwards to Venice, he was engaged to paint the ceiling of the church of St Sebastian in that city, and produced his celebrated work, the story of Esther, which at once established his fame. In conjunction with Tintoret, F. Bassano, and Battista Franco, he was employed to execute some works for the senate, and bore away the palm of victory,—an honour that was enhanced by the circumstance that Titian and Sansovino were the judges. He visited Rome in the suit of Grimani the Venetian ambassador; and while there he made the works of Michael Angelo and Raphael the especial objects of his study. Yet it must be observed that Paul Veronese was guided solely by the impulses of his own genius and vivid imagination, which delighted in gorgeous effect and magnificence of costume, even where such accessories were out of place,—a peculiarity that is manifest in his great picture of the Marriage at Cana, in which the guests are represented in the rich attire of the luxurious Venetian nobility of his time. He was esteemed the greatest of the Lombard school, and was not inappropriately styled *Il pittore felice.* At Venice the specimens of this great master are very numerous. His principal works are the following: *The Marriage at Cana* (in which he has introduced at least 150 heads), now in the Louvre; *The Feast of Simon*, with Mary Magdalene washing our Saviour's feet,—painted for the church of St Sebastian; *Christ at Table with his Disciples*, —painted for the church of SS. Giovanni e Paolo; *The Feast of Simon*, differently painted from that above mentioned,—presented by the republic, in 1665, to Louis XIV.

This great painter died at Venice in 1588; and a statue of brass was erected to his memory in the church of St Sebastian. (See Lanzi, *Storia Pittorini.*)

CAGLIOSTRO, Alessandro, *Count*, the arch-impostor of modern times, was born at Palermo in 1743. Joseph Balsamo—for such was the count's real name—gave early indications of those talents which afterwards gained for him so wide a notoriety. He received the rudiments of his education at the convent of Cartagirone; where, being employed to read to the monks during dinner, he scandalized the good fathers by repeating the names and detailing the adventures of the most notoriously profligate females of his native town. For these and similar misdeeds he was expelled from the convent and disowned by his relations. He now signalized himself by the ingenuity with which he contrived to perpetrate his crimes without exposing himself to the risk of detection. He began by forging tickets for the theatres, then he forged a will; he next robbed his own uncle, and ultimately committed a murder. For this latter offence he was imprisoned and brought to trial, but through a defect in the evidence escaped with his life. On his release he engaged a goldsmith, by name Marano, to assist him in searching for a hidden treasure; the said Marano paying 60 ounces of gold in advance to defray expenses. On arriving at the cave, where Joseph declared the treasure to be, six devils prepared beforehand rushed out upon the goldsmith, beat him soundly, and left him insensible. Dreading the vengeance of Marano, Balsamo quitted Sicily, and visited in succession Greece, Egypt, Arabia, Persia, Rhodes (where he took lessons in alchemy and the cognate sciences from the Greek Althotas), Malta, Naples, Rome, and Venice. At Rome he married a beautiful but unprincipled woman, with whom he travelled under a variety of names through the various countries of Europe. It is unnecessary to recount the various infamous means which he employed to support himself during his travels. At Strasbourg he reaped an abundant harvest by professing the art of making old people young; in which pretension he was seconded by his wife, who, though only twenty years of age, declared that she was sixty, and that she had a son a veteran in the Dutch service. In Paris he was implicated in the affair of the diamond necklace; and though he escaped conviction by the matchless impudence of his defence, he was imprisoned for other reasons in the Bastile. On his liberation he visited England, where he succeeded well at first, but was ultimately overreached by some English lawyers, and confined for a while in the Fleet. He then left the ungrateful country, and travelled through Europe till he arrived at Rome, where he was arrested in 1789. He was tried and condemned to death for being a freemason, but the sentence was afterwards commuted to perpetual imprisonment. He died in the fortress-prison of San Leo in 1795. For a detailed account of the life, adventures, and character of Joseph Balsamo, see Carlyle's *Miscellanies*, and Dumas' *Memoirs of a Physician.*

CAHER, or Cahir, a market-town in Tipperary, Ireland, on the river Suir, 96 miles S.S.W. from Dublin. It

contains a handsome parish church, a Roman Catholic chapel, and a meeting-house of the Society of Friends. There is also a market-house, a fever hospital, several public schools, a police-station house, and large cavalry barracks. In the neighbourhood, on an island on the Suir, is Cahir Castle, the residence of the Earl of Glengall. The trade of the town arises chiefly from the flour-mills in the neighbourhood, although repeated attempts have been made to introduce the manufacture of linen and straw-plait. There is a weekly corn-market in Cahir, and fairs are held seven times a-year. Pop. (1851) 3719.

CAHORS, a town in the south of France, capital of the department of the Lot, on the high road between Paris and Toulouse, 358 miles S.W. from Paris, and 60 miles north of Toulouse. N. Lat. 44. 27., E. Long. 1. 24. It stands on the right bank of the river Lot, on a rocky peninsula formed by a bend in the stream, and communicates with the opposite shore by three bridges; one, which is the Pont Valendré, built in the thirteenth century, and surmounted by three massive towers. In the more ancient part of the town the streets are narrow and the houses antique; but in the modern and more elevated quarter there are many handsome buildings, with terraces which command an extensive view. The most remarkable building is the cathedral, occupying the site, if not actually consisting of the remains, of an ancient Roman temple, with recent additions in the Gothic and Byzantine styles. Besides it, there is the theological seminary; the hotel of the prefecture, formerly an episcopal palace; a theatre, a public library, and a monument erected to Fenelon in front of the university, of which he was a student. Cahors is the see of a bishop, and the seat of judicial and commercial tribunals of the first class. Its educational establishments comprise a royal college, a diocesan seminary, and a primary school. The principal articles of manufacture are stoneware, cotton-yarn, woollen stuffs, and paper; and it has a considerable traffic in oil, hemp, flax, hides, truffles, and a strong deeply-coloured wine which is made in the neighbouring districts. Pop. (1851) 12,103. The population of the arrondissement of the same name in 1851 was 118,515.

Cahors is the ancient Divona, afterwards called Civitas Cadurcorum from the Celtic tribe whose capital it was, and still exhibits traces of its greatness during the Roman sway. The most conspicuous remains are those of an immense aqueduct, which conveyed the water to the city from a distance of about 19 miles by a precipitous route along the mountain-sides, and crossed the valley of Larroque-des-arcs on a bridge 180 feet high. There are also remains of baths, a theatre, a marble altar, erected, according to the inscription, in honour of Lucterius Leo, and a celebrated fountain supposed to be the fountain Divona (the fountain of the goddess), and now called Des Chartreux, from the Carthusian convent to which it has been attached.

CAIAPHAS, high priest of the Jews, was the successor of Simon. He condemned our Saviour to death. What became of Caiaphas after he was deposed (A.D. 38), is not known.

CAILLE, Nicolas Louis de la, a celebrated French astronomer, born at Rumigny in the department of Aisne, March 15, 1713. His father was a gentleman in easy circumstances, who devoted the greater part of his time to the study of philosophy and natural science, and early succeeded in inspiring his son with similar tastes. On the death of this parent the young La Caille found himself entirely destitute. He was soon enabled, however, to resume his studies by the generous interposition of the Duke of Bourbon. His first intention was to enter the church, but he speedily abandoned his theological studies, and devoted himself to the physical sciences, especially astronomy. On his arrival at Paris he was cordially welcomed by Cassini, who gave him an apartment in the observatory. He here gained the friendship of Maraldi, whom he helped to take the bearings of the French coast from Nantes to Bayonne. Such was the ability he displayed on this occasion, that he was employed to assist in the verification of the French meridian. This gave him an opportunity of correcting the measurements of Picard, taken in 1669. While absent on this mission, he was appointed professor of mathematics in the Mazarin college. His calculations completed, he proved by a comparison of the different arcs which he had measured that degrees go on increasing from the equator to the pole; a proposition familiar to every one now, but at that time directly opposed to the results of previous researches. After taking possession of his professorial chair he published successively *Leçons élémentaires de Mathématiques*, 1741; *Leçons de Mécanique*, 1743; *Leçons d'Astronomie*, 1746, re-edited by Lalande in 1780; *Eléments d'Optique*, 1750. He also calculated the eclipses for 1800 years for the first edition of the work entitled *L'art de vérifier les dates*.

Being curious to determine and verify the stars of the southern hemisphere, he undertook a voyage to the Cape of Good Hope, where in 127 nights he calculated the positions of 10,000 stars, with a quickness and correctness, says Delambre, that would have been deemed impossible, considering the deficient means at his disposal. He likewise determined at the Cape the parallax of the moon, and of the planets Mars and Venus, and measured a degree of the southern hemisphere. While engaged in these duties, he received orders from the French government to survey the islands of Bourbon and Mauritius, and determine their positions. During these various voyages he devoted much of his time to the problem of longitudes, on which subject he had a controversy with the German Euler on his return to Paris in 1754. To escape the public curiosity, he shut himself up in his observatory, dividing his time between his calculations and his duties of professor and academician. In 1757 he published his *Astronomiæ fundamenta*, and in the following year his *Tables Solaires*. He soon after published the *Traité de la gradation de la lumière*, of which Bouguer had bequeathed him the manuscript at his death, and brought out a new edition of the *Traité de la Navigation* by the same author. In the midst of his multifarious labours, he was surprised by a violent attack of the gout. Feeling his illness increase, and that he had no prospect of recovery, he gave back all the instruments that he had borrowed from his friends, and died March 21, 1762, leaving his MSS. to Maraldi, who published the *Cœlum Australe Stelliferum* in the year after the author's death. It was said of La Caille by Lalande, that he made more observations and calculations than all the astronomers of his time put together.

CAIMACAN, or Kaimacam, a dignity in the Ottoman empire, answering to lieutenant, or rather deputy, amongst us. There are usually two caimacans, one residing at Constantinople as the governor; the other attending the grand vizir in quality of lieutenant; and sometimes there is a third caimacan. Among the Tartars of the Crimea, the caimacan acts as the deputy of the khan during his absence.

CAIN, eldest son of Adam and Eve, killed his brother Abel, for which he was condemned by God to banishment and a vagabond state of life. Cain retired to the land of Nod on the east of Eden, and built a city, to which he gave the name of his son Enoch.

CAINITES, a sect of heretics in the second century, so called from their respect for Cain. They pretended that the virtue which produced Abel was of an order inferior to that which had produced Cain, and that this was the reason why Cain overcame Abel; for they admitted a great number of genii, or virtues, of different ranks and orders. They honoured those who carry in Scripture the most visible marks of reprobation, as Esau, Korah, Dathan, Abiram, and the inhabitants of Sodom. They particularly venerated the traitor Judas, on the ground that the death of Christ had saved mankind. They had also a forged gospel of Judas.

CAIRN, (in Welsh *Carne*), the name given to those ancient heaps of stones found in Scotland and Wales, generally of a conical form, and surmounted by a flat stone. They appear to have been used as sepulchral monuments, to commemorate great events, and perhaps also in connection with religious rites. See BARROW.

CAIRNGORM. See ABERDEENSHIRE.

CAIRNGORM, a yellow or brown variety of rock-crystal or crystallized silica, from the mountain Cairngorm in Scotland.

CAIRO, the modern capital of Egypt, occupies the natural centre of the country, situate on the east bank of the Nile, 12 miles above the apex of its delta, 112 miles S.E. of Alexandria, and 75 miles west from Suez. N. Lat. 30. 2. 4.; E. Long. 31. 15. 36. It is built partly on the plain and partly on the lower slopes of the rocky range of Mokattem, on a spur of which stands the citadel, in a most advantageous position to command the town.

Cairo occupies a site of about 7 miles in circumference, and is surrounded by a wall strongly built and fortified with lofty towers. The prospect from the ramparts of the citadel is one of great magnificence and beauty. Below lies the city, its gardens, squares, palaces, and mosques, in all the beauty of their delicately carved domes, and minarets covered with fantastic tracery,—the port of Bulâk,—the gardens and palace of Shubra,—the broad river studded with islands,—the valley of the Nile dotted with groups of trees,—with the pyramids on the north horizon,—the fields, gardens, and villas on the west,—and on the east the barren cliffs, backed by an ocean of sand. The interior of the city, however, is far from presenting so pleasant an aspect. It is little better than a labyrinth of tortuous lanes, narrow, unpaved, and continually swept with clouds of dust blown from huge mounds of rubbish outside the walls. The most of the houses of the poorer classes consist of miserable mud hovels, with filthy courts, dilapidated windows, and tattered awnings. In marked contrast to these are the houses of the wealthier citizens, built generally in a style of elaborate arabesque, the windows shaded with projecting cornices of graceful woodwork, and ornamented with stained glass. A winding passage leads through the ornamented doorway into the court, in the centre of which is a fountain shaded with palm-trees. The principal apartment is generally paved with marble; in the centre a decorated lantern is suspended over a fountain, whilst round the sides are richly inlaid cabinets, and windows of stained glass; and in a recess is the *divan*, a low narrow cushioned seat running round the walls. The basement story is generally built of the soft calcareous stone of the neighbouring hills, and the upper story, which contains the harem, of painted brick. The town is walled off into quarters, deriving their names from the character or condition of their occupants, and is intersected in its whole breadth by a canal which conveys the waters of the Nile from Old Cairo to the different parts of the city. The most prominent object in Cairo is the citadel, standing on an eminence 250 feet above the level of the town. It contains the pasha's palace, a mosque of oriental alabaster built on the site of Joseph's Hall, and the pasha's harem. In the centre is a famous well called Joseph's well, sunk in the solid rock to the level of the Nile—a work generally attributed to Saladin. The citadel also contains an arsenal, a cannon foundry, and a manufactory of fire-arms. Next to the citadel in importance are the mosques, 400 in number, including, however, many that are falling to ruins. The most magnificent is the mosque of Sultan Hasan, standing in the immediate vicinity to the fort, celebrated for the grandeur of its porch and cornice, and the delicate honeycomb tracery which adorns them. Besides it there is the mosque of Tulun (founded A.D. 879), exhibiting very ancient specimens of the pointed arch; the mosque of Sultan el Hakem, the fanatical patron of the Druzes, founded A.D. 1003; the mosque of Ezher, the seat of the Mohammedan college where gratuitous instruction is given in the Koran, and where a number of blind paupers find a secure asylum. Attached to the mosque of Sultan Kalaoon is the Morostan or asylum for the insane. But the highest style of architectural magnificence is to be seen in the tombs, which are mostly outside the walls. On the east are what are known to Europeans as the tombs of the caliphs, although the graves of the Abbasides and Ommiades are not to be found in Egypt. They are the tombs of the Circassian or Borgite mamelukes—a race extinguished by Mehemet Ali. Their lofty gilt domes and fanciful network of arabesque tracery are fast falling to ruins, and the mosques attached to them are the haunts of a few solitary sheikhs, and of hordes of Arab beggars.

The gates of Cairo are built in the prevailing Saracenic style, round-headed, with cornices and towers. The principal square in the city is the Uzbekeeh, once covered by the Nile, but now drained and planted. Emerging from this square we come to Bulâk, the port of Cairo, formerly an island, but now joined to the bank of the river. In it are several of the pasha's factories for spinning, weaving, dyeing and printing cotton, for casting and making arms. Here too is the government printing-press established by the late pasha, from which there have issued many oriental and numerous translations of French scientific works.

Three miles south of Cairo stands the Coptic village Musr el Ateekeh, originally called Fostat, or Old Cairo. It occupies part of the site of the ancient Egyptian Babylon, and still gives indications, from the style of its masonry and the character of its ruins, of having been a Roman station. It contains the celebrated depot called Joseph's granary, still used as a storehouse for the troops, and the mosque of Amer. Opposite it is the beautiful island of Rhoda and the Nilometer. Four miles north of Bulâk, and about the same distance from Cairo, stands the palace of Shubra, a pile of low narrow buildings, deeply imbedded in groups of walnut, orange, and cypress trees.

Except public buildings there is very little worthy of special notice in Cairo. The scheme of public instruction here, as in Alexandria, is that which was organized by the late pasha, and embraces primary, preparatory, and polytechnic schools. During the lifetime of Mehemet Ali, their founder, there were no fewer than 800 pupils attending the four primary and 1500 attending the two preparatory schools of Cairo; but as this result was obtained partly by compulsion and partly by bribery, it remains to be seen whether or not from the violence of the effort it will not be followed by a powerful reaction.

The commerce of Cairo, although still depressed, is considerable. Being the rendezvous of one of the great caravans to Mecca, it is still the centre in which the slaves, gum, and gold-dust of the interior, and the oils and flannels of the north of Africa, with the European merchandise from Alexandria, are exchanged for the coffee, perfumes, spices, and shawls of Arabia and India. As the residence of the learned and wealthy of Egypt, it affords a market for the agricultural produce of the surrounding districts; and in addition to the making of arms already alluded to, it contains manufactories of sal-ammoniac, saltpetre, coarse gunpowder, glass lamps, and linen cloths.

From the central situation of Cairo, and its proximity to the hot sandy deserts, its temperature is much higher than near the coast; but the diseases which infest it, such as the plague, ophthalmia, and malignant fevers, seem to originate in its "stifled filth," and other local causes which advancing civilization will greatly remove, rather than in the unhealthiness of its situation. Pop. estimated at about 200,000, comprising about 121,000 Mohammedans, 60,000 Copts, 4000 Jews, and the rest Franks, Greeks, and Armenians.

Cairo is said to have been founded by El-Moez, the first of the Fatemite rulers of Egypt, about A.D. 969. It was partly burnt in 1171 by the Saracens, to check the progress of the invaders, but was rebuilt by Saladin, and shared the fortunes of the various Egyptian dynasties, till it fell into the hands of the Turkish Selim I. in 1517. It was nearly destroyed by an earthquake in 1754. It was taken by the French in 1798, but retaken by the British in 1801.

CAISSON (from the French *caisse*, a chest), in the military art, a wooden chest, into which several bombs are put, and sometimes gunpowder only. This is buried under some work of which the enemy intend to possess themselves, and fired when they have got possession.

CAISSON also denotes a wooden frame or chest used in laying the foundations of the piers of a bridge.

CAISTOR, a market-town and parish in Lincolnshire, 20 miles N.N.E. of Lincoln, and 153 miles from London, It was called by the Saxons *Thong-Castor*, because, it is said, Hengist, after defeating the Scots, obtained from Voltigern as much land as could be inclosed by an ox-hide cut into thongs. It has a grammar-school, with an exhibition at Jesus College, Cambridge. Market-day Saturday. Pop. of parish (1851) 2407.

CAITHNESS, the most northern county of the Scottish mainland, bounded west and south by Sutherlandshire, east and north by the Northern Ocean, situated between Lat. 58. 5. and 58. 40. N., Long. 3. 0. and 3. 55. W.; extreme length 53 miles; extreme breadth 33 miles; extent of coast 105 miles; area 455,708 acres, or 712 square miles, about two-thirds of which is moorland. The form of Caithness nearly resembles an irregular triangle, having as its greatest side the line of coast on the S.E., stretching from the Ord of Caithness to Duncansby Head. The surface of the county generally is flat and tame, consisting for the most part of barren moors, and almost entirely destitute of trees. It presents a gradual slope from the north and east upwards to the ridge of hills on the west and south, which separates it from Sutherlandshire, and which on the southern boundary, where it is bifurcated, attains considerable elevation. The one branch called the Maiden Paps contains the peak of Morven, 2334 above the level of the sea; the other, continuing in the line of the main ridge, juts into the sea, and terminates in the huge granitic precipice called the Ord of Caithness. In the centre of the county, hemmed in by the hills on the western boundary, the ridge of the Maiden Paps, and the sea, is a large undulating plain comprising nearly four-fifths of its whole extent. On its southern side it is broken up by several detached hills, and in the interior contains a considerable number of small lakes. The most depressed part of the county lies in the peninsula, formed in the N.E. corner by the indentation of Dunnet bay and Sinclair bay. The more elevated portion presents a light sandy soil which admits of considerable cultivation, but the low grounds are covered with extensive morasses, producing only heath and rough grass. The geological formation consists chiefly of sandstone, sandstone flag, and occasionally limestone; but granite and gneiss are also found in the west. On the east Caithness presents a precipitous coast, with scarcely a creek in which a vessel, even of small size, can find shelter. On the northern coast, where the Pentland Firth separates it from the Orkney islands, stand at the distance of 13 miles from each other the two bold headlands of Duncansby Head, flanked by two insular "stalks" of freestone, on the N.E. (Lat. 59. 39. N., Long. 30. 1. W.), and Dunnet Head on the N.W. (Lat. 58. 40. N., Long. 3. 21. W.), the most northern point of Scotland. The one is marked by the white steeple of Cannisby on the west, the other by a lighthouse on the rock 346 feet above the level of the sea. The navigation of the Pentland Firth is attended with considerable dangers, from the strength and eddies of the current—the eastern branch of the great Atlantic stream. Off the island of Stroma, which is separated from the Mainland by a strait three miles broad, is a small vortex called the Swalchie, while closer inshore are the "Merry Men of Mey," a group of breakers caused by eddies between projecting headlands. On the east coast, in addition to the harbour of Wick, erected in 1831, at a cost of above L.40,000, there is a small harbour to the south at Sarclet, and another to the north at Staxigoe, a small pier at Clyth and another at Lybster. On the northern coast, Scrabster roads in Thurso bay affords tolerably good anchorage, while at Thurso and Sandside bay are commodious harbours for larger vessels. The climate of Caithness is variable, but not unhealthy; and though the winter storms fall with great severity on the unsheltered coast, yet, from its proximity to a large expanse of sea, the cold is not intense, and snow seldom lies many days continuously. In winter and spring the northern shore is subject to frequent disastrous gales from the N. and N.W. The waters of Reay, Thurso, and Wick, are the principal streams which traverse it, but none of them are of any particular importance. The largest lochs are those of Wattin and Cathel, but there are numerous small ones well stocked with trout. A great change has taken place within the last few years in the agricultural position of Caithness, in consequence of the improved mode of cultivation introduced chiefly by the late James Traill, Esq. of Ratter. That part of the agricultural district which stretches along the coast is still mostly in the hands of small farmers, who cultivate the soil only during the intervals of the fishing-season; but inland, in the more elevated districts, and along the banks of the principal streams, the land is let out into large farms with leases long enough to encourage the holder to improve the soil, and practise a rotation of crops. In the pasturage ground black cattle and sheep, chiefly of the Leicester and Cheviot breeds, are reared for the southern markets; and, independently of the weekly corn-markets at Thurso and Wick, the rapidity of communication with the south is opening up a valuable market for the produce of the dairy and farm yard. The principal crops raised are oats, beans, potatoes, turnips, and a little flax; wheat can be grown only where draining has been carried to considerable perfection.

But the great source of profit to the inhabitants is to be found in the fisheries of cod, ling, lobsters, and herring, which abound all around the coast. The most important is the herring-fishery, beginning about the end of July and lasting for about six weeks, the centre of operations being at Wick and the surrounding districts. The number of fishermen employed in 1853 was 4651; the value of boats, nets, lines, &c., for the same year, was estimated at L.72,203, and the number of barrels of herrings caught was 231,429.[1] Besides these more immediately engaged in manning the boats, the fisheries give employment to a large number of coopers, curers, packers, and others, making in 1853 a total of 9600 persons employed. The salmon-fisheries on the coast and at the mouths of rivers were formerly very productive, and are still let at high prices. Scattered along the coast are valuable quarries of freestone, slate, and of excellent flag for pavements. The county of Caithness is far from rich in other minerals. Slight indications of lead and iron, and it is said of copper, have been found in the mountainous districts; and indications of coal, or rather of bituminous shale, have been noticed at Canisbay. The early history of Caithness may, to some extent, be traced in the various character of the remains and the diversity of its local nomenclature. Picts' houses, Norwegian names, and Danish mounds, attest that the Celts were successively displaced by

[1] Since 1809, according to the Fishery-Board returns, the number of barrels caught has risen from 20,656, to 231,429.

Caius.

these different tribes; and the numbe and strength of its fortified keeps leave us to infer that its annals present the usual record of feuds, assaults, and reprisals. Circles of erect stones, as at Steinster Loch and Bower, the ruins of Popish chapels and places of pilgrimage in almost every district, illustrate the changes which have come over its ecclesiastical condition. The most important remains are those of Bucholie Castle, Girnigoe Castle, and the tower of Keiss; and on the S.E. coast the castles of Clyth, Swiney, Forse, Latheron, Knockinnan, Dunbeath, Achastle, and Berridale. About six miles from Thurso stand the ruins of Braal Castle, the residence of the ancient bishops of Caithness. The principal gentlemen's seats in Caithness are Barrowgill Castle, the residence of the Earl of Caithness; Watten Castle, the residence of Sir R. A. Anstruther, Bart.; Akergill Castle, the residence of Sir George Dunbar, Bart.; Thurso Castle, the residence of Sir George Sinclair, Bart., Castlehill, the residence of George Traill, Esq., M.P. &c.

Caithness is divided into 13 parishes, and contains 13 churches belonging to the Establishment (in 4 of which there is service in Gaelic); 16 belonging to the Free Church (in 8 of which there is service in Gaelic); 1 United Presbyterian, and 1 Roman Catholic.

The county returns one member to the imperial parliament. The parliamentary constituency in 1853 was 683. The principal towns are Wick and Thurso; the most important villages are Broadhaven, Castletown, Louisburgh, Sarclet, and Staxigoe. Pop. (1831) 34,529, (1841) 36,343, (1851) 38,709. Annual value of property assessed (1849) L.71,441.

CAIUS, Kaye, or Keye, Dr John, the founder of Caius College in Cambridge, was born at Norwich in 1510. He was admitted while very young a student in Gonville Hall in the above-mentioned university. From his exercises performed there it seems probable that he intended to prosecute the study of divinity. He travelled into Italy, and at Padua studied under the celebrated Montanus; and in 1541 took his degree in physic at Bologna. In 1543 he visited several parts of Italy, Germany, and France; and returning to England, he began to practise first at Cambridge, then at Shrewsbury, and afterwards at Norwich. He removed to London in 1547, and was admitted fellow of the college of physicians, of which he was several years president. In 1557, being then physician to Queen Mary, he obtained a license to advance Gonville Hall into a college, and he endowed it with several considerable estates, adding an entire new square at the expense of L.1834. Of this college he accepted the mastership, which he held till within a short period of his death. He was physician to Edward VI., Queen Mary, and Queen Elizabeth. Towards the latter end of his life he retired to his own college at Cambridge, where having resigned the mastership to Dr Leggie of Norwich, he spent the remainder of his life as a fellow commoner. He died in July 1573, and was buried in the chapel of his own college. Dr Caius was a learned, active, and benevolent man. In 1557 he erected a monument in St Paul's to the memory of Linacre. In 1563 he obtained a grant for the college of physicians to take the bodies of two malefactors annually for dissection; and he was the inventor of the *insignia* which distinguish the president from the rest of the fellows.

He wrote, 1. Annals of the College from 1555 to 1572. 2. Translation of several of Galen's works, printed at different times abroad. 3. *Hippocrates de Medicamentis;* first discovered and published by Dr Caius; also *De Ratione Victus*, Lov. 1556, 8vo. 4. *De Medendi Methodo*, Basle, 1554; Lond. 1556, 8vo. 5. Account of the Sweating Sickness in England, Lond. 1556, 1721. It is entitled *De Ephemera Britannica.* 6. History of the University of Cambridge, Lond. 1568, 8vo; 1574, 4to, in Latin. 7. *De Thermis Britannicis;* but it is doubtful whether this work was ever printed. 8. Of some Rare Plants and Animals, Lond. 1570. 9. *De Canibus Britannicis*, 1570, 1729. 10. *De Pronunciatione Græcæ et Latinæ Linguæ*, Lond. 1574. 11. *De Libris propriis*, Lond. 1570. Besides many other works which never were printed.

Cajazzo || Calabria.

CAJAZZO, a city of Italy, province of Terra di Lavoro, in the kingdom of Naples, near the Volturno. It has a cathedral, several other churches, and 3500 inhabitants. Excellent wine is produced in the vicinity.

CAJEPUT, a volatile oil obtained by distillation from a species of Melaleuca, which has obtained the name of *melaleuca cajeputi;* cajeputi being its Malay name. This tree, or rather shrub, is a native of the island of Amboyna, and of the southern part of Borneo. Cajeput oil is prepared from the leaves which are collected in a hot dry day, macerated in water, and distilled after fermenting for a night. When distilled it is limpid; but being generally transported to Europe in copper flasks it acquires a greenish colour. When imported in glass bottles, it is perfectly pellucid. It is frequently adulterated. It should be free from colour, or of a bluish-green. This oil is extremely pungent to the taste, and has the odour of a mixture of turpentine and camphor. When dropped in water, it diffuses itself over the surface, and then entirely evaporates. It should burn without leaving any residuum. It is very soluble in alcohol, and sparingly so in water. Like other volatile oils, the cajeput is a powerful stimulant, and is used medicinally where such medicines are required. Some practitioners have given it a high character as a remedy for cholera; but it does not appear to have any claim as a specific in the treatment of that disease. The dose taken internally is about five drops. It is used externally as a rubefacient, and is also resorted to occasionally with advantage in toothache.

CAJETAN, Cardinal, was born at Cajeta in the kingdom of Naples in 1469. His proper name was Thomas de Vio, but he adopted that of Cajetan from the place of his nativity. For his zeal in defending the papal pretensions, in a work entitled *Of the Power of the Pope*, he obtained the bishopric of Cajeta. He was afterwards raised to the archiepiscopal see of Palermo, and in 1517 was made a cardinal by Leo X. The year following he went as legate into Germany, to quiet the commotions raised by Luther against indulgences; but that reformer, under protection of Frederick elector of Saxony, set him at defiance; for though he obeyed the cardinal's summons in repairing to Augsburg, yet he rendered all his proceedings ineffectual. Cajetan was employed in several other negotiations and transactions, being as able in business as in letters. He died in 1534. He wrote commentaries upon Aristotle's philosophy, and upon Thomas Aquinas's theology; and made a free translation of the Old and New Testaments, excepting Solomon's Song and the Prophets, and the Revelation of St John.

CAKE (German *kuchen*), a small mass of dough baked; or a composition of flower, butter, sugar, or other ingredients, baked in a small flattened mass.

CALABAR, Old, a river of Upper Guinea, Africa, which falls into the bight of Biafra by a wide estuary, in Lat. 5. N., Long. 8. 20. E. The Cross river, which was formerly considered a branch of the Calabar, was discovered by Captain Becroft in 1841–2 to be the main stream. See an account of this expedition in the London Geographical Society's Journal, vol. xiv.

Calabar, *New*, a branch of the Quorra river, flowing S.E. and entering the bight of Benin by the same estuary with the Bonny.

CALABASH (Spanish *calabaza*), in *Commerce*, a kind of vessel formed of a dried gourd-shell, or of a calabash shell, used for containing liquors or goods, as pitch, rosin, and the like. Calabash is also a popular name of the *cucurbita* or gourd plant.

CALABRIA, one of the four provinces into which the continental part of the kingdom of Naples, or of the Two Sicilies, was formerly divided, but now the name given to 3 out of the 15 provinces of the later division of that country. It is the most southern part of Italy, being bounded

north by the province of Basilicata, and surrounded east, west, and south by the Mediterranean. It has an area of 6879 square miles, extending from Cape Spartivento (N. Lat. 37. 56.), to Monte Pollino on the southern border of Basilicata (N. Lat. 40. 0.) The coast line, more than 1500 miles in length, is extremely irregular, and indented with numerous bays; but the mouths of the rivers are rendered inaccessible to all but the smallest craft, by the continual accumulation of silt and the smallness of the tides.

The territory is exceedingly rugged and mountainous, but the summits of the hills are covered with extensive forests of oak, beech, elm, and pine, and towards the coast the branches of the Apennines open up into fertile and well-watered valleys. The Apennines traverse its whole extent, entering the province on the north in a direction S.E. to N.W., but afterwards changing their course into S.W. to N.E.; and including the eastern offshoot which occupies the central district of La Sila, they cover nearly the whole breadth of the peninsula. The elevation of the hills is not so great as in the northern, although greater than those in the central provinces; the most prominent peaks are Monte Sila, in Calabria Citra, 4632 feet, and Monte Aspromonte in Calabria Ultra II. 4110 feet. From the main range numerous small branches run off both to the eastern and western shores. The province is well watered with numerous streams, which in the north and south have a short and rapid course and are easily flooded, but in the central district are longer. On the approach of the unhealthy season, the wealthier inhabitants migrate annually to the lofty table-land of La Sila, where their flocks are fattened in the extensive pastures. The agriculture of Calabria, as that of Naples generally, is in a very rude and barbarous condition, a circumstance which is partly attributable to the extreme fertility of the soil. The principal productions are corn, wine, raw silk, oil of an inferior quality, cotton, manna from the manna-ash, rice, liquorice, and saffron. The horses of Calabria are remarkable for their high spirit and compact form, but their numbers are rapidly diminishing, and they are gradually being supplanted by mules. The other stock consists of sheep, goats, oxen, buffaloes, and pigs. All round the coast are considerable fisheries of the tunny, the sword-fish, the anchovy, and mullet.

The inhabitants of Calabria are a brave, hardy, well-built race, but ignorant and half-civilized. Education is chiefly in the hands of priests, who, as a class, are notoriously ignorant. From the oppressive nature of the excise regulations, the lower classes are greatly addicted to smuggling.

The three provinces into which Calabria is now divided are Calabria Citeriore, Calabria Ulteriore Seconda, and Calabria Ulteriore Prima, being so called from their position relative to Naples, and each of them stretching across the peninsula from sea to sea.

Calabria Citeriore is the most northern of the three provinces, and has an area of 2613 square miles, with a population in 1851 of 435,811. The most elevated parts of this province are in the southern and central districts, which are covered by the vast forests of La Sila, and furnished timber for the navies of antiquity. On account of the wastefulness and improvidence of the government, the forests of the Neapolitan Apennines are gradually becoming less productive; and not only is a large amount of timber destroyed, but the decayed vegetable matter has been allowed to dry up the springs and obstruct the mountain streams so as to cover the table-land with pestilential marshes. Corigliano, in the Adriatic, is the principal depot for the timber felled in the province; it is also the principal seat of the manna trade and liquorice factories. The principal rivers are the Crati, which rises near the high-road on the south of Cosenza, and after a course of 60 miles, falls into the Gulf of Taranto, between Capo Spulico and Capo del Trionto; and the Neto, which rises in the heart of La Sila, and falls into the Adriatic, between Strongoli and Cotrone. The principal towns are, Cosenza, Rossano, Paola, and Castrovillari; and these give name to four arrondissements into which the province is subdivided.

Calabria Ulteriore Seconda, on the south of Calabria Citra, having a coast line from the Punta dell' Alice to the Callipari on the east, and from the Savuto to the mouth of the Messina on the west. Area 2100 square miles. Pop. (1851) 381,147. Its principal trade is in manna and saffron, but at Cantazaro is a manufactory of silk, and at Mongiana are iron foundries established by the Neapolitan government. At Maida are some seams of coal, antimony, and alabaster, which might be made available for exports. The principal towns, Cantazaro, Cotrone, Nicastro, and Monteleone, give name to the four arrondissements into which the province is divided.

Calabria Ulteriore Prima, the most southerly province of Italy, contains an area of 1250 square miles, with a pop. (1851) of 319,662. On the northern frontier are the mines Lo Stilo, from which the iron is obtained for the government foundries. At the Villa S. Giovanni is a manufactory of silk thread for foreign consumpt, and at Acciarello a manufactory of soap, but the trade of the province is confined chiefly to raw silk, cotton, fruit, liquorice, wine, brandy, and essential oils. The principal towns are Reggio, Gerace, and Palmi. They are the capitals of the arrondissements which bear their names.

CALABRITTO, a city of Italy, in the Neapolitan province of Principato-Citeriore, with 2160 inhabitants.

CALAHORRA, capital of the judicial district and diocese of the same name, in the province of Logroño, Spain, 24 miles S.E. of Logroño, N. Lat. 42. 12., W. Long. 2. 0. It occupies an elevated site on the left bank of the river Cidacos, near its junction with the Ebro, and contains about 1320 houses, mostly mean, a cathedral in the mixed Gothic style, an episcopal palace, and several conventual and other schools. The climate is cold and damp, but the soil produces in abundance grain, pulse, flax, wine, and oil. Pop. 5994.

Calahorra is the ancient *Calagurris Nassica*, celebrated for its fidelity to Sertorius in his war with Pompey and Metellus; and in the suburbs may still be traced the remains of an ancient Roman circus, an aqueduct, and a naumachia. It is said to have been the birth-place of the rhetorician Quintilian.

CALAIS, a town of France, and capital of a canton of the same name, in the department of Pas de Calais on the south shore of the Straits of Dover, 26 miles E.S.E. of Dover, and 233 miles north from Paris. N. Lat. 50. 57. 45., E. Long. 1. 51. 18. It is built in a rectangular form, having one of its longer sides towards the sea, which washes it on the north and west, while on the east and south it is surrounded by low and marshy ground which easily admits of being flooded so as to strengthen its defences. It is strongly fortified by bastions and forts, and communicates both with the port and the land by means of gates and drawbridges. Overlooking the town on the west stands the citadel, a fortress of great strength, erected by Cardinal Richelieu in 1560. In the centre of the town is the great market-place, in which stands the Hotel de Ville, surmounted by a tower and lighthouse for the shipping, and adorned with busts of the Duke of Guise, Eustache de Saint Pierre, and Cardinal Richelieu. The principal church, erected in the Gothic style by the English during their occupancy of Calais, contains an altar-piece by Vandyk, and is surmounted by a graceful tower. The apartments of Henry VIII. are still pointed out in the Hotel de Guise; and in a suburban wood-yard, a pillar marks the grave of Lady Hamilton, whose history is so painfully associated with that of Nelson. The harbour of Calais is shallow, admitting vessels (of from 400 to 500 tons) only at high water; but the pier, three-quarters of a mile long, forms an agreeable promenade. The principal in-

stitutions are the schools of design and hydrography, the public libraries, and the baths. Its commerce consists chiefly in the exportation of wine, corn, oil, salt, brandy, wood, and eggs; and in the importation of linen, thread, machinery, ironmongery, and colonial produce. Many of the vessels engaged in the cod, herring, and mackerel fisheries, belong to Calais; and the manufacture of bobbin-net in imitation of English goods has so rapidly increased of late that the building of factories has already encroached on the inner ramparts. The use of steam instead of water power has also been greatly extended. Besides these, the manufacture of soap, straw-bonnets, and leather, gives employment to a considerable number of hands. Calais has communication with Dover and London by submarine telegraph laid down in 1851, and by steamers which cross twice a-day. It used to be the principal landing-place for English travellers on the continent, but in this respect has been greatly supplanted by Boulogne. Pop. 12,000, many of whom are English.

Calais continued a petty fishing village with a natural harbour at the mouth of a stream till the end of the tenth century. It was first improved by Baldwin IV. Count of Flanders in 997, and afterwards in 1224 was regularly fortified by Philippe of France, Count of Boulogne. It was besieged by Edward III. after the battle of Crécy, and held out resolutely for eleven months by the bravery of Jean de Vienne the governor. Having been saved, at the intercession of Eustache de Saint Pierre and Queen Philippa, from the cruel fate with which Edward menaced them, the inhabitants were induced to surrender, and left the city to be occupied by an English colony. It continued in the hands of the English till 1558, when it was taken by the Duke of Guise after a short siege of seven days, and the English were expelled. It was held by the Spaniards for two years, 1596–8, till the ratification of the treaty of Vervins.

Calais, Pas de. See Pas de Calais.

CALAMANCO, a sort of woollen stuff, of a fine gloss, and checkered in the warp.

CALAMIANES, a group of small islands in the Asiatic Archipelago, about twelve in number, and situated to the N. and N.E. of the Philippines. They are surrounded by numerous shoals and rocks, which render the navigation intricate and dangerous. The largest of these islands are called Busvagon and Calamiane, the latter of which is about twenty-three miles in length by fifteen in breadth.

CALAMINE, the native carbonate and silicate of zinc, which, though very generally found in the same deposits, differ materially both in their mineralogical and chemical characters. Calamine is generally white or yellow; occasionally, however, it is blue, green, gray, and brown. It varies also from transparent to opaque; has a vitreous lustre; and occurs both crystallized, stalactitic, mamillated, and massive. It is frequently found in veins, associated with blende, and ores of iron and lead. This very useful ore of zinc contains generally from 60 to 70 per cent. of that metal. See Mineralogy, and *Index*.

CALAMIS, a celebrated Greek sculptor, who flourished about 500 B.C. He was a contemporary of Phidias. He wrought in marble, in bronze, and in gold and ivory. Pliny speaks of his horses as being unrivalled. He is noticed by Cicero and Quintilian, and many of his works are mentioned in Pausanias.

CALAMISTRUM, or Calamister, in *Antiquity*, a hollow iron instrument which was used heated for curling the hair. In Cicero's time it was common for the more effeminate of the Roman youth, as well as the matrons, to appear with their hair curled in this way.

CALAMITES, one of the most abundant of the fossils of the coal fields of Europe and America. The original has had the structure of the Calami among recent vegetables.

CALAMUS, (καλάμος), in the ancient poets, a reed-pipe, the musical instrument of shepherds, and usually made of an oaten stalk or a reed. Calamus also denoted a reed-pen, The ancients used a stylus to write on tablets covered with wax, and a reed or rush for writing on parchment or papyrus.

CALAMY, Edmund, an eminent Presbyterian divine, born at London in February 1600, and educated at Pembroke Hall, Cambridge, where his opposition to the Arminian party, then powerful in that society, excluded him from a fellowship. Dr Felton, bishop of Ely, however, made him his chaplain and gave him a living; and in 1639 he was chosen minister of St Mary Aldermanbury in London. Upon the opening of the long parliament he distinguished himself in defence of the Presbyterian cause, and had a principal share in writing the work entitled *Smectymnus*, against episcopacy. The initials of the names of the several contributors formed the name under which it was published, viz. S. Marshal, E. Calamy, T. Young, M. Newcomen, and W. Spurstow. Calamy was afterwards an active member in the assembly of divines, and a strenuous opposer of sectaries; and he used his utmost endeavours to prevent the outrages which were committed after the king was brought from the Isle of Wight. In Cromwell's time he lived privately, but was assiduous in promoting the king's return; for which he was afterwards offered a bishopric, but declined it. He was ejected for nonconformity in 1662 and, on witnessing the devastation of the great fire of London, he was so affected by the sight, that he died shortly afterwards, October 29, 1666.

Calamy, *Edmund*, grandson to the preceding (by his eldest son, Mr Edmund Calamy, who was ejected from the living of Moreton in Essex, in 1662), was born in London, April 5, 1671. After having learned the languages, and gone through a course of natural philosophy and logic at a private academy in England, he studied philosophy and civil law at the university of Utrecht, and attended the lectures of the learned Grævius. While there, an offer of a professor's chair in the university of Edinburgh was made him by Mr Carstairs, principal of that university, sent over on purpose to find a person properly qualified for such an office. This he declined, and returned to England in 1691, bringing with him letters from Grævius to Dr Pococke, canon of Christ Church and regius professor of Hebrew, and to Dr Bernard, Savilian professor of astronomy, who obtained leave for him to prosecute his studies in the Bodleian Library. Having resolved to make divinity his principal study, he entered into an examination of the controversy between the conformists and nonconformists, which determined him to join the latter; and, coming to London in 1692, he was unanimously chosen assistant to Mr Matthew Sylvester at Blackfriars. In 1694 he was ordained at Mr Annesley's meeting-house in Little St Helen's, and soon afterwards was invited to become assistant to Mr Daniel Williams in Hand-Alley. In 1702 he was chosen one of the lecturers in Salters' Hall; and in 1703 he succeeded Mr Vincent Alsop as pastor of a great congregation in Westminster. He drew up the table of contents to Baxter's History of his Life and Times, which was sent to the press in 1696; made some remarks on the work itself, and added to it an index; and, reflecting on the usefulness of the book, he saw the expediency of continuing it, as Baxter's history came no lower than the year 1684. Accordingly he composed an abridgment of it, with an account of many other ministers who were rejected after the restoration of Charles II.; their apology, containing the grounds of their nonconformity and practice as to stated and occasional communion with the Church of England; and a continuation of their history until the year 1691. This work was published in 1702. He afterwards published a moderate defence of nonconformity, in three tracts, in answer to some tracts of Dr Hoadley. In 1709 Mr Calamy made a tour to Scotland, and had the degree of doctor of divinity conferred on him by the universities of Edinburgh, Aberdeen, and Glasgow.

In 1713 he published a second edition of his Abridgment of Baxter's History of his Life and Times; in which, among various additions, there is a continuation of the history through King William's reign and Queen Anne's, down to the passing of the Occasional bill. At the end is subjoined the reformed liturgy, which was drawn up and presented to the bishops in 1661. In 1718 he wrote a vindication of his grandfather and several other persons, against certain reflections cast upon them by Archdeacon Echard in his History of England; and in 1728 appeared his continuation of the account of the ministers, lecturers, masters, and fellows of colleges, and schoolmasters, who were ejected, after the Restoration in 1660, by or before the Act of Uniformity. He died June 3, 1732. Besides the pieces already mentioned, he published a great many sermons on several subjects and occasions. He was twice married, and had thirteen children.

CALANUS, the Indian philosopher who met Alexander in the course of his expedition to that country, and consented to accompany the Macedonian army. But falling very ill at Pasargada in Persia, he committed himself to the funeral pile, after the custom of his sect and country, and perished while reciting the praises of the Hindu deities.

CALAS, Jean, a Protestant merchant at Toulouse, who was barbarously murdered under forms of law which were employed to shelter the sanguinary dictates of ignorant and fanatical zeal. He was born at La Caparède in Languedoc, in 1698, and had lived forty years at Toulouse. His wife was an Englishwoman of French extraction. They had three sons and three daughters. His son Louis had embraced the Roman Catholic faith, through the persuasions of a female domestic who had lived thirty years in the family. In October 1761 the family consisted of Calas, his wife, Marc-Antoine their son, Pierre their second son, and this domestic. Antony was educated for the bar; but being of a melancholy turn of mind, he was continually dwelling on passages from authors on the subject of suicide, and one night in that month he hanged himself in his father's warehouse. The crowd collected on so shocking a discovery, supposed that he had been strangled by the family to prevent him from changing his religion, and that this was a common practice among Protestants. The officers of justice adopted the popular tale, and were supplied by the mob with what they accepted as conclusive evidence of the fact. The fraternity of White Penitents took the body, buried it with great ceremony, and performed a solemn service for the deceased as a martyr; the Franciscans followed their example; and these formalities led to the popular belief in the guilt of the unhappy family. Being all condemned to the rack in order to extort confession, they appealed to the parliament; but this body, being as weak as the subordinate magistrates, sentenced the father to the torture, ordinary and extraordinary, to be broken alive upon the wheel, and then to be burnt to ashes; which diabolical decree was carried into execution on the 9th of March 1762. Pierre Calas, the surviving son, was banished for life: the rest were acquitted. The distracted widow, however, found some friends, and among these Voltaire, who laid her case before the council of state at Versailles; and the parliament of Toulouse was ordered to transmit the proceedings. These the king and council unanimously agreed to annul; the chief magistrate of Toulouse was degraded and fined; old Calas was declared to have been innocent; and every imputation of guilt was removed from the family. See *Causes Célèbres*, tom. iv.

CALASH, (French *calèche*), a light chariot or carriage with very low wheels, used chiefly for taking the air in parks and gardens. Calash also denotes a kind of wide cover for the head, sometimes used by ladies.

CALASIO, Mario de, a Franciscan, and professor of the Hebrew language at Rome, was born in 1550. His concordance of the Bible (which occupied him forty years) was published at Rome in 1621, the year after his death. This work has been highly approved and commended both by Protestants and Roman Catholics, and is indeed an admirable work; for, besides the Hebrew words of the Bible, which compose the body of the book, with the Latin version over against them, there are in the margin the differences between the Septuagint version and the Vulgate; so that at one view may be seen wherein the three Bibles agree, and wherein they differ. At the beginning of every article there is a kind of dictionary, which gives the signification of each Hebrew word; affords an opportunity of comparing it with other oriental languages (Syriac, Arabic, and Chaldee); and is extremely useful for determining more exactly the true meaning of the Hebrew words. It has been several times reprinted; but the original edition is the best.

CALASIRIS, in *Antiquity*, a long Egyptian garment edged below with fringe or tassels. (Herodot. ii. 81.) Also a Persian garment of the same kind.

CALATAFIMI, a city of Sicily, in the intendancy of Trapani. It lies between two hills, in a fine corn country, seven miles S.W. of Alcamo, and contains 10,000 inhabitants. This district is celebrated for its dairy and breeding cattle.

CALATAGIRONE, a town of Sicily, in the province of Catania, and 35 miles S.W. of the town of that name. It is in a very pleasant and salubrious situation, the streets are wide, clean, and well paved, and many of the public buildings are elegant. It is the seat of a bishopric, and has a royal college, hospital, orphan asylum, &c. This is one of the most industrious and commercial towns in the island. Pop. about 22,000.

CALATAYUD, a town of Spain, capital of the district of the same name, in the province of Aragon, 45 miles S.W. of Saragossa, N. Lat. 41. 24., W. Long. 1. 35. It stands on the left bank of the river Jalon, near its confluence with the Jiloca, partly on the plain and partly on a rocky slope, which is covered with remains of ancient Moorish fortifications. It contains about 1000 houses, generally spacious and well-built, several squares, the largest of which is used as the market-place, numerous convents, three hospitals, a fort, a provincial and municipal hall, an episcopal palace, a college, barracks, a theatre, and a bull-arena; there are also two *collegiatas*, or collegiate churches, both of them handsome edifices, and eleven other parish churches. The principal articles of manufacture are coarse brown paper, leather, and woollen stuffs. The soil of the neighbourhood is fertile and well-cultivated. Pop. 7125. Calatayud (*Job's Castle*) is a Moorish city, but stands near the site of the ancient Bilbilis, the birth-place of the poet Martial, and was for the most part built out of its ruins.

CALATHUS, in *Antiquity*, a kind of basket made of light wood or reeds, in which women placed their work, or gathered flowers and fruit. The figure of the calathus, as represented on ancient monuments, is narrow below, and widening towards the top. The calathus of Minerva is celebrated by the poets. Calathus also signified a wine-cup used in sacrifices.

CALATRAVA, a single tower, the remains of an ancient city on the left bank of the Guadiana, New Castile, Spain. It is called *Calatrava la Vieja*, in order to distinguish it from *Calatrava la Nueva*, a convent founded in the neighbourhood by the knights of Calatrava.

Calatrava, Knights of, a military order in Spain, instituted by Sancho III. king of Castile, upon the following occasion. When that prince took the strong fort of Calatrava from the Moors of Andalucia, he gave it to the Templars, who wanting courage to defend it returned it to him again, A.D. 1157. Then Don Raymon, of the order of the Cistercians, accompanied by several persons of high rank, offered to defend the place, which the king thereupon delivered up to them, giving them a charter as the knights of Calatrava. This order increased so much under Alphonso, that the knights desired to have a grand master, who was accord-

ingly appointed. Ferdinand and Isabella, with the consent of Pope Innocent VIII., afterwards reunited the grand mastership of Calatrava to the Spanish crown, so that the kings of Spain became perpetual administrators of this office. The knights of Calatrava bear a cross gules, fleur-de-lised with green. Their rule and habit were originally those of the Cistercians. (Fr. de Rader y Andrada, *Cronica de las tres ordines de Sanctiago, Calatrava, y Alcantara*, Toledo, 1572, fol.; Rev. E. Clarke's *Spain*.)

CALAURIA, in *Ancient Geography*, an island of Greece, in the Saronic bay, over against the port of Troezen, was celebrated for its temple of Poseidon. Hither Demosthenes fled to escape from Antipater, and poisoned himself.

CALCAR, JOHN DE, an eminent painter, born at Calcar, in the duchy of Clèves, in 1499. He was a disciple of Titian at Venice, and perfected himself by studying Raphael. He imitated those masters with the greatest success. Among his various pieces is a Nativity representing the angels around the infant Christ; which he arranged so that the light emanated from the child. He died at Naples in 1546. (Vasari.)

CALCAREOUS SPAR, or CRYSTALLIZED CARBONATE OF LIME, one of the most generally diversified substances in the mineral kingdom, and certainly that which presents the greatest variety of crystalline forms. Haüy has drawn and described upwards of 500 of these; and since his time not fewer than 800 other distinct modifications have been determined, all of which, when fractured, present as their primitive form an obtuse rhomb of 105° 5′ and 74° 55′. The most prevalent colour of calcareous spar is white, though it also presents numerous shades of yellow, green, blue, and red, most of them pale. Its dark brown and black colours are owing to the admixture of bitumen. It is transparent or translucent, and has in the clear specimens a very distinct double refraction. It has a vitreous lustre, and perfect cleavage. The pure varieties consist, according to the analyses of Stromeyer and Phillips, of—

Lime	56·15	55·50
Carbonic acid	43·70	44·00;

but the coloured ones not unfrequently contain small portions of oxide of iron, silica, magnesia, alumina, carbon, and bitumen. It effervesces violently with acids, and if pure is entirely soluble in nitric acid. At an ordinary heat it does not fuse, but gives off its carbonic acid, shines with a peculiar brightness, and ultimately becomes quicklime. Among the most distinguished localities of calcareous spar may be enumerated Andreasberg and other mining districts in the Hartz, where the varieties in six-sided prisms have been found of great beauty; Alston Moor in Cumberland, which affords numerous flat rhombic crystals; and Derbyshire, whence the pyramidal forms, sometimes of very large dimensions, are obtained. Under the head of calcareous spar there are a number of sub-species, which depend chiefly upon their mode of composition, and upon admixtures and impurities, with which the individuals have been affected at their formation. See MINERALOGY.

CALCEARIUM, in *Antiquity*, money given to the Roman soldiers to purchase shoes. In monasteries, *calcearium* denoted the service of cleaning shoes.

CALCEDONY. The distinction between this substance and agate rests upon very arbitrary grounds. Agate frequently presents a variety of colours, and a multiplicity of beautiful delineations. Calcedony is generally of one uniform colour, of a light brown, and sometimes nearly white. It occurs in irregular masses, forming grotesque cavities in the trap rocks, particularly in Iceland and the Faroe Isles, from the former of which there are specimens in the Museum of Edinburgh of a very large size. These stalactites appear always to have proceeded from the upper part of the cavity, which is sometimes filled up to the very summit with solid matter. From a close examination of these specimens, we are led to believe that the material must have been introduced into the cavity either in a state of the most attenuated fluidity, or even in a gaseous form. The structure can be traced down the sides of the cavity, regularly surrounding every portion of the stalactite, and passing across the horizontal plate which uniformly forms the base of these cavities. A slight intermixture of opalescent matter, which renders the calcedony more white and opaque, delineates this structure in the most perfect manner, and is a common occurrence in Faroe.

Calcedony is not confined to the trap rocks; it occurs in granite; and the most beautiful specimens known were found in one of the mines of Cornwall, distinguished by the name of Trevascus. It was, however, in one solitary cell that these occurred. Although the mine has continued to yield calcedony of the same character, nothing similar to these magnificent specimens has been produced since. They can scarcely be compared to anything which they resemble more than the anatomized wing of a large bat, exhibiting the bones and arteries in the most perfect manner. One of these beautiful specimens, which was in the possession of the late Mr Greville, is now in the British Museum.

Calcedony is used for the construction of cups and plates, and other articles of taste, of which the most splendid specimens are imported into this country from India. The labour which has been bestowed in the manufacture of these articles, and the perfection with which it has been accomplished, is a matter of surprise to all who examine them. There are some of them as thin and as delicate as china. The finest stones are of course selected for this purpose. They are generally clear and almost transparent, still maintaining the warm brown colour which characterizes the stone. They often have the appearance of having been hammered, so shaded and undulated is the aspect of the mass; and to add to their beauty, the fine dendritic Mocha stones are often selected. We are in ignorance even of the locality where these beautiful objects are manufactured, whether in Japan or China; but to this country they generally come from India, where, we believe, they are found among the most precious jewels in the repositories of the nabobs and princes of the East.

Calcedony in Europe is confined to labours on a much smaller scale, such as knife-handles, and mortars for chemical purposes; also for snuff-boxes, buttons, and other minor objects. The principal manufactory is at Oberstein in the Palatinate.

Calcedony is semitransparent; its texture is fine and compact; the fracture is scaly, resembling that of wax; it is less hard than rock crystal, but gives fire with steel. No indications of regular form have ever been observed in this substance; for we need not except the pale blue variety from Tresztyan in Transylvania, which is decidedly a pseudomorphic formation in the form of fluor spar. Calcedony frequently assumes the forms of other minerals, as well as of shells in many instances; but these may be considered as accidents unconnected with the history of the substance.

Connected with agate and calcedony, we may at once enumerate the different varieties which are still maintained by mineralogists.

1. Sardonyx (quartz, agate, sardoine of the French). This variety is characterized by a rich orange colour.

2. Carnelian (cornaline of the French). The characteristic colour of this variety is a brilliant red.

3. Prase (the chrysoprase of the Germans). This variety occurs at Kosmütz in Silesi. It sometimes possesses a most brilliant green colour, and is nearly transparent.

4. Plasma, semitransparent, and of a dark grass-green colour. It was very much used by the ancients as a stone for engraving.

5. Onyx (the band-agate of the Germans). This stone, when of favourable colours, is used by artists for forming cameos.

Mineralogists have split the agate into a variety of other denominations, which are not worth enumerating.

CALCEOLARIA, a very ornamental genus of plants introduced into Britain from the western slopes of the South American Andes. They belong to the natural order of *Scrofularineæ*. Most of them have yellow slipper-shaped flowers, but great variety of colour has been produced by forming hybrids.

CALCEUS, or CALCIUS, in Roman antiquity, a shoe or half boot. The Romans, when reclining at table, laid aside their shoes; hence *calceos poscere*, to rise from table. The form and colour of the calceus sometimes denoted the rank of the wearer; hence the phrase *calceos mutare*, to become a senator.

CALCHAS, a famous soothsayer who followed the Greek army to Troy. He foretold that the siege would last ten years; and that the fleet, which was detained in the port of Aulis by contrary winds, would not sail till Agamemnon's daughter had been sacrificed to Diana. After the taking of Troy he retired to Colophon, where (as an oracle had foretold) he died of grief because he was unable to divine certain events which the soothsayer Mopsus had predicted.

CALCINATION, the operation of reducing a substance to a powder, or to a friable state, by the action of heat. See CHEMISTRY.

CALCIUM, the metallic basis of lime. See CHEMISTRY.

CALC-SINTER, or STALACTITIC CARBONATE OF LIME. This occurs mamillated, or in long pendulous masses or tubes, commonly coating, or even entirely filling, the interior of caves. Though deposited from water loaded with particles of lime, and therefore in a constant state of formation, these stalactites (which outside are commonly of a yellowish-white colour, and present an infinity of different shapes and sizes) invariably afford when broken the most distinct cleavage. In this way the perfect rhomb, having the same angles as that of the calcareous spar, is easily produced from any portion of them. The extensive caverns of Adelsberg in Carniola derive their entire splendour from the thousands of these stalactites with which they are naturally ornamented in the shape of festoons, curtains, foliage, and whatever else a lively imagination may choose to invent out of the variety of fanciful and extraordinary forms they assume. These caverns constitute a labyrinth of many miles within the porous limestone rocks of the vicinity, and as yet perhaps but a small portion of them has been explored. (See ADELSBERG.) The cave of Macallister, commonly called the Spar Cave, on Loch Sunart in the Isle of Skye, is another of the same description, though much inferior in extent and beauty to that of Adelsberg. The oriental alabaster, which is this same mineral in a massive state, was much prized by the ancients for statuary purposes.

CALC-TUFF, or CALCAREOUS TUFA, is the most impure, the most irregular, and the most porous, of all the varieties of limestone. It occurs in beds generally in the vicinity of lakes and rivers; also encrusting rocks, and enveloping animal and vegetable remains in the proximity of calcareous springs. Immense deposits of calc-tuff have taken place at Terni, and on the banks of the river Anio near Tivoli; where some very curious impressions, such as that of a cart-wheel, trunks of trees, &c., are to be met with. The celebrated Grecian temples of Pæstum are formed of this stone, and no doubt owe their existence at the present period to the circumstance of its becoming harder the longer it is exposed to the air; for, as the quarries whence it has been procured are in the immediate vicinity, and the stone previous to being exposed is so much softer, modern Vandals have found it easier to go directly to the quarry for what they wanted, than attack the long weather-beaten and now indurated Doric pillars of the temples. From its property of hardening so much on exposure to the atmosphere and to water, this rock makes a very useful building stone in the formation of bridges. Over the Danube at Ulm a very handsome bridge has been constructed of this stone, which, when brought from the neighbouring mountains, is cut into the required dimensions with the assistance merely of the axe and the saw.

CALCULI, little stones or pebbles anciently used in making computations, taking suffrages, playing at draughts, and the like. In after times, pieces of ivory, of silver, gold, and other materials, were used in lieu of the calculi, but still retained the ancient name. Computists, when they were slaves or newly freed men, were called *calculones;* those of a better condition were named *calculatores* or *numerarii*. There was ordinarily one of these in each family of distinction. The Roman judges anciently gave their opinions by calculi, which were white for absolution, and black for condemnation. Hence *calculus albus* denoted a favourable vote, either in the case of a person to be acquitted of a charge, or elected to some dignity or post; and *calculus niger* had a contrary signification. This usage is said to have been borrowed from the Thracians, who marked their happy or prosperous days by *white*, and their unhappy by *black* pebbles, which were put each night into an urn.

Besides the diversity of colour, there were some calculi also which had figures or characters engraven on them; as those used in taking the suffrages in the senate and in assemblies of the people. Their form is still seen in some medals of the Cassian family; and the manner of casting them into the urns is represented on the medals of the Licinian family. The letters marked upon these calculi were U. R. for *uti rogas*, and A. for *antiquo;* the first of which expressed an approbation of the law, the latter a rejection of it. Afterwards the judges who sat in capital causes used calculi marked with the letter A. for *absolvo;* C. for *condemno;* and N. L. for *non liquet*, signifying that more full information was required.

CALCULI, *Urinary*. See CHEMISTRY, and SURGERY.

CALCULUS, in late Latin, signified a small weight, equal to two grains of *cicer* (chick-pea). Two calculi were equal to the Greek κεράτιον, and to the Latin *siliqua*.

CALCULUS, in *Mathematics*, is a general name given to various ways of investigating or establishing the truths of that science by the aid of conventional symbols or characters which represent the things treated of; also the operations to be performed on them, and the relations in which they stand to one another. Thus we have the common *Arithmetical* Calculus, and the *Algebraic* Calculus. The term is applied to a considerable number of distinct mathematical theories, the principal of which are these:

The *Differential* CALCULUS and the *Integral* CALCULUS. The invention of these is claimed for Leibnitz. They are identical with the *Fluxionary* CALCULUS, the invention of Newton.

The CALCULUS *of Partial Differences*, which is a branch of the Differential and Integral Calculus.

The CALCULUS *of Variations*, another branch of the same theory. Its principal object is to determine when mathematical qualities, subject to certain conditions, are the greatest or least possible. This theory, first broached by James and John Bernouilli, was perfected by Euler and La Grange, who have discussed it in their writings. See a distinct treatise on this subject by Mr Woodhouse of Cambridge.

The CALCULUS *of Exponentials*, or Exponential Calculus. This may include the doctrine of logarithms; but the name is commonly applied to the method of finding the differentials or fluxions of exponential and logarithmic quantities. John Bernouilli was the first who treated of this subject as a distinct calculus. (Bernouilli *Opera*, tom. i. p. 179.)

The CALCULUS *of Functions*, the same in effect with the Differential or Fluxionary Calculus. La Grange gave this name to his particular view of the subject. (*Théorie des Fonctions Analytiques;* also *Leçons sur le Calcul des Fonctions*.)

The CALCULUS *of Finite Differences*. This investigates the properties of quantities by means of their differences. It is of great value in the summation of infinite series. Brooke Taylor's *Methodus Incrementorum*, Stirling's *Methodus Differentialis*, and Emerson's *Method of Increments*, also his *Differential Method*, all treat of this subject. There are also various treatises in works on the Differential Calculus, as Lacroix, &c.

The CALCULUS *of Derivations*. This is applicable to the doctrine of series, and is due to a Continental mathematician, Arbogast, who has composed a treatise on the subject. (Arbogast, *Du Calcul des Dérivations*.)

The CALCULUS *of Probabilities*. This treats of everything connected with the *Doctrine of Chances*. The most valuable work on this subject is La Place's *Théorie Analytique des Probabilités*. See also De Morgan's work.

The CALCULUS *of Sines*. This branch of mathematical science was embodied in a distinct form by Euler. See his various writings, particularly his *Analysis Infinitorum*. We have explained this calculus in our article ALGEBRA.

There are some other mathematical theories which have been distinguished each as a separate *Calculus*, as Landen's *Residual Analysis*, Glennie's *Antecedental Calculus* (*Edin. Phil. Trans.* vol. iv.), &c.

CALCULUS Minervæ, in *Antiquity*, denoted the decision of a cause in regard to which the judges were equally divided. The expression is taken from the story of Orestes, at whose trial before the Areopagites, for the murder of his mother, the votes being equally divided for and against him, Minerva interposed and gave the casting vote or calculus in his behalf.

CALCUTTA, one of the largest and most splendid cities of Asia, the modern capital of Hindustan, and the seat of the supreme government of the British in India. It is situated on the left bank of the river Hooghly, which forms the western channel of the Ganges, and is distant by the river's course about one hundred miles from the sea. The country from the mouth of the Hooghly to Diamond Harbour is dreary in the extreme; the banks of the river are high, and the adjacent land on each side, which is perfectly flat, forms a complete wilderness of timber and brushwood, the haunt of tigers and other beasts of prey. Advancing up the river the scene gradually improves, the country becomes more and more cultivated, the shipping and the bustle on the river increase, and the beautiful country seats on its banks announce proximity to the capital. The city, with its numerous spires and other public edifices, presents at a distance a striking appearance, and on landing the magnificence of the buildings commands the admiration of all strangers. The town extends along the left or eastern bank of the river for the distance of four miles and a half, having an average breadth of about a mile and a half, and covering an area of eight square miles. Near the landing place, called "Old Fort Ghat," is a large square, each side measuring above two hundred and fifty yards. The middle is occupied by a fine tank or open reservoir of water for the supply of the town. This square forms the centre of what is properly termed the town or business quarter of Calcutta, in contradistinction to the fashionable or court end, Chowringhee, containing the residences of Europeans, and of natives of distinction. To the north along the bank of the river, lies the Black Town, which is occupied entirely by natives.

About a quarter of a mile to the south of the commercial quarter, and opposite to Chowringhee stand Fort-William and the barracks, which form on this side a great ornament to the city. The intermediate space, which is an extensive open plain, is termed the esplanade. The citadel of Fort-William, which was begun by Lord Clive in 1757 after the battle of Plassey, is the strongest and most regular fortress in India, but the works are so extensive that they would require at least 9000 or 10,000 men, with 600 pieces of cannon, to defend them. On the west of the esplanade stands the Government-house (erected by the Marquis Wellesley), which is the largest and most splendid building in Calcutta. It is the residence of the governor-general, where he holds levees, and transacts all the government business; it also contains magnificent apartments for public entertainments. The custom-house faces the river, and forms part of the west side of the great square. It is built upon the site of the Old Fort which was taken in 1757 by Surajah Dowlah. Near to it is the famous Black Hole, which is now converted into a warehouse; and before the gate stands the monument which has been erected as a memorial of the unfortunate persons who perished there. It is surrounded by an iron railing, but since it was struck by lightning, it has been allowed to go to decay. In front of the custom-house is the quay, which is of essential service to the numerous ships which there load and unload. The other public buildings are, the town-hall situate on the esplanade, built in the Doric style of architecture, and containing public rooms which, though handsome, are too confined for the climate, and for the number of the inhabitants; the supreme court of justice; the Mohammedan and Hindu Colleges; La Martinière (an educational institution supported by funds bequeathed by General Claude Martin, originally a common soldier in the French army, but subsequently a major-general in the East India Company's service); the Ochterlony monument raised in honour of Sir David Ochterlony, and designed in the Saracenic style of architecture as indicative of the high estimation in which the general held the followers of Islam; Metcalfe Hall, erected by subscription as a public testimonial to the character of Lord Metcalfe. At the S.W. angle of the fort is a ghat formed to perpetuate the memory of James Prinsep, one of the most eminent men of his age; and a little beyond is the monument raised to commemorate the victories of Maharajpore and Punniar, and constructed from the cannon captured on those fields. St Paul's cathedral is a fabric recently erected through the exertions and munificence of Bishop Wilson, aided by a pecuniary grant from the East India Company. Of places of worship 167 are devoted to the Hindu religion, and 74 to that of the Mohammedans. The Chinese have a temple, and the Jews a synagogue. There are three Baptist chapels, and two belonging to Independents not Baptists. There is one Greek and one Armenian church, and five Roman Catholic chapels. Of those connected with the national churches of Great Britain, the Church of England has eight, the Established Church of Scotland one, and the Free Church of that country one.

About three miles below Calcutta, on the opposite side of the river, and in a beautiful situation, stands the botanic garden, giving to a bend of the river the name of Garden Beach. It contains a splendid collection of plants from every quarter of the globe, and is laid out with great taste, but more with a view to practical utility than scientific arrangement. Horse-racing having been discouraged by government, the course, which was to the south of the town, is now converted into a ride; but the practice still continues at Barrackpoor, sixteen miles higher up the river, where the fashionable society of Calcutta assemble to partake of the amusement. The south side of the Tank Square is occupied by Writers' buildings, which make but an indifferent appearance. They form the residence of the civil servants of the Company who have newly arrived from Europe, and who are students at the college of Fort-William. The private houses in Calcutta, in the central part of the town, are built mostly after the European fashion, but modified to the nature of the climate, and to the magnificence of eastern manners. At Chowringhee, in a line with Government-house, is a range of elegant buildings ornamented with large verandahs, and another at right

angles with it, formerly occupied by native huts. These houses are built of brick covered with a species of stucco called chunam. They are all separated from each other, every one having attached to it a considerable piece of inclosed ground, in the middle of which it is situated. The approach is by a flight of steps under a large portico. The architecture is Grecian, and the profusion of columns, porticoes, and verandahs, gives to these buildings the air more of palaces than of private houses. To this part of Calcutta, the Black Town, which extends along the river to the north of Calcutta, forms a striking contrast. It is built after the model of Indian towns, is very large, and swarms with inhabitants. The streets are exceedingly narrow and crooked. Of late years, however, this quarter of the town has been greatly improved both in appearance and in salubrity; the streets have been widened and properly drained, and ponds have been filled; a large surface of stagnant water has been thereby removed, the exhalations from which were prejudicial to health; and the houses have been rendered less combustible by the substitution of tiles for thatch.

Calcutta is the great emporium of India. By means of the Ganges and its tributary streams it has an uninterrupted water communication with the whole of the lower provinces of Bengal, and also with the fertile territory subject to the jurisdiction of the lieutenant-governor of Agra. Being thus advantageously situated for commerce, it trades extensively with almost every country in the world, and numbers of vessels of every form and description are constantly arriving in or departing from the river, which in the vicinity of the town presents the busiest scene imaginable. Numerous dockyards have also been established, in which are built vessels of great burden and of admirable construction. Indigo, sugar, cotton, rice, opium, silk, and saltpetre, are the staple commodities of export. Those of import are British cotton goods, salt, copper, iron, and hardware.

The commerce of Calcutta has for a long period of years enjoyed the advantage of a bank, called the Bank of Bengal, established by government authority, and carried on under government inspection. Various acts have at different periods been passed by the government of India for its regulation; the last bears date the 18th March 1839, and took effect from the 1st May following. By this all previous charters and acts, except so far as continued by the new act, were cancelled and repealed; the capital stock previously fixed at 75 lacs of rupees was increased by one half; the nature of the transactions in which the bank might engage was prescribed, and the conditions and limitations under which its business was to be conducted were laid down. The stock is divided into shares of 4000 rupees, or quarter shares of 1000 rupees each; and a portion is and always has been held by government.

The educational institutions in Calcutta are numerous. Of these the principal are the Madrissa or Mohammedan College, founded by the British government in 1781, with the view of gratifying national predilections, and thus to gain over the learned and influential classes, and further to secure a regular supply of Mohammedan officers for the courts of law; the Sanscrit College, for which a handsome building has been erected, founded in 1821 for similar objects with respect to the other great division of the population, the Hindus; the Hindu College, established originally by native subscription, chiefly for the instruction of Hindu youths in the English language and the literature and science of Europe; Bishop's College, founded for the purpose of instructing native youths and others in the doctrines and discipline of Christianity, in order to their becoming preachers, catechists, and schoolmasters, under the Society for the Propagation of the Gospel in Foreign Parts. In 1823 a committee of public instruction was formed, who were authorized to exercise superintendence over all government seminaries, and to give an impulse as well as a judicious direction to efforts made for diffusing instruction among the native population. Subsequently the committee merged into a council of education, which still exists, but acts ministerially under the direction of the government. Under the patronage of a society of European ladies, native schools for girls, with female teachers, were established in 1821; and there is a female normal school, superintended by a committee, of which Mrs Mackenzie, well known in the literary world, is honorary secretary. Mr Bethune, for some time legislative member of the council of India, also established a female school, which subsequently was transferred to government. There are two schools for the education and maintenance of the children of Europeans in the military service of the Company, one for the children of officers, and the other for those of the privates. The charitable institutions are numerous: among these may be noticed St James' Schools, instituted by Bishop Middleton; the European Female Orphan Asylum; the Benevolent Institution, designed for the instruction of indigent Christian children; the Free School; the Church Missionary Alms-Houses; the Leper Asylum; and the General Assembly's Institution. There are several literary and scientific societies. The Asiatic Society, inaugurated under the patronage of Sir William Jones, still continues its sittings and the publication of its transactions, containing much interesting and curious matter relating to the history, literature, languages, and antiquities of Asia.

A census of the population taken in May 1850, by order of the chief magistrate, gives the following results :—

Europeans,	6,233
Eurasians (the progeny of European fathers and native mothers),	4,615
Americans	892
Chinese,	847
Asiatics,	15,342
Hindus,	274,335
Mohammedans,	110,918
	413,182

The occupations of these various classes are nearly what might be expected in the luxurious capital of a great empire, and in so great an emporium of maritime commerce. Public officers, lawyers, physicians, merchants, and their families, make up the bulk of the British inhabitants. The natives and foreigners of respectability are mostly engaged in trade, or live upon their property; and the lower classes are principally composed of retail dealers, mechanics, and servants.

The British merchants form a most respectable class, and contribute essentially to the prosperity of the settlement. Many of them are possessed of large fortunes, and live in a style of suitable splendour. The Armenians are the most numerous body of foreign merchants in Calcutta. They trade extensively to all parts of the East, are uncommonly diligent and attentive to business, and are considered to have a more minute intelligence from foreign ports than any other body of merchants. The native bankers, agents, and money-dealers, are numerous. Though formerly timorous, the Hindu now adventures in almost every species of mercantile speculations; and goods belonging to native merchants, to the amount of several millions sterling, are generally lying for sale in the warehouses of Calcutta. The native merchants of an inferior class engross nearly the whole of the retail trade of Calcutta, under the titles of Banians, Sircars, and other appellations. In the transactions of usury these men are watchful and acute beyond even those engaged in similar pursuits in the west.

The English society in Calcutta is of the best description, and numerous fêtes are given during the cold season, which lasts from September to April, on a splendid scale, by the governor-general and other public functionaries, as well as

by private individuals. There is a theatre, chiefly supported by amateur performers; and public concerts are given, also supported by amateur talent. The usual mode of visiting is in palanquins, but many of the British have carriages adapted to the climate; and the breed of horses having been greatly improved, it is the universal practice to drive out between sunset and dinner. It is only during the cold season that it is possible to venture abroad in the heat of the day, which, in the rest of the year, is devoted to repose. The hot season begins in April. Every day the heat increases until the middle of June, when the periodical rains begin, which last till August. The weather then being extremely close, is more oppressive and more unhealthy than before. The mean temperature is about 66° in January, 69° in February, 80° in March, 85° in April and May, 83° in June, 81° in July, 82° in August and September, 79° in October, 74° in November, and 66° in December. The annual fall of rain during six years, commencing with 1830, averaged sixty-four inches.

Calcutta is about to be lighted with gas, a company having been formed for the purpose. Farther improvements may be anticipated. The present mode of communication between Howra, on the opposite bank of the river, and the metropolis, is by ferry; but Howra has been selected as the locality for the terminus of the East India railway; and upon the opening of the first section, which is now complete, greater facilities will be required, as well of access from Howra as of egress from the city in the same direction. Various contrivances have been suggested, but it is obvious that any expedient will be inadequate until the Hooghly shall have been spanned by a substantial bridge in the immediate vicinity of the terminus.

It was in the last year of the seventeenth century that the East India Company obtained from Aurungzebe, emperor of Delhi, the grant of certain villages scattered over the site now occupied by the city of Calcutta. To this locality the Company's factory was removed from the town of Hooghly; and the necessary works of defence being raised, the new settlement, in compliment to the reigning king of England, received the name of Fort-William. One of the villages, transferred to the British, was called Calcutta, and hence the appellation by which the metropolis of India has been since known. Such at no distant period was the lowly origin of the seat of government, whence a foreign nation now gives law to the whole of India.

In 1752 a ditch was dug round a considerable part of the town, as a barrier against the inroads of the Mahrattas. The trade of Bengal alone supplied rich cargoes for many ships annually, besides what was carried on in small vessels to the adjacent countries It was this flourishing state of Calcutta which probably induced the nabob Surajah Dowlah to attack it in the year 1756. Having had the fort of Cossimbazar delivered up to him, he marched against Calcutta with all his forces, and invested the place. Disunion, and the cowardice of some whose efforts ought to have been exerted in defence of the settlement, facilitated the triumph of the nabob. It being resolved to remove the females to a ship lying in the river, two civil servants of the Company, named Manningham and Frankland, volunteered to superintend their departure, and having thus effected their escape refused to return. The governor, Mr Drake, followed their example; and in the conduct of affairs, Mr Holwell then assumed the first place by unanimous consent, Mr Peake an elder member of council foregoing his claim. Ultimate success was hopeless, and the defence was protracted only to afford opportunity for an escape to a ship in the river. But this hope failed—the ship, through the unskilfulness of the pilot, having taken the ground. Signals were then made, and constantly repeated, to the vessel in which the previous fugitives had found safety, but without effect. The result was not only the fall of the place, but the capture of its unfortunate inmates. A hundred and forty-six of these were forthwith consigned for the night to a horrible dungeon, only about eighteen feet square, from which only twenty-three came out alive in the morning. The injuries which Calcutta suffered at this time, however, were soon repaired. The place was retaken by Admiral Watson and Colonel Clive early in 1757; Surajah Dowlah was defeated, deposed, and put to death; and Meer Jaffier succeeded him in the nabobship. Since that time the immense acquisition of territory by the British in this part of the world, and the constant state of security enjoyed by this city, have raised it to its present prosperity and splendour. Fort-William stands in Long. 88. 25. E., Lat. 22. 33. N. (E. T.)

CALDANI, L. MARCO ANTONIO, a distinguished Italian anatomist and physician, was born at Bologna in 1725. After holding various minor appointments, he was chosen assistant to the celebrated anatomist Morgagni at Padua; but disgusted with the envy which his distinguished position drew down upon him, he withdrew to Venice. Soon after, however, he was appointed to the professorship of the theory of medicine, with the promise of being elected to succeed Morgagni, who was now very old and infirm. In 1771 he published his *Elements of Pathology*, and soon afterwards the *Elements of Physiology*. In this same year he took possession of the chair of anatomy, vacant by the death of Morgagni, and endeavoured, though without success, to found an anatomical museum. At the age of seventy-six, though threatened with blindness, he published, with the assistance of his nephew, a valuable series of anatomical plates. He died in 1813, at the age of eighty-eight.

CALDARIUM, in the ancient Roman baths, a vessel containing warm water for bathing. See BATHS.

CALDER, a river of Yorkshire, which rises on the borders of Lancashire, near Burnley, and after a winding eastward course of about 40 miles, joins the Aire. It receives during its course several smaller streams, and is navigable for nearly 30 miles, forming part of the canal system of Yorkshire and Lancashire. On its banks are the towns of Dewsbury and Wakefield.

CALDERINUS, DOMITIUS, a very learned critic, born at Torri, near Caldiero, in the vicinity of Verona, A.D. 1445. He read lectures upon polite literature at Rome with great reputation, and he also wrote commentaries on many of the ancient poets. He died in 1477, aged thirty-two.

CALDERON DE LA BARCA, DON PEDRO, a celebrated Spanish dramatic author, born of noble parentage at Madrid in 1601. Having early completed his studies, he attached himself to some patrons about court; but being soon disgusted with this state of dependence he enlisted as a common soldier, and made several campaigns in Italy and Flanders. During this time, however, he cultivated a taste for dramatic poetry; and having attracted the notice of Philip IV., who was a passionate admirer of the drama, that prince invited Calderon to Madrid in 1636, made him a knight of the order of St Iago, and was guided by his advice in all matters connected with the theatricals of the court. It is also said that during the minority of Louis XIV. Calderon visited Paris, and composed verses in praise of Anne of Austria, the destined bride of Philip IV. In 1652, he devoted himself to the church, and became a canon at Toledo. From this period till that of his death, which happened on the 25th of May 1681, he abandoned dramatic composition, except on sacred subjects. His works are very numerous, exceeding, it is said, five hundred. No nation, in fact, can boast of such prolific writers as Spain. Lopez de Vega, for instance, is said to have composed two thousand *comedias;* a fertility which would be less surprising if the pieces themselves were of an inferior order, or destitute of merit; but though deformed by the most extraordinary faults they are at the same time enlivened by brilliant coruscations of genius and fancy. It must, however, be admitted that Virvez, and particularly Lopez and Calderon, had begun, even in the age of Cervantes, to corrupt the Spanish drama. Before their time, the productions of Castillejo and of Juan de la Cueva were more regular, though less forcible, spirited, and interesting; but after their appearance the unities were totally disregarded, and dramatic writers assumed a degree of license which was pushed to the utmost height of extravagance. Cervantes opposed himself strenuously to this innovation, but in vain. Lopez and Calderon were as well acquainted with the established rules as Cervantes himself; but they

knew only to despise them. The judicious author of the *Bibliothèque Espagnol* places Calderon on a footing of equality with Lopez de Vega, and says that this was the general opinion among their contemporaries. But Linguet, in his *Théatre Espagnol*, hesitates not to place Calderon in the first rank; whilst Emmanuel de Guerra says that Calderon imitated no one (*a ninguno imito*), and drew from his own imagination alone. This is indeed evident; for his delineations are deficient in truth, and his characters are altogether fantastical. The pieces of Calderon, like those of the Spanish theatre generally, are divided into three *days* or acts, and the scene is often changed. His comedies almost always exhibit vice triumphant; and it cannot with any truth be said of him, *castigat ridendo mores.* The *gracioso* or buffoon is, for the most part, one of his principal characters; and sometimes, as in *Heraclius*, a couple of these personages are introduced. The piece of Calderon entitled *No ai burlas con el Amor* appears to have suggested to Molière the idea of his *Femmes Savantes;* while the one entitled *Nunca la peor es cierto* has been grossly disfigured by Scarron in his comedy of *La Fausse Apparence.* Lastly, the infamous Collot d'Herbois caused to be represented, with a certain degree of success, in 1777, on one of the provincial theatres of France, and again in 1789, in the Théatre Français at Paris, the *Paysan Magistrat*, imitated from the piece of Calderon entitled *Alcalde de Zalamea.* Besides his plays, Calderon composed a considerable number of *Autos Sacramentales*, or sacred pieces, analogous to those which are elsewhere denominated *Mysteries, Acts of the Saints*, and *Moralities.* Calderon is not relished in France, and comparatively little known in Britain.. In Germany, however, he enjoys a great reputation. Schlegel has translated some of his best pieces; while his *Constant Prince*, and *Life is a Dream*, have been repeatedly represented with success on the boards at Weimar. The former of these pieces is generally considered as the masterpiece of Calderon. The works of Calderon were reprinted at Madrid in 1726 and 1760, in ten volumes 4to; and a collection of his *Autos Sacramentales* appeared at Madrid in 1759, in six volumes 4to. His manuscript *Letters* are preserved among the archives of the house of Calderon.

CALDERWOOD, David, an industrious historian of the Church of Scotland, and a strenuous defender of its discipline, was born in 1575. He was educated at Edinburgh, where he took the degree of A.M. in 1593. About 1604 he became minister of Crailing near Jedburgh; and he speedily began to take a conspicuous part in the ecclesiastical proceedings of that period.

The king was extremely anxious to assimilate the Church of Scotland to the Church of England. Having succeeded in obtruding episcopacy, it was the next object of his solicitude to enlarge the authority and jurisdiction of the bishops. His schemes were however opposed by many of the clergy; nor was any one more resolute in his opposition than Calderwood.

In 1617 James paid a visit to Scotland. During the sitting of the parliament, which assembled on the 17th of June, the clergy held several meetings in the Little Church, one or more of the bishops being always present. The general conduct of the high Episcopalian functionaries was such as to fill many of the Presbyterian clergy with alarm; so that at last a considerable number of them having assembled in the music-school, they resolved upon drawing up a remonstrance to his Majesty. Two of the Edinburgh clergy, Hewat and Struthers, were appointed to prepare it; and when it was fully adjusted, Archibald Simson, minister of Dalkeith, was directed to sign it as clerk of the meeting; but the names of all those who attended were subscribed in a separate paper, which was delivered to him as a voucher to be used according to circumstances. He presented a copy to the clerk register, who refused to read it in parliament; and having been summoned before the High Commission, he declined to produce the signatures, and was committed as a prisoner to the castle of Edinburgh. This paper he had entrusted to the master of the music-school, Patrick Henryson, who delivered it to Calderwood. The minister of Crailing was therefore cited to appear at St Andrews on the 8th of July, and there to exhibit the roll of names, and "to answer for his mutinous and seditious assistance to the said assembly." Hewat and Simson were summoned at the same time, and they all made their appearance; but their examination was deferred till the 12th, in order that it might take place in his Majesty's presence. James conducted himself in his usual manner; but the stern and undaunted Calderwood was not to be overawed by any earthly authority which he conceived to be unjustly exercised. The king having at length whispered in the primate's ear, "his Majesty," he stated, "saith that if ye will not be content to be suspended spiritually ye shall be suspended corporally." Undismayed by this declaration, he replied, "Sir, my bodie is in your Majesty's hands to do with it as it pleaseth your Majesty; but as long as my bodie is free, I will teach, notwithstanding of their sentence."

Hewat, adhering to the protestation, was deprived, and confined in the town of Dundee; but as he had obtained a grant of the temporalities of Crossragwell abbey he was not left without a provision. Simson, who had aggravated the original offence by writing a letter in which he disparaged the English bishops, likewise received sentence of deprivation, and was for several months detained in prison; but on making his submission he was at length reinstated. A similar sentence was pronounced on Calderwood, who was committed to prison at St Andrews, and was afterwards removed to Edinburgh. The privy-council, which long exercised an undefined and despotic jurisdiction, ordained him to be banished from the kingdom for refusing to acknowledge the sentence of the High Commission; and the whole proceedings in this case exhibit a curious example of the arbitrary and iniquitous administration of that period. On giving security to banish himself from the kingdom before the ensuing Michaelmas, and not to return without the royal license, he was released from prison. He accompanied Lord Cranstoun to Carlisle, where that nobleman presented to the king a petition in his favour; but it was followed by no beneficial result. The subsequent application of Lord Cranstoun to the privy-council, and to the bishops, was attended with no better success.

He continued for a considerable time to linger in his native country; and during this interval he began the publication of his anonymous works in support of the Presbyterian cause. In 1618 he printed a Latin tract on the polity of the Church of Scotland. The general assembly, which met at Perth on the 25th of August, gave a new impulse to his mind: and in 1619 he produced an English work, in which he undertook to demonstrate the nullity of the assembly itself, and the unlawfulness of its five articles, relating to kneeling at the communion, the observance of festivals, confirmation, private baptism, and private communion.

While Calderwood was still lurking in Scotland, an attempt was made to apprehend him at Edinburgh, in the house of James Cathkin, a bookseller; but the officers neither found him nor any copies of his obnoxious publication relative to the *Perth Assembly.* Calderwood was in the mean time concealed at Cranstoun, in a secret apartment allotted to him by Lady Cranstoun, who rendered him many services. He afterwards removed from one place to another, till the 27th of August 1619, when he embarked at Newhaven, and sailed for Holland. Where he chiefly resided in that country we are not informed; but Bishop

Calderwood. Guthry states, that "in the time of his exile he had seen the wild follies of the English Brownists in Arnheim and Amsterdam."[1] During his residence in Holland he published various works, and, among the rest, his *Altare Damascenum*. At one period his enemies supposed him to be dead; and he has recorded a very extraordinary attempt to impose upon the world a recantation fabricated in his name.[2]

Calderwood appears to have returned to Scotland in 1624. He was still found to be the most redoubtable champion of presbytery; and after the abolition of episcopacy, he was appointed minister of Pencaitland, in the county of Haddington. During the remainder of his life, he continued to take an active part in the affairs of the church; and as firmness may be nearly allied to obstinacy, he appears to have maintained his own opinions with habitual keenness. It was he that introduced the practice, which is now confirmed by long usage, of dissenting from the decision of the assembly, and requiring the protest to be entered in the record. In 1649, an act having been introduced respecting the election of ministers, he proposed that the right of electing should be vested in the presbytery, leaving to the people the power of declaring their dissent, upon reasons of which it should be competent for the presbytery to judge; but this suggestion was not adopted; and, according to Baillie's statement, "Calderwood entered a very sharp protestation against our act, which he required to be registered. This is the first protestation we heard of in our time; and had it come from any other it had not escaped censure."[3]

He devoted many years to the preparation of a History of the Church of Scotland. In 1648 the general assembly urged him to complete the design, and voted him a yearly pension of eight hundred pounds.[4] He left behind him an historical work of great extent, and of great value, not indeed as a masterly composition, but as a storehouse of authentic materials for history. An abridgment, which appears to have been prepared by himself,[5] was published after his death. An excellent edition of this important work has been recently published by the Wodrow Society. The author's manuscript, which lately belonged to General Calderwood Durham, has been presented to the British Museum. A copy, transcribed under the inspection of Wodrow, is among the archives of the church; another belongs to the library of the university of Glasgow; and, as Dr M'Crie has stated, "in the Advocates' Library, besides a complete copy of that work, there is a folio volume of it, reaching to the end of the year 1572. It was written in 1634, and has a number of interlineations and marginal alterations, differing from the other copies, which, if not made by the author's own hand, were most probably done under his eye."[6]

Calderwood died at Jedburgh on the 29th of October 1650,[7] aged seventy-five. He appears to have been a man of unbending integrity, fearless in maintaining his opinions, and uniformly consistent in his professions; but as human virtues are never perfect, his decision of character had some tendency to deviate into that obstinacy of humour from which good men are not always exempted.

His works are numerous; and as they were almost all published without the author's name, it is not easy to form a complete and accurate catalogue. The place of printing is omitted in all the original editions, but several, if not most of them, appear to have been printed in Holland.

Caldron || Caldwall. CALDRON, or CAULDRON (French *chaudron*, Latin *caldarium*), a large kitchen utensil of copper or iron with a moveable handle by which to hang it on the chimney-hook.

CALDWALL, or CHALDWALL, RICHARD, a learned physician, born in Staffordshire, about 1513. He studied physic in Brasen-nose College, Oxford, and was examined, admitted into, and made censor of, the College of Physicians at London, all in one day. Six weeks after he was chosen one of the elects; and in 1570 he was made president of that college. Wood says that Caldwall wrote several essays on professional subjects. Camden mentions that he founded, and handsomely endowed, a chirurgical lecture in the College of Physicians. These lectures, known as the *Lumleian Lectures*, are still given. He died in 1585.

CALEDONIA, the ancient name of Scotland. From the testimonies of Tacitus, Dio, and Solinus, we find that the ancient Caledonia comprehended all that country situated to the north of the rivers Forth and Clyde. In proportion as the Silures or Cimbri advanced northwards, the Caledonians, circumscribed within narrower limits, were forced to pass over into the islands which fringe the western coasts of Scotland. It is about this period, probably, that we ought to fix the first great migration of the British Gael into Ireland; that kingdom being much nearer to the promontory of Galloway and Cantyre than many of the Scottish isles are to the continent of North Britain.

To the country which the Caledonians possessed they gave the name of *Gael-doch*, which is the only appellation the Scots who speak the Gaelic language know for their own division of Britain. *Gael-doch* is a compound formed from *Gael*, the first colony of the ancient Gauls who transmigrated into Britain, and *doch*, a district or division of a country. The Romans, by transposing the letter *l* in *Gael*, and by softening into a Latin termination the *ch* of *doch*, formed, it is supposed, the well-known name of Caledonia This name, according to Chalmers, is merely the Latinized form of *Celyddoni*, from *Celyddon*, the descriptive appellation given to the country by the British colonists, and signifying literally *the Coverts*.

At the period when Agricola invaded North Britain, A.D. 81, that portion of the island appears to have been possessed by twenty-one tribes of aboriginal inhabitants, having little or no political connection with one another, although evidently identical in origin, in language, in customs, and in manners. The names and topographical positions of these Caledonian tribes or clans have been preserved and pretty accurately ascertained. They were, 1. The *Ottadini*, or *Ottadeni*, who occupied the S.E. boundary of North Britain, extending along the whole line of coast from the southern Tyne to the Firth of Forth, and including the half of Northumberland, the eastern part of Roxburghshire, and the whole of Berwickshire and of East Lothian; 2. The *Gadeni*, who inhabited the interior of the country, to the west of the *Ottadini*, including the western part of Northumberland, a small part of Cumberland to the north of the Irthing, the western part of Roxburghshire, the whole of Selkirkshire, Tweeddale, a considerable part of Mid-Lothian, and nearly all West Lothian; their pos-

1 Memoirs of Henry Guthry, late Bishop of Dunkeld, p. 78, edit. Glasg. 1748, 12mo.

2 Calderwood's Recantation; or, a tripartite Discourse, directed to such of the Ministerie, and others in Scotland, that refuse Conformitie to the Ordinances of the Church; wherein the Causes and bad Effects of such Separation, the legal Proceedings against the refractarie, and Nullitie of their Cause, are softly launced, and they louingly inuited to the Vniformitie of the Chvrch. Lond. 1622, 4to.

3 Baillie, vol ii. p. 340.

4 Baillie, vol. ii. p. 307.

5 See Dr M'Crie's appendix to the *Memoirs of Veitch and Bryson*, p. 495, 501.

6 M'Crie's *Life of Knox*, vol. i p. vi.—Some of his papers are preserved among Wodrow's MSS. in the Advocates' Library. Two original letters from John Paget to Calderwood occur in M. 6. 9. No. 107–8.

7 *Bannatyne Miscellany*, vol. i. p. 205. Baillie, in a passage already quoted, mentions that Calderwood was sixty-six years old in 1641.

sessions extending from the Tyne on the south to the Firth of Forth on the north; 3. The *Selgovæ*, who inhabited Annandale, Nithsdale, and Eskdale in Dumfriesshire, and the eastern part of Galloway as far as the river Deva or Dee, which was their western boundary; 4. The *Novantæ*, who possessed the middle and western parts of Galloway, from the Dee on the east to the Irish Sea on the west; on the south they were bounded by the Solway Firth and the Irish Sea, and on the north by the chain of hills which separates Galloway from Carrick; 5. The *Damnii*, the most important of the southern tribes, who inhabited the whole extent of country from the ridge of hills which separates Galloway from Ayrshire on the south, to the river Earne on the north, and possessed all Strathclyde, the shires of Ayr, Renfrew, and Stirling, and a small part of those of Dumbarton and Perth; 6. The *Horestii*, who inhabited the country between *Bodotria* or Forth on the south, and the *Tavus* or Tay on the north, comprehending the shires of Clackmannan, Kinross, and Fife, with the eastern part of Strathern, and the country westward of the Tay as far as the river Brann; 7. The *Venecontes* who possessed the territory between the Tay on the south and the Carron on the north, comprehending Gowrie, Strathmore, Stormont, and Strathardle in Perthshire, together with the whole of Angus, and the larger part of Kincardineshire; 8. The *Taizalæ*, who inhabited the northern part of the Mearns, and the whole of Aberdeenshire as far as the Doveran; 9. The *Vacomagi*, who inhabited the country on the south side of the Moray Firth, from the Doveran on the east to the Ness on the west, comprehending the shires of Banff, Elgin, Nairn, the eastern part of Inverness, and Braemar in Aberdeenshire; 10. The *Albani*, afterwards called *Damnii-Albani*, who possessed the interior districts between the lower ridge of the Grampians, which skirts the southern side of the loch and river Tay on the south, and the chain of mountains which forms the southern limit of Inverness-shire on the north; 11. The *Attacoti*, who inhabited the whole of the country from Lochfyne on the west to the eastward of the river Leven and Lochlomond, comprehending the whole of Cowal in Argyleshire and the greater part of Dumbartonshire; 12. The Caledonii proper, who inhabited the whole of the interior of the country from the ridge of mountains which separates Inverness and Perth on the south, to the range of hills which forms the forest of Balnagowan in Ross on the north, comprehending all the middle parts of Inverness and Ross; 13. The *Cantæ*, who possessed the east of Ross from the Moray Firth on the south to the Firth of Dornoch on the north; 14. The *Logi*, who possessed the south-eastern coast of Sutherland, extending from the Dornoch Firth on the S.W. to the Helmsdale river on the east; 15. The *Cornabii*, who inhabited the south, the east, and the N.E. of Caithness, from the Helmsdale river, comprehending the three great promontories of Noss-head, Duncansby-head, and Dunnet-head; 16. The *Careni*, a small tribe who inhabited the north-western corner of Caithness, and the eastern half of Strathnaver in Sutherlandshire, having the river Naver, the *Navari fluvius* of Ptolemy, for their western boundary; 17. The *Mertæ*, who occupied the interior of Sutherland; 18. The *Carnonacæ*, who inhabited the northern and western coast of Sutherland, and a small part of the western shore of Ross, from the Naver on the east to the *Volsas* bay on the S.W.; 19. The *Cerones*, who inhabited the western coast of Ross, from the *Volsas* bay on the north to Lochduich on the south; 20. The *Cerones*, who inhabited the whole western coast of Inverness, and the districts of Ardnamurchan, Morven, Sunart, and Ardgower in Argyleshire, having Lochduich on the north, and the Linne-loch on the south; and, 21. The *Epidii*, who inhabited the S.W. of Argyleshire, from Linne-loch on the north, to the Firth of Clyde and the Irish Sea on the south, including Cantyre [illegible] the country of the *Albani*, and by Lochfyne. Such, according to the best authorities, were the names and geographical positions of the twenty-one tribes which, at the time of the Roman invasion, occupied the whole of North Britain.

When the tribes of North Britain were attacked by the Romans under Agricola (see article Britain, chap. i.), they entered into associations, in order that, by uniting their strength, they might be more able to repel the common enemy. But the particular name of the tribe which either its superior power or military reputation placed at the head of the association, was the general name given by the Romans to all the confederates. Hence it is that the *Mœatæ*, who inhabited the districts of Scotland lying southward of the Firth, and the *Caledonians*, who inhabited the west and N.W. parts, engrossed the glory which belonged in common, though in an inferior degree, to the other tribes settled of old in North Britain.

The origin of the appellations *Scoti* and *Picti*, introduced by the later Roman authors, has occasioned much controversy among antiquaries in modern times. It seems tolerably certain, however, that the Scots and Picts were one and the same people; or rather, that the term *Picti* or Picts was the generic, and that of *Scoti* or Scots, only a specific appellation. Eumenius the orator, who first mentions the Picts, alludes to the *Caledones aliique Picti;* an expression which implies that the *Caledones* and *other* tribes were considered as Picts. Again, with reference to the question whether the Scots were aboriginal Britons, or merely emigrants from Ireland, it has been shown by arguments which appear to be invincible, that they came originally from Ireland; but, on the other hand, it seems equally certain that the Scots of Ireland, or the *Scoticæ gentes* of Porphyry, a branch of the great Celtic family, passed over, at a very remote period, from the shores of Britain into Ireland, and before the beginning of the fifth century had given their name to the whole of that country. Their name, however, does not occur in the Roman annals till A.D. 360; but all the authors of the fourth century agree that Ireland was the proper country of the Scots, and that they invaded the Roman territories in North Britain about the period above mentioned. They are described as an erratic or wandering race, who carried on a predatory system of warfare, and also as a transmarine people, who came from Ireland, their native island. Under the denomination of Picts were included the Caledonians and Scots, and probably also the Attacots, a warlike clan, settled on the shores of Dumbarton and Cowal. See Scotland.

Caledonia, New, an island in the South Sea, discovered by Captain Cook. See Australasia.

CALEDONIAN Canal. See Navigation, Inland; and Scotland.

CALELLA, a small seaport town of Spain, in the province of Barcelona, in Lat. 41. 37. N., Long. 2. 45. E. It numbers about 600 houses, and contains a hospital, a college of primary instruction, a parish church, and a prison. Besides a considerable transit trade, there is carried on an active manufacture of cotton fabrics and blond-lace; while shipbuilding and the distilling of brandy give employment to a part of the population, which amounts to 3035.

CALENBERG, a principality of Hanover, in the arrondissement of Hanover, bounded north by Hoya and Lüneburg; east by Lüneburg and Hildesheim; south by Brunswick; west by Lippe-Detmold, Pyrmont, Schaumburg, and Schaumburg-Lippe. Area 1050 square miles. The northern part is flat and covered with patches of moorland, the southern part is hilly, with broad and fertile valleys intervening. It is traversed by the Weser and the Leine, and derives its name from the ancient Castle of Calenberg on the Leine, once a princely residence, but now in ruins. The chief town in the principality is Hanover. Pop. 19,300.

CALENDAR.

A CALENDAR is a method of distributing time into certain periods adapted to the purposes of civil life, as hours, days, weeks, months, years, &c.

Of all the periods marked out by the motions of the celestial bodies, the most conspicuous, and the most intimately connected with the affairs of mankind, are the *solar day*, which is distinguished by the diurnal revolution of the earth and the alternation of light and darkness, and the *solar year*, which completes the circle of the seasons. But in the early ages of the world, when mankind were chiefly engaged in rural occupations, the phases of the moon must have been objects of great attention and interest; hence the *month*, and the practice adopted by many nations of reckoning time by the motions of the moon, as well as the still more general practice of combining lunar with solar periods. The solar day, the solar year, and the lunar month, or lunation, may therefore be called the *natural* divisions of time. All others, as the hour, the week, and the civil month, though of the most ancient and general use, are only arbitrary and conventional.

Day.—The true solar day is the interval of time which elapses between two consecutive returns of the same terrestrial meridian to the sun, and therefore, by reason of the inclined position of the ecliptic, and the unequal progressive motion of the earth in its orbit, is not always of the same absolute length. But as it would be hardly possible, in the artificial measurement of time, to have regard to this small inequality, which is besides constantly varying, the *mean solar day* is employed for all civil purposes. This is the time in which the earth *would* make one revolution on its axis, as compared with the sun, if the earth moved at an equable rate in the plane of the equator. The mean solar day is therefore a result of computation, and not marked by any astronomical phenomenon; but its difference from the true solar or apparent day is so small as to escape ordinary observation.

The subdivision of the day into twenty-four parts, or hours, has prevailed since the remotest ages, though different nations have not agreed either with respect to the epoch of its commencement or the manner of distributing the hours. Europeans in general, like the ancient Egyptians, place the commencement of the civil day at midnight, and reckon twelve morning hours from midnight to midday, and twelve evening hours from midday to midnight. Astronomers, after the example of Ptolemy, regard the day as commencing with the sun's culmination, or noon, and find it most convenient for the purposes of computation to reckon through the whole twenty-four hours. Hipparchus reckoned the twenty-four hours from midnight to midnight. Some nations, as the ancient Chaldeans and the modern Greeks, have chosen sunrise for the commencement of the day; others, again, as the Italians and Bohemians, suppose it to commence at sunset. In all these cases the beginning of the day varies with the seasons at all places not under the equator. In the early ages of Rome, and even down to the middle of the fifth century after the foundation of the city, no other divisions of the day were known than sunrise, sunset, and midday, which was marked by the arrival of the sun between the Rostra and a place called Græcostasis, where ambassadors from Greece and other countries used to stand. The Greeks divided the natural day and night into twelve equal parts each, and the hours thus formed were denominated *temporary hours*, from their varying in length according to the seasons of the year. The hours of the day and night were of course only equal at the time of the equinoxes. The whole period of day and night they called νυχθημερον.

Week.—The week is a period of seven days, having no reference whatever to the celestial motions; a circumstance to which it owes its unalterable uniformity. Although it did not enter into the calendar of the Greeks, and was not introduced at Rome till after the reign of Theodosius, it has been employed from time immemorial in almost all eastern countries; and as it forms neither an aliquot part of the year nor of the lunar month, those who reject the Mosaic recital will be at a loss, as Delambre remarks, to assign to it an origin having much semblance of probability. It might have been suggested by the phases of the moon, or by the number of the planets known in ancient times, an origin which is rendered more probable from the names universally given to the different days of which it is composed. In the Egyptian astronomy, the order of the planets, beginning with the most remote, is Saturn, Jupiter, Mars, the Sun, Venus, Mercury, the Moon. Now, the day being divided into twenty-four hours, each hour was consecrated to a particular planet, namely, one to Saturn, the following to Jupiter, the third to Mars, and so on according to the above order; and the day received the name of the planet which presided over its first hour. If, then, the first hour of a day was consecrated to Saturn, that planet would also have the 8th, the 15th, and the 22d hour; the 23d would fall to Jupiter, the 24th to Mars, and the 25th, or the first hour of the second day, would belong to the Sun. In like manner the first hour of the 3d day would fall to the Moon, the first of the 4th day to Mars, of the 5th to Mercury, of the 6th to Jupiter, and of the 7th to Venus. The cycle being completed, the first hour of the 8th day would return to Saturn, and all the others succeed in the same order. According to Dio Cassius, the Egyptian week commenced with Saturday. On their flight from Egypt, the Jews, from hatred to their ancient oppressors, made Saturday the last day of the week.

The English names of the days are derived from the Saxon. The ancient Saxons had borrowed the week from some eastern nation, and substituted the names of their own divinities for those of the gods of Greece. In legislative and justiciary acts the Latin names are still retained.

Latin.	English.	Saxon.
Dies Solis.	Sunday.	Sun's day.
Dies Lunæ.	Monday	Moon's day.
Dies Martis.	Tuesday.	Tiw's day.
Dies Mercurii.	Wednesday.	Woden's day
Dies Jovis.	Thursday.	Thor's day.
Dies Veneris.	Friday.	Friga's day.
Dies Saturni.	Saturday.	Seterne's day.

Month.—Long before the exact length of the year was determined, it must have been perceived that the synodic revolution of the moon is accomplished in about 29½ days. Twelve lunations, therefore, form a period of 354 days, which differs only by about 11¼ days from the solar year. From this circumstance has arisen the practice, perhaps universal, of dividing the year into twelve *months*. But in the course of a few years the accumulated difference between the solar year and twelve lunar months would become considerable, and have the effect of transporting the commencement of the year to a different season. The difficulties that arose in attempting to avoid this inconvenience induced some nations to abandon the moon alto-

gether, and regulate their year by the course of the sun. The month, however, being a convenient period of time, has retained its place in the calendars of all nations; but, instead of denoting a synodic revolution of the moon, it is usually employed to denote an arbitrary number of days approaching to the twelfth part of a solar year.

Among the ancient Egyptians, the month consisted of thirty days invariably; and in order to complete the year, five days were added at the end, called supplementary days. They made use of no intercalation, and by losing a fourth of a day every year, the commencement of the year went back one day in every period of four years, and consequently made a revolution of the seasons in 1461 years. Hence 1461 Egyptian years are equal to 1460 Julian years of 365¼ days each. This year is called *vague*, by reason of its commencing sometimes at one season of the year, and sometimes at another.

The Greeks divided the month into three decades, or periods of ten days; a practice which was imitated by the French in their unsuccessful attempt to introduce a new calendar at the period of the revolution. This division offers two advantages; the first is, that the period is an exact measure of the month of thirty days; and the second is, that the number of the day of the decade is connected with and suggests the number of the day of the month. For example, the 5th of the decade must necessarily be the 5th, the 15th, or the 25th of the month; so that when the day of the decade is known, that of the month can scarcely be mistaken. In reckoning by weeks, it is necessary to keep in mind the day of the week on which each month begins.

The Romans employed a division of the month and a method of reckoning the days which appears not a little extraordinary, and must, in practice, have been exceedingly incommodious. Instead of distinguishing the days by the ordinal numbers first, second, third, &c. they counted *backwards* from three fixed epochs, namely, the *Calends*, the *Nones*, and the *Ides*. The Calends were placed invariably on the first day of the month, and were so denominated because it had been an ancient custom of the pontiffs to call the people together on that day, to apprize them of the festivals, or days that were to be kept sacred during the month. The Ides (from an obsolete verb *iduare*, to divide) were at the middle of the month, either the 13th or the 15th day; and the Nones were the *ninth* before the Ides, counting inclusively. From these three terms the days received their denomination in the following manner:—Those which were comprised between the Calends and the Nones were called *the days before the Nones;* those between the Nones and the Ides were called *the days before the Ides;* and, lastly, all the days after the Ides to the end of the month were called *the days before the Calends* of the succeeding month. In the months of March, May, July, and October, the Ides fell on the 15th day, and the Nones consequently on the 7th; so that each of these months had six days named from the Nones. In all the other months the Ides were on the 13th and the Nones on the 5th; consequently there were only four days named from the Nones. Every month had eight days named from the Ides. The number of days receiving their denomination from the Calends depended on the number of days in the month and the day on which the Ides fell. For example, if the month contained 31 days, and the Ides fell on the 13th, as was the case in January, August, and December, there would remain 18 days after the Ides, which, added to the first of the following month, made 19 days of Calends. In January, therefore, the 14th day of the month was called the *nineteenth before the Calends of February* (counting inclusively), the 15th was the 18th before the Calends, and so on to the 30th, which was called the third before the Calends (*tertio Calendas*), the last being the second of the Calends, or the day before the Calends (*pridie Calendas*). As frequent allusion is made by classical writers to this embarrassing method of computation, which is carefully retained in the ecclesiastical calendar, we will here give a table showing the correspondence of the Roman months with those of modern Europe.

Days of the Month.	March. May. July. October.	January. August. December.	April. June. September. November.	February.
1	Calendæ.	Calendæ.	Calendæ.	Calendæ.
2	6	4	4	4
3	5	3	3	3
4	4	Prid. Nonas.	Prid. Nonas.	Prid. Nonas.
5	3	Nonæ.	Nonæ.	Nonæ.
6	Prid. Nonas.	8	8	8
7	Nonæ.	7	7	7
8	8	6	6	6
9	7	5	5	5
10	6	4	4	4
11	5	3	3	3
12	4	Prid. Idus.	Prid. Idus.	Prid. Idus.
13	3	Idus.	Idus.	Idus.
14	Prid. Idus.	19	18	16
15	Idus.	18	17	15
16	17	17	16	14
17	16	16	15	13
18	15	15	14	12
19	14	14	13	11
20	13	13	12	10
21	12	12	11	9
22	11	11	10	8
23	10	10	9	7
24	9	9	8	6
25	8	8	7	5
26	7	7	6	4
27	6	6	5	3
28	5	5	4	2
29	4	4	3	Prid. Calen.
30	3	3	Prid. Calen.	Martii.
31	Prid. Calen.	Prid. Calen.		

Year.—The year is either astronomical or civil. The solar astronomical year is the period of time in which the earth performs a revolution about the sun, or passes from any point of the ecliptic to the same point again; and consists of 365 days 5 hours 48 minutes and 49·62 seconds of mean solar time. The civil year is that which is employed in chronology, and varies among different nations, both in respect of the season at which it commences, and of its subdivisions. When regard is had to the sun's motion alone, the regulation of the year, and the distribution of the days into months, may be effected without much trouble; but the difficulty is greatly increased when it is sought to reconcile solar and lunar periods, or to make the subdivisions of the year depend on the moon, and at the same time to preserve the correspondence between the whole year and the seasons.

Of the Solar Year.—In the arrangement of the civil year, two objects are sought to be accomplished: the first is, the equable distribution of the days among twelve months; and the second is, the preservation of the beginning of the year at the same distance from the solstices or equinoxes. Now, as the year consists of 365 days and a fraction, and 365 is a number not divisible by 12, it is impossible that the months can all be of the same length,

and at the same time include all the days of the year. By reason also of the fractional excess of the length of the year above 365 days, it likewise happens that the years cannot all contain the same number of days if the epoch of their commencement remains fixed; for the day and the civil year must necessarily be considered as beginning at the same instant; and therefore the extra hours cannot be included in the year till they have accumulated to a whole day. As soon as this has taken place, an additional day must be given to the year.

The civil calendar of all European countries has been borrowed from that of the Romans. Romulus is said to have divided the year into ten months only, including in all 304 days, and it is not very well known how the remaining days were disposed of. The ancient Roman year commenced with March, as is indicated by the names September, October, November, December, which the four last months still retain. July and August, likewise, were anciently denominated Quintilis and Sextilis, their present appellations having been bestowed in compliment to Julius Cæsar and Augustus. In the reign of Numa two months were added to the year, January at the beginning, and February at the end; and this arrangement continued till the year 452 B. C., when the Decemvirs changed the order of the months, and placed February after January. The months now consisted of twenty-nine and thirty days alternately, to correspond with the synodic revolution of the moon, so that the year contained 354 days; but a day was added to make the number odd, which was considered more fortunate, and the year therefore consisted of 355 days. This differed from the solar year by ten whole days and a fraction; but, to restore the coincidence, Numa ordered an additional or intercalary month to be inserted every second year between the 23d and 24th of February, consisting of twenty-two and twenty-three days alternately, so that four years contained 1465 days, and the mean length of the year was consequently $366\frac{1}{4}$ days. The additional month was called *Mercedinus*, or *Mercedonius*, from *merces*, wages, probably because the wages of workmen and domestics were usually paid at this season of the year. According to the above arrangement, the year was too long by one day, which rendered another correction necessary. As the error amounted to twenty-four days in as many years, it was ordered that every third period of eight years, instead of containing four intercalary months, amounting in all to ninety days, should contain only three of those months, consisting of twenty-two days each. The mean length of the year was thus reduced to $365\frac{1}{4}$ days; but it is not certain at what time the octennial periods, borrowed from the Greeks, were introduced into the Roman calendar, or whether they were at any time strictly followed. It does not even appear that the length of the intercalary month was regulated by any certain principle, for a discretionary power was left with the pontiffs, to whom the care of the calendar was committed, to intercalate more or fewer days according as the year was found to differ more or less from the celestial motions. This power was quickly abused to serve political objects, and the calendar consequently thrown into confusion. By giving a greater or less number of days to the intercalary month, the pontiffs were enabled to prolong the term of a magistracy, or hasten the annual elections; and so little care had been taken to regulate the year, that, at the time of Julius Cæsar, the civil equinox differed from the astronomical by three months, so that the winter months were carried back into autumn, and the autumnal into summer.

In order to put an end to the disorders arising from the negligence or ignorance of the pontiffs, Cæsar abolished the use of the lunar year and the intercalary month, and regulated the civil year entirely by the sun. With the advice and assistance of Sosigenes, he fixed the mean length of the year at $365\frac{1}{4}$ days, and decreed that every fourth year should have 366 days, the other years having each 365. In order to restore the vernal equinox to the 25th of March, the place it occupied in the time of Numa, he ordered two extraordinary months to be inserted between November and December in the current year, the first to consist of thirty-three, and the second of thirty-four days. The intercalary month of twenty-three days fell into the year of course, so that the ancient year of 355 days received an augmentation of ninety days; and the year on that occasion contained in all 445 days. This was called the last year of confusion. The first Julian year commenced with the 1st of January of the 46th before the birth of Christ, and the 708th from the foundation of the city.

In the distribution of the days through the several months, Cæsar adopted a simpler and more commodious arrangement than that which has since prevailed. He had ordered that the first, third, fifth, seventh, ninth, and eleventh months, that is January, March, May, July, September, and November, should have each thirty-one days, and the other months thirty, excepting February, which in common years should have only twenty-nine, but every fourth year thirty days. This order was interrupted to gratify the vanity of Augustus, by giving the month bearing his name as many days as July, which was named after the first Cæsar. A day was accordingly taken from February and given to August; and in order that three months of thirty-one days might not come together, September and November were reduced to thirty days, and thirty-one given to October and December. For so frivolous a reason was the regulation of Cæsar abandoned, and a capricious arrangement introduced, which it requires some pains to remember.

The additional day which occurred every fourth year was given to February, as being the shortest month, and was inserted in the calendar between the twenty-fourth and twenty-fifth day. February having then twenty-nine days, the twenty-fifth was the sixth of the calends of March, *sexto calendas;* the preceding, which was the additional or intercalary day, was called *bis-sexto calendas*, hence the term *bissextile*, which is still employed to distinguish the year of 366 days. The English denomination of *Leap-Year* would have been more appropriate if that year had differed from common years in *defect*, and contained only 364 days. In the ecclesiastical calendar the intercalary day is still placed between the 24th and 25th of February; in the civil calendar it is the 29th.

The regulations of Cæsar were not at first sufficiently understood; and the pontiffs, by intercalating every third year instead of every fourth, at the end of thirty-six years had intercalated twelve times instead of nine. This mistake having been discovered, Augustus ordered that all the years from the thirty-seventh of the era to the forty-eighth inclusive should be common years, by which means the intercalations were reduced to the proper number of twelve in forty-eight years. No account is taken of this blunder in chronology; and it is tacitly supposed that the calendar has been correctly followed from its commencement.

Although the Julian method of intercalation is perhaps the most convenient that could be adopted, yet, as it supposes the year too long by 11 minutes 10·35 seconds, it could not without correction very long answer the purpose for which it was devised, namely, that of preserving always the same interval of time between the commencement of the year and the equinox. Sosigenes could scarcely fail to know that his year was too long; for it had been shown

long before, by the observations of Hipparchus, that the excess of $365\frac{1}{4}$ days above a true solar year would amount to a day in 300 years. The real error is indeed more than double of this, and amounts to a day in 129 years; but in the time of Cæsar the length of the year was an astronomical element not very well determined. In the course of a few centuries, however, the equinox sensibly retrograded towards the beginning of the year. When the Julian calendar was introduced, the equinox fell on the 25th of March. At the time of the Council of Nice, which was held in 325, it fell on the 21st; and when the reformation was made in 1582, it had retrograded to the 11th. In order to restore the equinox to its former place, Pope Gregory XIII. directed ten days to be suppressed in the calendar; and as the error of the Julian intercalation was now found to amount to three days in 400 years, he ordered the intercalations to be omitted on all the centenary years excepting those which are multiples of 400. According to the Gregorian rule of intercalation, therefore, every year of which the number is divisible by four without a remainder, is a leap year, excepting the centurial years, which are only leap years when divisible by four after suppressing the two zeros. Thus 1600 was a leap year, but 1700, 1800, and 1900, are common years; 2000 will be a leap year, and so on.

As the Gregorian method of intercalation has been adopted in all Christian countries, Russia excepted, it becomes interesting to examine with what degree of accuracy it reconciles the civil with the solar year. According to the best determinations of modern astronomy (Bailli's *Tables*, p. 16), the solar year consists of 365 days 5 h. 48 min. 49·62 sec. or 365·242241 days. Now the Gregorian rule gives 97 intercalations in 400 years; 400 years therefore contain $365 \times 400 + 97$, that is, 146,097 days; and consequently one year contains 365·2425 days, or 365 d. 5 h. 49 min. 12 sec. This exceeds the true solar year by 22·38 seconds, which amount to a day in 3866 years. It is perhaps unnecessary to make any formal provision against an error which can only happen after so long a period of time; but as 3866 differs little from 4000, it has been proposed to correct the Gregorian rule by making the year 4000 and all its multiples common years. With this correction the rule of intercalation is as follows:—

Every year the number of which is divisible by 4 is a leap year; excepting the last year of each century, which is a leap year only when the number of the century is divisible by 4: but 4000, and its multiples, 8000, 12,000, 16,000, &c. are common years. Thus the uniformity of the intercalation, by continuing to depend on the number four, is preserved, and by adopting the last correction the commencement of the year would not vary more than a day from its present place in a thousand centuries.

In order to discover whether the coincidence of the civil and solar year could not be restored in shorter periods by a different method of intercalation, we may proceed as follows:—The fraction 0.242241, which expresses the excess of the solar year above a whole number of days, being converted into a continued fraction, becomes

$$\cfrac{1}{4+\cfrac{1}{7+\cfrac{1}{1+\cfrac{1}{4+\cfrac{1}{7+\cfrac{1}{1+,\ \&c.}}}}}}$$

which gives the series of approximating fractions,

$$\frac{1}{4},\ \frac{7}{29},\ \frac{8}{33},\ \frac{39}{161},\ \frac{281}{1160},\ \frac{320}{1321}.$$

The first of these gives the Julian intercalation of one day in four years, and is considerably too great. It supposes the year to contain 365 days 6 hours.

The second gives seven intercalary days in twenty-nine years, and errs in defect, as it supposes a year of 365 d. 5 h. 47 min. 35 sec.

The third gives eight intercalations in thirty-three years, or seven successive intercalations at the end of four years respectively, and the eighth at the end of five years. This supposes the year to contain 365 d. 5 h. 49. min. 5·45 sec.

The fourth fraction, $\frac{39}{161} = \frac{32+7}{132+29} = \frac{4 \times 8 + 7}{4 \times 33 + 29}$, combines four periods of thirty-three years with one of twenty-nine, and would consequently be very inconvenient in application. It supposes the year to consist of 365 d. 5 h. 48 min. 49·19 sec.

The fifth gives 281 intercalary days in 1160 years, and supposes a year of 365 d. 5 h. 49·19 sec.

The sixth, $\frac{320}{1321} = \frac{960}{3963}$, gives 960 intercalary days in 3963 years, whereas the Gregorian rule gives 961 in that time. It gives a year of 365 d. 5 h. 48 min. 49·59 sec., differing from the true solar year only by three-hundredths of a second.

The fraction $\frac{8}{33}$ offers a convenient and very accurate method of intercalation. It implies a year differing in excess from the true year only by 15·38 seconds, while the Gregorian year is too long by 25·38 seconds. In a period of thirty-three years, therefore, it produces a nearer coincidence between the civil and solar years than the Gregorian method in 400 years; and, by reason of its shortness, confines the evagations of the mean equinox from the true within much narrower limits. It has been stated by Scaliger, Weidlar, Montucla, and others, that the modern Persians actually follow this method, and intercalate eight days in thirty-three years. The statement has, however, been contested on good authority; and it seems proved (see Delambre, *Astronomie Moderne*, tom. i. p. 81) that the Persian intercalation combines the two periods $\frac{7}{29}$ and $\frac{8}{33}$. If they follow the combination $\frac{7+4\times 8}{29+4\times 33} = \frac{39}{161}$, their determination of the length of the tropical year has been extremely exact. The discovery of the period of thirty-three years is ascribed to Omar Cheyam, one of the eight astronomers appointed by Gelal-Eddin Malech Schah, sultan of Khorassan, to reform or construct a calendar, about the year 1079 of our era.

If the commencement of the year, instead of being retained at the same place in the seasons by a uniform method of intercalation, were made to depend on astronomical phenomena, the intercalations would succeed each other in an irregular manner, sometimes after four years and sometimes after five; and it would occasionally, though rarely indeed, happen, that it would be impossible to determine the day on which the year ought to begin. In the calendar, for example, which was attempted to be introduced in France in 1793, the beginning of the year was fixed at the midnight preceding the day in which the true autumnal equinox falls. But supposing the instant of the sun's entering into the sign Libra to be very near midnight, the small errors of the solar tables might render it doubtful to which day the equinox really belonged; and it would be in vain to have recourse to observation to obviate the difficulty. It is therefore infinitely more commodious to determine the commencement of the year by a fixed rule of intercalation; and of the various methods

which might be employed, no one, perhaps, is on the whole more easy of application, or better adapted for the purposes of computation, than the Gregorian.

Of the Lunar Year and Luni-solar Periods.—The lunar year, consisting of twelve lunar months, contains only 354 days; its commencement consequently anticipates that of the solar year by eleven days, and passes through the whole circle of the seasons in about thirty-four lunar years. It is therefore so obviously ill adapted to the computation of time, that, excepting the modern Jews and Mahommedans, almost all nations who have regulated their months by the moon have employed some method of intercalation by means of which the beginning of the year is retained at nearly the same fixed place in the seasons.

In the early ages of Greece the year was regulated entirely by the moon. Solon divided the year into twelve months, consisting alternately of twenty-nine and thirty days, the former of which were called *deficient* months, and the latter *full* months. The lunar year, therefore, contained 354 days, exceeding the exact time of twelve lunations by about 8·8 hours. The first expedient adopted to reconcile the lunar and solar years seems to have been the addition of a month of thirty days to every second year. Two lunar years would thus contain 25 months, or 738 days, while two solar years, of $365\frac{1}{4}$ days each, contain $730\frac{1}{2}$ days. The difference of $7\frac{1}{2}$ days was still too great to escape observation; it was accordingly proposed by Cleostratus of Tenedos, who flourished shortly after the time of Thales, to omit the biennary intercalation every eighth year. In fact, the $7\frac{1}{2}$ days by which two lunar years exceeded two solar years, amounted to thirty days, or a full month, in eight years. By inserting, therefore, three additional months instead of four in every period of eight years, the coincidence between the solar and lunar year would have been exactly restored if the latter had contained only 354 days, inasmuch as the period contains $354 \times 8 + 3 \times 30 = 2922$ days, corresponding with eight solar years of $365\frac{1}{4}$ days each. But the true time of 99 lunations is 2923·528 days, which exceeds the above period by 1·528 days, or thirty-six hours and a few minutes. At the end of two periods, or sixteen years, the excess is three days, and at the end of 160 years, thirty days. It was therefore proposed to employ a period of 160 years, in which one of the intercalary months should be omitted; but as this period was too long to be of any practical use, it was never generally adopted. The common practice was to make occasional corrections as they became necessary, in order to preserve the relation between the octennial period and the state of the heaven; but these corrections being left to the care of incompetent persons, the calendar soon fell into great disorder, and no certain rule was followed till a new division of the year was proposed by Meton and Euctemon, which was immediately adopted in all the states and dependencies of Greece.

The *Metonic Cycle*, which may be regarded as the *chef d'œuvre* of ancient astronomy, is a period of nineteen solar years, after which the new moons again happen on the same days of the year. In nineteen solar years there are 235 lunations, a number which, on being divided by nineteen, gives twelve lunations for each year, with seven of a remainder, to be distributed among the years of the period. The period of Meton, therefore, consisted of twelve years, containing twelve months each, and seven years containing thirteen months each; and these last formed the third, fifth, eighth, eleventh, thirteenth, sixteenth, and nineteenth years of the cycle. As it had now been discovered that the exact length of the lunation is a little more than twenty-nine and a half days, it became necessary to abandon the alternate succession of full and deficient months; and, in order to preserve a more accurate correspondence between the civil month and the lunation, Meton divided the cycle into 125 full months of thirty days, and 110 deficient months of twenty-nine days each. The number of days in the period was therefore 6940. In order to distribute the deficient months through the period in the most equable manner, the whole period may be regarded as consisting of 235 full months of thirty days, or of 7050 days, from which 110 days are to be deducted. This gives one day to be suppressed in sixty-four; so that if we suppose the months to contain each thirty days, and then omit every sixty-fourth day in reckoning from the beginning of the period, those months in which the omission takes place will be the deficient months of course.

The number of days in the period being known, it is easy to ascertain its accuracy both in respect of the solar and lunar motions. The exact length of nineteen solar years is $19 \times 365{\cdot}24224 = 6939{\cdot}60156$ days, or 6939 days 14 hours 26·275 minutes; hence the period, which is exactly 6940 days, exceeds nineteen revolutions of the sun by nine and a half hours nearly. On the other hand, the exact time of a synodic revolution of the moon is 29·5305887 days; 235 lunations, therefore, contain $235 \times 29{\cdot}5305887 = 6939{\cdot}68834$ days, or 6939 days 16 hours 31·2 minutes, so that the period exceeds 235 lunations only by seven and a half hours.

After the Metonic cycle had been in use about a century, a correction was proposed by Calippus. At the end of four cycles, or seventy-six years, the accumulation of the seven and a half hours of difference between the cycle and 235 lunations amounts to thirty hours, or one whole day and six hours. Calippus, therefore, proposed to quadruple the period of Meton, and deduct one day at the end of that time by changing one of the full months into a deficient month. The period of Calippus, therefore, consisted of three Metonic cycles of 6940 days each, and a period of 6939 days; and its error in respect of the moon, consequently, amounted only to six hours, or to one day in 304 years. This period exceeds seventy-six true solar years by fourteen hours and a quarter nearly, but coincides exactly with seventy-six Julian years; and in the time of Calippus the length of the solar year was almost universally supposed to be exactly $365\frac{1}{4}$ days. The Calippic period is frequently referred to as a date by Ptolemy.

The *Mahommedan Year*, which is regulated entirely by the moon, consists of twelve months, containing twenty-nine and thirty days alternately; and in order to preserve the correspondence between the civil month and the lunation, a method of intercalation is employed, which, in point of accuracy, could scarcely be surpassed. The moon's synodic revolution is performed in 29 days 12 hours 44 min. 2·8 sec., whereas the civil month supposes it only $29\frac{1}{2}$ days. Now the excess, which is 44 min. 2·8 sec., amounts to 8 hours 48 min. 35·6 sec. in a year, and, neglecting the seconds, to 264 hours, or eleven days, in thirty years. Hence, eleven times in thirty years one day is added to the last month; so that in a period of thirty years there are nineteen simple years of 354 days and eleven intercalary years of 355 days. The average length of the year, therefore, differs from twelve lunations only by 35·6 seconds. The eleven intercalary years are the second, fifth, seventh, tenth, thirteenth, sixteenth, eighteenth, twenty-first, twenty-fourth, twenty-sixth, and twenty-ninth, of each cycle of thirty years.

For an account of the year adopted by the Jews, Chinese, Indians, and some other nations, and of the correspondence of their eras and epochs with those employed by Europeans, the reader may consult the article CHRONOLOGY.

Ecclesiastical Calendar.—The ecclesiastical calendar, which is adopted in all the Catholic, and most of the Pro-

testant countries of Europe, is luni-solar, being regulated partly by the solar, and partly by the lunar year; a circumstance which gives rise to the distinction between the movable and immovable feasts. So early as the second century of our era, great disputes had arisen among the Christians respecting the proper time of celebrating Easter, which governs all the other movable feasts. The Jews celebrated their passover on the 14th day of the *first month*, that is to say, the lunar month of which the fourteenth day either falls on, or next follows, the day of the vernal equinox. Most Christian sects agreed that Easter should be celebrated on a Sunday. Others followed the example of the Jews, and adhered to the 14th of the moon; but these, as usually happened to the minority, were accounted heretics, and received the appellation of Quarto-decimantes. In order to terminate dissensions, which produced both scandal and schism in the church, the council of Nice, which was held in the year 325, ordained that the celebration of Easter should thenceforth always take place on the Sunday which immediately follows the full moon that happens upon, or next after, the day of the vernal equinox. Should the fourteenth of the moon, which is regarded as the day of full moon, happen on a Sunday, the celebration of Easter was deferred to the Sunday following, in order to avoid concurrence with the Jews and the above-mentioned heretics. The observance of this rule renders it necessary to reconcile three periods which have no common measure, namely, the week, the lunar month, and the solar year; and as this can only be done approximately, and within certain limits, the determination of Easter is an affair of considerable nicety and complication. It is to be regretted that the reverend fathers who formed the council of Nice were not advised to abandon the moon altogether, and appoint Easter to be celebrated on the first or second Sunday of April. The ecclesiastical calendar would in this case have possessed all the simplicity and uniformity of the civil calendar, which only requires the adjustment of the civil to the solar year; but they were probably not sufficiently versed in astronomy to be aware of the practical difficulties which their regulation had to encounter.

Dominical Letter.—The first problem which the construction of the calendar presents is to connect the week with the year, or to find the day of the week corresponding to a given day of any year of the era. As the number of days in the week and the number in the year are prime to one another, two successive years cannot begin with the same day; for if a common year begins, for example, with Sunday, the following year will begin with Monday, and if a leap year begins with Sunday, the year following will begin with Tuesday. For the sake of greater generality, the days of the week are denoted by the first seven letters of the alphabet, A, B, C, D, E, F, G, which are placed in the calendar beside the days of the year, so that A stands opposite the first day of January, B opposite the second, and so on to G, which stands opposite the seventh; after which A returns to the eighth, and so on through the 365 days of the year. Now, if one of the days of the week, Sunday for example, is represented by E, Monday will be represented by F, Tuesday by G, Wednesday by A, and so on; and every Sunday through the year will have the same character E, every Monday F, and so with regard to the rest. The letter which denotes Sunday is called the *Dominical Letter*, or the *Sunday Letter;* and when the dominical letter of the year is known, the letters which respectively correspond to the other days of the week become known at the same time.

Solar Cycle.—In the Julian calendar the dominical letters are readily found by means of a short cycle, in which they recur in the same order without interruption The number of years in the intercalary period being four, and the days of the week being seven, their product is $4 \times 7 = 28$; twenty-eight years is therefore a period which includes all the possible combinations of the days of the week with the commencement of the year. This period is called the *Solar Cycle*, or the *Cycle of the Sun*, and restores the first day of the year to the same day of the week. At the end of the cycle the dominical letters return again in the same order on the same days of the month; hence a table of dominical letters, constructed for twenty-eight years, will serve to show the dominical letter of any given year from the commencement of the era to the reformation. The cycle, though probably not invented before the time of the council of Nice, is regarded as having commenced nine years before the era, so that the year *one* was the tenth of the solar cycle. To find the year of the cycle, we have therefore the following rule: *Add nine to the date, divide the sum by twenty-eight; the quotient is the number of cycles elapsed, and the remainder is the year of the cycle.* Should there be no remainder, the proposed year is the twenty-eighth or last of the cycle. This rule is conveniently expressed by the formula $\left(\frac{x+9}{28}\right)_r$, in which x denotes the date, and the symbol r denotes that the remainder, which arises from the division of $x+9$ by 28, is the number required. Thus, for 1840, we have $\frac{1840+9}{28} = 66\frac{1}{28}$, therefore $\left(\frac{1840+9}{28}\right)_r = 1$, and the year 1840 is the first of the solar cycle.

In order to make use of the solar cycle in finding the dominical letter, it is necessary to know that the first year of the Christian era began with Saturday. The dominical letter of that year, which was the tenth of the cycle, was consequently B. The following year, or the 11th of the cycle, the letter was A; then G. The fourth year was bissextile, and the dominical letters were F, E; the following year D, and so on. In this manner it is easy to find the dominical letter belonging to each of the twenty-eight years of the cycle. But at the end of a century the order is interrupted in the Gregorian calendar by the secular suppression of the leap year; hence the cycle can only be employed during a century. In the reformed calendar the intercalary period is four hundred years, which number being multiplied by seven, gives two thousand eight hundred years as the interval in which the coincidence is restored between the days of the year and the days of the week. This long period, however, may be reduced to four hundred years; for since the dominical letter goes back five places every four years, its variation in four hundred years, in the Julian calendar, was five hundred places, which is equivalent to only three places (for five hundred divided by seven leaves three); but the Gregorian calendar suppresses exactly three intercalations in four hundred years, so that after four hundred years the dominical letters must again return in the same order.

Hence the following table of dominical letters for four hundred years will serve to show the dominical letter of any year in the Gregorian calendar for ever. It contains four columns of letters, each column serving for a century. In order to find the column from which the letter in any given case is to be taken, strike off the two last figures of the date, divide the preceding figures by four, and the remainder will indicate the column. The symbol X, employed in the formula at the top of the column, denotes the date after the two last figures have been suppressed. For example, required the dominical letter of the year 1839? In this case $X = 18$, therefore $\left(\frac{X}{4}\right)_r = 2$; and in the second column of letters, opposite 39, we find F, which is the letter of the proposed year.

TABLE I.—*Dominical Letters.*

Years of the Century.	$\left(\frac{X}{4}\right)_r=1$	$\left(\frac{X}{4}\right)_r=2$	$\left(\frac{X}{4}\right)_r=3$	$\left(\frac{X}{4}\right)_r=0$
	C	E	G	B, A
1 29 57 85	B	D	F	G
2 30 58 86	A	C	E	F
3 31 59 87	G	B	D	E
4 32 60 88	F, E	A, G	C, B	D, C
5 33 61 89	D	F	A	B
6 34 62 90	C	E	G	A
7 35 63 91	B	D	F	G
8 36 64 92	A, G	C, B	E, D	F, E
9 37 65 93	F	A	C	D
10 38 66 94	E	G	B	C
11 39 67 95	D	F	A	B
12 40 68 96	C, B	E, D	G, F	A, G
13 41 69 97	A	C	E	F
14 42 70 98	G	B	D	E
15 43 71 99	F	A	C	D
16 44 72	E, D	G, F	B, A	C, B
17 45 73	C	E	G	A
18 46 74	B	D	F	G
19 47 75	A	C	E	F
20 48 76	G, F	B, A	D, C	E, D
21 49 77	E	G	B	C
22 50 78	D	F	A	B
23 51 79	C	E	G	A
24 52 80	B, A	D, C	F, E	G, F
25 53 81	G	B	D	E
26 54 82	F	A	C	D
27 55 83	E	G	B	C
28 56 84	D, C	F, E	A, G	B, A

It deserves to be remarked, that as the dominical letter of the first year of the era was B, the first column of the above table will give the dominical letter of every year from the commencement of the era to the reformation. For this purpose divide the date by 28, and the letter opposite the remainder, in the first column of figures, is the dominical letter of the year. For example, suppose the date to be 1148. On dividing this number by 28, the remainder is 0, or 28; and opposite 28, in the first column of letters, we find D, C, which, therefore, are the dominical letters of the year 1148.

Lunar Cycle and Golden Number.—In connecting the lunar month with the solar year, the framers of the ecclesiastical calendar adopted the period of Meton, which they supposed to be exact. A different arrangement has, however, been followed with respect to the distribution of the months. The lunations are supposed to consist of twenty-nine and thirty days alternately, or the lunar year of 354 days; and in order to make up nineteen solar years, six embolismic or intercalary months, of thirty days each, are introduced in the course of the cycle, and one of twenty-nine days at the end. This gives $19 \times 354 + 6 \times 30 + 29 = 6935$ days, to be distributed among 235 lunar months. But every leap year one day must be added to the lunar month in which the 29th of February is included. Now, if leap year happens on the first, second, or third year of the period, there will be five leap years in the period, but only four when the first leap year falls on the fourth. In the former case the number of days in the period becomes 6940, and in the latter 6939. The mean length of the cycle is therefore $6939\frac{3}{4}$ days, agreeing exactly with nineteen Julian years.

By means of the lunar cycle the new moons of the calendar were indicated before the reformation. As the cycle restores these phenomena to the same days of the civil month, they will fall on the same days in any two years which occupy the same place in the cycle; consequently a table of the moon's phases for 19 years will serve for any year whatever when we know its number in the cycle. This number is called the *Golden Number*, either because it was so termed by the Greeks, or because it was usual to mark it with red letters in the calendar. The Golden Numbers were introduced into the calendar about the year 530, but disposed as they would have been if they had been inserted at the time of the council of Nice. The cycle is supposed to commence with the year in which the new moon falls on the 1st of January, which took place the year preceding the commencement of our era. Hence, to find the Golden Number N, we have $N = \left(\frac{x+1}{19}\right)_r$, which gives the following rule: *Add* 1 *to the date, divide the sum by* 19; *the quotient is the number of cycles elapsed, and the remainder is the Golden Number.* When the remainder is 0, the proposed year is of course the last or 19th of the cycle. It ought to be remarked that the new moons, determined in this manner, may differ from the astronomical new moons sometimes so much as two days. The reason is, that the sum of the solar and lunar inequalities, which are compensated in the whole period, may amount in certain cases to 10°, and thereby cause the new moon to arrive on the second day before or after its mean time.

Dionysian Period.—The cycle of the sun brings back the days of the month to the same day of the week; the lunar cycle restores the new moons to the same day of the month; therefore $28 \times 19 = 532$ years, includes all the variations in respect of the new moons and the dominical letters, and is consequently a period after which the new moons again occur on the same day of the month and the same day of the week. This is called the *Dionysian* or *Great Paschal period*, from its having been employed by Dionysius Exiguus, familiarly styled *Denys the Little*, in determining Easter Sunday. It was however first proposed by Victorius of Aquitain, who had been appointed by Pope Hilary to revise and correct the church calendar. Hence it is also called the Victorian period. It continued in use till the Gregorian reformation.

Cycle of Indiction.—Besides the solar and lunar cycles, there is a third of 15 years, called the cycle of indiction, frequently employed in the computations of chronologists. This period is not astronomical, like the two former; but has reference to certain judicial acts which took place at stated epochs under the Greek emperors. Its commencement is referred to the 1st of January of the year 313 of the common era. By extending it backwards, it will be found that the first of the era was the fourth of the cycle of indiction. The number of any year in this cycle will therefore be given by the formula $\left(\frac{x+3}{15}\right)_r$, that is to say, *add* 3 *to the date, divide the sum by* 15, *and the remainder is the year of the indiction.* When the remainder is 0, the proposed year is the fifteenth of the cycle.

Julian Period.—The Julian period, proposed by the celebrated Joseph Scaliger as an universal measure of chronology, is formed by taking the continued product of

the three cycles of the sun, of the moon, and of the indiction, and is consequently $28 \times 19 \times 15 = 7980$ years. In the course of this long period no two years can be expressed by the same numbers in all the three cycles. Hence, when the number of any proposed year in each of the cycles is known, its number in the Julian period can be determined by the resolution of a very simple problem of the indeterminate analysis. It is unnecessary, however, in the present case, to exhibit the general solution of the problem, because when the number in the period corresponding to any one year in the common era has been ascertained, it is easy to establish the correspondence for all other years, without having again recourse to the direct solution of the problem. We shall therefore find the number of the Julian period corresponding to the first of our era.

We have already seen that the year 1 of the era had 10 for its number in the solar cycle, 2 in the lunar cycle, and 4 in the cycle of indicti n; the question is therefore to find a number such, that when it is divided by the three numbers 28, 19, and 15 respectively, the three quotients shall be 10, 2, and 4.

Let x, y, and z, be the three quotients of the divisions; the number sought will then be expressed by $28\,x + 10$, by $19\,y + 2$, or by $15\,z + 4$. Hence the two equations

$$28\,x + 10 = 19\,y + 2 = 15\,z + 4.$$

To resolve the equation $28\,x + 10 = 19\,y + 2$, or $y = x + \frac{9\,x + 8}{19}$, let $m = \frac{9\,x + 8}{19}$, we have then $x = 2\,m + \frac{m - 8}{9}$. Let $\frac{m - 8}{9} = m'$; then $m = m' + 8$; hence $x = 18\,m' + 16 + m' = 19\,m + 16$..........(1)

Again, since $28\,x + 10 = 15\,z + 4$, we have $15\,z = 28\,x + 6$, or $z = 2\,x - \frac{2\,x - 6}{15}$. Let $\frac{2\,x - 6}{15} = n$; then $2\,x = 15\,n + 6$, and $x = 7\,n + 3 + \frac{n}{2}$. Let $\frac{n}{2} = n'$; then $n = 2\,n'$; consequently

$$x = 14\,n' + 3 + n' = 15\,n' + 3 \text{.........(2)}$$

Equating the above two values of x, we have $15\,n' + 3 = 19\,m' + 16$; whence $n' = m' + \frac{4\,m' + 13}{15}$. Let $\frac{4\,m' + 13}{15} = p$; we have then $4\,m' = 15\,p - 13$, and $m' = 4\,p - \frac{p + 13}{4}$. Let $\frac{p + 13}{4} = p'$; then $p = 4\,p' - 13$; whence $m' = 16\,p' - 52 - p' = 15\,p' - 52$. Now in this equation p' may be any number whatever, provided $15\,p'$ exceed 52. The smallest value of p' (which is the one here wanted) is therefore 4; for $15 \times 4 = 60$. Assuming therefore $p' = 4$, we have $m' = 60 - 52 = 8$; and consequently, since $x = 19\,m' + 15$, $x = 19 \times 8 + 16 = 168$. The number required is consequently $20 \times 168 + 10 = 4714$.

Having found the number 4714 for the first of the era, the correspondence of the years of the era and of the period is as follows:

Era, 1, 2, 3,... x,
Period, 4714, 4715, 4716,...$4713 + x$;

from which it is evident, that if we take P to represent the year of the Julian period, and Y the corresponding year of the Christian era, we shall have

$$P = 4713 + Y, \text{ and } Y = P - 4713.$$

With regard to the numeration of the years previous to the commencement of the era, the practice is not uniform. Chronologists, in general, reckon the year preceding the first of the era -1, the next preceding -2, and so on. In this case

Era, -1, -2, -3,... $-x$,
Period, 4713, 4712, 4711,...$4714 - x$;

whence

$$P = 4714 - Y, \text{ and } Y = 4714 - P.$$

But astronomers, in order to preserve the uniformity of computation, make the series of years proceed without interruption, and reckon the year preceding the first of the era 0. In this case

Era, 0, -1, -2,... $-x$,
Period, 4713, 4712, 4711,...$4714 - x$;

therefore

$$P = 4713 - Y, \text{ and } Y = 4713 - P.$$

Reformation of the Calendar.—The ancient church calendar was founded on two suppositions, both erroneous, namely, that the year contains $365\frac{1}{4}$ days, and that 235 lunations are exactly equal to nineteen solar years. It could not therefore long continue to preserve its correspondence with the seasons, or to indicate the days of the new moons with the same accuracy. About the year 730, the venerable Bede had already perceived the anticipation of the equinoxes, and remarked that these phenomena then took place about three days earlier than at the time of the council of Nice. Five centuries after the time of Bede, the divergence of the true equinox from the 21st of March, which now amounted to seven or eight days, was pointed out by John of Sacrobosco, in a work published under the title *De Anni Ratione;* and by Roger Bacon, in a treatise *De Reformatione Calendarii*, which, though never published, was transmitted to the pope. These works were probably little regarded at the time; but as the errors of the calendar went on increasing, and the true length of the year, in consequence of the progress of astronomy, became better known, the project of a reformation was again revived in the fifteenth century; and in 1474 Pope Sextus IV. invited Regiomontanus, the most celebrated astronomer of the age, to Rome, to superintend the reconstruction of the calendar. The premature death of Regiomontanus caused the design to be suspended for the present: but in the following century numerous memoirs appeared on the subject, among the authors of which were Stœffler, Albert Pighius, John Schœner, Lucas Gauricus, and other mathematicians of celebrity. At length Pope Gregory XIII. perceiving that the measure was likely to confer a great eclat on his pontificate, undertook the long-desired reformation; and having found the governments of the principal catholic states ready to adopt his views, he issued a brief in the month of March 1582, in which he abolished the use of the ancient calendar, and substituted that which has since been received in almost all Christian countries under the name of the *Gregorian Calendar* or *New Style.* The author of the system adopted by Gregory was Aloysius Lilius, or Luigi Lilio Ghiraldi, a learned astronomer and physician of Naples, who died, however, before its introduction; but the individual who most contributed to give the ecclesiastical calendar its present form, and who was charged with all the calculations necessary for its verification, was Clavius, by whom it was completely developed and explained in a great folio treatise of 800 pages, published in 1603, the title of which is given at the end of this article.

It has already been mentioned that the error of the Julian year was corrected in the Gregorian calendar by the suppression of three intercalations in 400 years. In order to restore the commencement of the year to the same place in the seasons that it had occupied at the time of the council of Nice, Gregory directed the day following the feast of St Francis, that is to say the 5th of October, to be reckoned the 15th of that month. By this regulation

 the vernal equinox, which now happened on the 11th of March, was restored to the 21st. From 1582 to 1700, the difference between the old and new style continued to be ten days; but 1700 being a leap year in the Julian calendar, and a common year in the Gregorian, the difference of the styles during the eighteenth century was eleven days. The year 1800 was also common in the new calendar, and, consequently, the difference in the present century is twelve days. From 1900 to 2100 it will be thirteen days.

The restoration of the equinox to its former place in the year, and the correction of the intercalary period, were attended with no difficulty; but Lilius had also to adapt the lunar year to the new rule of intercalation. The lunar cycle contained 6939 days 18 hours, whereas the exact time of 235 lunations, as we have already seen, is $235 \times 29{\cdot}5305887 = 6939$ days 16 hours 31·2 minutes. The difference, which is 1 hour 28·8 minutes, amounts to a day in 308 years, so that at the end of this time the new moons occur one day earlier than they are indicated by the golden numbers. During the 1257 years that elapsed between the council of Nice and the reformation, the error had accumulated to four days, so that the new moons, which were marked in the calendar as happening, for example, on the 5th of the month, actually fell on the first. It would have been easy to correct this error by placing the golden numbers four lines higher in the new calendar; and the suppression of the ten days had already rendered it necessary to place them ten lines lower, and to carry those which belonged, for example, to the 5th and 6th of the month, to the 15th and 16th. But, supposing this correction to have been made, it would have again become necessary, at the end of 308 years, to advance them one line higher, in consequence of the accumulation of the error of the cycle to a whole day. On the other hand, as the golden numbers were only adapted to the Julian calendar, every omission of the centenary intercalation would require them to be placed one line lower, opposite the 6th, for example, instead of the 5th of the month; so that, generally speaking, the places of the golden numbers would have to be changed every century. On this account Lilius thought fit to reject the golden numbers from the calendar, and supply their place by another set of numbers called *Epacts*, the use of which we shall now proceed to explain.

Epacts.—Epact is a word of Greek origin, employed in the calendar to signify the moon's age at the end of the year. The common solar year containing 365 days, and the lunar year only 354 days, the difference is eleven; whence, if a new moon fall on the 1st of January in any year, the moon will be eleven days old on the first day of the following year, and twenty-two days on the first of the third year. The numbers eleven and twenty-two are therefore the epacts of those years respectively. Another addition of eleven gives thirty-three for the epact of the fourth year; but in consequence of the insertion of the intercalary month in each third year of the lunar cycle, this epact is reduced to three. In like manner the epacts of all the following years of the cycle are obtained by successively adding eleven to the epact of the former year, and rejecting thirty as often as the sum exceeds that number. They are therefore connected with the golden numbers by the formula $\left(\frac{11\ n}{30}\right)_r$, in which n is any whole number; and for a whole lunar cycle (supposing the first epact to be 11), they are as follows: 11, 22, 3, 14, 25, 6, 17, 28, 9, 20, 1, 12, 23, 4, 15, 26, 7, 18, 29. But the order is interrupted at the end of the cycle; for the epact of the following year, found in the same manner, would be $29 + 11 = 40 = 10$, whereas it ought again to be 11 to correspond with the moon's age and the golden number 1. The reason of this is, that the intercalary month, inserted at the end of the cycle, contains only twenty-nine days instead of thirty; whence, after 11 has been added to the epact of the year corresponding to the golden number 19, we must reject twenty-nine instead of thirty, in order to have the epact of the succeeding year; or, which comes to the same thing, we must add twelve to the epact of the last year of the cycle, and then reject thirty as before.

This method of forming the epacts might have been continued indefinitely if the Julian intercalation had been followed without correction, and the cycle been perfectly exact; but as neither of these suppositions is true, two equations or corrections must be applied, one depending on the error of the Julian year, which is called the solar equation; the other on the error of the lunar cycle, which is called the lunar equation. The solar equation occurs three times in 400 years, namely, in every secular year which is not a leap year; for in this case the omission of the intercalary day causes the new moons to arrive one day later in all the following months, so that the moon's age at the end of the month is one day less than it would have been if the intercalation had been made, and the epacts must accordingly be all diminished by unity. Thus the epacts 11, 22, 3, 14, &c. become 10, 21, 2, 13, &c. On the other hand, when the time by which the new moons anticipate the lunar cycle amounts to a whole day, which, as we have seen, it does in 308 years, the new moons will arrive one day earlier, and the epacts must consequently be increased by unity. Thus the epacts 11, 22, 3, 14, &c. in consequence of the lunar equation, become 12, 23, 4, 15, &c. In order to preserve the uniformity of the calendar, the epacts are changed only at the commencement of a century; the correction of the error of the lunar cycle is therefore made at the end of 300 years. In the Gregorian calendar this error is assumed to amount to one day in $312\frac{1}{2}$ years, or eight days in 2500 years, an assumption which requires the line of epacts to be changed seven times successively at the end of each period of 300 years, and once at the end of 400 years; and, from the manner in which the epacts were disposed at the reformation, it was found most correct to suppose one of the periods of 2500 years to terminate with the year 1800.

The years in which the solar equation occurs, counting from the reformation, are 1700, 1800, 1900, 2100, 2200, 2300, 2500, &c. Those in which the lunar equation occurs are 1800, 2100, 2400, 2700, 3000, 3300, 3600, 3900, after which, 4300, 4600, and so on. When the solar equation occurs, the epacts are diminished by unity; when the lunar equation occurs, the epacts are augmented by unity; and when both equations occur together, as in 1800, 2100, 2700, &c. they compensate each other, and the epacts are not changed.

In consequence of the solar and lunar equations, it is evident that the epact, or moon's age at the beginning of the year, must, in the course of centuries, have all different values from one to thirty inclusive, corresponding to the days in a full lunar month. Hence, for the construction of a perpetual calendar, there must be thirty different sets or lines of epacts. These are exhibited in the subjoined table (Table II.), called the *Extended Table of Epacts*, which is constructed in the following manner. The series of golden numbers is written in a line at the top of the table, and under each golden number is a column of thirty epacts, arranged in the order of the natural numbers, beginning at the bottom and proceeding to the top of the column. The first column, under the golden number 1, contains the epacts 1, 2, 3, 4, &c. to 30 or 0. The second column, corresponding to the following year in the lunar cycle, must have all its epacts augmented by 11; the low-

est number therefore in the column is 12, then 13, 14, 15, and so on. The third column, corresponding to the golden number 3, has for its first epact 12 + 11 = 23; and in the same manner all the nineteen columns of the table are formed. Each of the thirty lines of epacts is designated by a letter of the alphabet, which serves as its index or argument. The order of the letters, like that of the numbers, is from the bottom of the column upwards.

TABLE II.—*Extended Table of Epacts.*

Years.	Index.	Golden Numbers. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1700 1800 8700	C	*	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18
1900 2000 2100	B	29	10	21	2	13	24	5	16	27	8	19	*	11	22	3	14	25′	6	17
2200 2400	A	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16
2300 2500	u	27	8	19	*	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15
2600 2700 2800	t	26	7	18	29	10	21	2	13	24	5	16	27	8	19	*	11	22	3	14
2900 3000	s	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13
3100 3200 3300	r	24	5	16	27	8	19	*	11	22	3	14	25′	6	17	28	9	20	1	12
3400 3600	q	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	*	11
3500 3700	p	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10
3800 3900 4000	n	21	2	13	24	5	16	27	8	19	*	11	22	3	14	25′	6	17	28	9
4100	m	20	1	12	23	4	15	62	7	18	29	10	21	2	13	24	5	16	27	8
4200 4300 4400	l	19	*	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7
4500 4600	k	18	29	10	21	2	13	24	5	16	27	8	19	*	11	22	3	14	25′	6
4700 4800 4900	i	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5
5000 5200	h	16	27	8	19	*	11	22	3	14	25	6	17	28	9	20	1	12	23	4
5100 5300	g	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	*	11	22	3
5400 5500 5600	f	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2
5700 5800	e	13	24	5	16	27	8	19	*	11	22	3	14	25′	6	17	28	9	20	1
5900 6000 6100	d	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	*
6200 6400	c	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29
6300 6500	b	10	21	2	13	24	5	16	27	8	19	*	11	22	3	14	25′	6	17	28
6600 6800	a	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27
6700 6900	P	8	19	*	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26
7000 7100 7200	N	7	18	29	10	21	2	13	24	5	16	27	8	19	*	11	22	3	14	25′
7300 7400	M	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24
7500 7600 7700	H	5	16	27	8	19	*	11	22	3	14	25	6	17	28	9	20	1	12	23
7800 8000	G	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	*	11	22
7900 8100	F	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21
8200 8300 8400	E	2	13	24	5	16	27	8	19	*	11	22	3	14	25′	6	17	28	9	20
1500 1600	D	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19

In the tables of the church calendar the epacts are usually printed in Roman numerals, excepting the last, which is designated by an asterisk (*), used as an indefinite symbol to denote 30 or 0; and 25, which in the eight last columns is expressed in Arabic characters, for a reason that will immediately be explained. In the table here given, this distinction is made by means of an accent placed over the last figure.

At the reformation the epacts were given by the line D. The year 1600 was a leap year; the intercalation accordingly took place as usual, and there was no interruption in the order of the epacts; the line D was employed till 1700. In that year the omission of the intercalary day rendered it necessary to diminish the epacts by unity, or to pass to the line C. In 1800 the solar equation again occurred, in consequence of which it was necessary to descend one line to have the epacts diminished by unity; but in this year the lunar equation also occurred, the anticipation of the new moons having amounted to a day; the new moons accordingly happened a day earlier, which rendered it necessary to take the epacts in the next higher line. There was consequently no alteration; the two equations destroyed each other. The line of epacts belonging to the present century is therefore C. In 1900 the solar equation occurs, after which the line is B. The year 2000 is a leap year, and there is no alteration. In 2100 the equations again occur together and destroy each other, so that the line B will serve three centuries, from 1900 to 2200. From that year to 2300 the line will be A. In this manner the line of epacts belonging to any given century is easily found, and the method of proceeding is obvious. When the solar equation occurs alone, the line of epacts is changed to the next lower in the table; when the lunar equation occurs alone, the line is changed to the next higher; when both equations occur together, no change takes place. In order that it may be perceived at once to what centuries the different lines of epacts respectively belong, we have placed them in a column on the left hand side of the above table.

The use of the epacts is to show the days of the new moons, and consequently the moon's age on any day of the year. For this purpose they are placed in the calendar

(Table III.) along with the days of the month and dominical letters, in a retrograde order, so that the asterisk stands beside the 1st of January, 29 beside the 2d, 28 beside the 3d, and so on to 1, which corresponds to the 30th. After this comes the asterisk, which corresponds to the 31st of January, then 29, which belongs to the 1st of February, and so on to the end of the year. The reason of this distribution is evident. If the last lunation of any year ends, for example, on the 2d of December, the new moon falls on the 3d; and the moon's age on the 31st, or at the end of the year, is twenty-nine days. The epact of the following year is therefore twenty-nine. Now that lunation having commenced on the 3d of December, and consisting of thirty days, will end on the 1st of January. The 2d of January is therefore the day of the new moon, which is indicated by the epact twenty-nine. In like manner, if the new moon fell on the 4th of December, the epact of the following year would be twenty-eight, which, to indicate the day of next new moon, must correspond to the 3d of January.

Calendar.

TABLE III.—*Gregorian Calendar.*

Days.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December	
	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L
1	*	A	29	D	*	D	29	G	28	B	27	E	26	G	25 24	C	23	F	22	A	21	D	20	F
2	29	B	28	E	29	E	28	A	27	C	25'26	F	25'25	A	23	D	22	G	21	B	20	E	19	G
3	28	C	27	F	28	F	27	B	26	D	25 24	G	24	B	22	E	21	A	20	C	19	F	18	A
4	27	D	25'26	G	27	G	25'26	C	25'25	E	23	A	23	C	21	F	20	B	19	D	18	G	17	B
5	26	E	25 24	A	26	A	25 24	D	24	F	22	B	22	D	20	G	19	C	18	E	17	A	16	C
6	25'25	F	23	B	25'25	B	23	E	23	G	21	C	21	E	19	A	18	D	17	F	16	B	15	D
7	24	G	22	C	24	C	22	F	22	A	20	D	20	F	18	B	17	E	16	G	15	C	14	E
8	23	A	21	D	23	D	21	G	21	B	19	E	19	G	17	C	16	F	15	A	14	D	13	F
9	22	B	20	E	22	E	20	A	20	C	18	F	18	A	16	D	15	G	14	B	13	E	12	G
10	21	C	19	F	21	F	19	B	19	D	17	G	17	B	15	E	14	A	13	C	12	F	11	A
11	20	D	18	G	20	G	18	C	18	E	16	A	16	C	14	F	13	B	12	D	11	G	10	B
12	19	E	17	A	19	A	17	D	17	F	15	B	15	D	13	G	12	C	11	E	10	A	9	C
13	18	F	16	B	18	B	16	E	16	G	14	C	14	E	12	A	11	D	10	F	9	B	8	D
14	17	G	15	C	17	C	15	F	15	A	13	D	13	F	11	B	10	E	9	G	8	C	7	E
15	16	A	14	D	16	D	14	G	14	B	12	E	12	G	10	C	9	F	8	A	7	D	6	F
16	15	B	13	E	15	E	13	A	13	C	11	F	11	A	9	D	8	G	7	B	6	E	5	G
17	14	C	12	F	14	F	12	B	12	D	10	G	10	B	8	E	7	A	6	C	5	F	4	A
18	13	D	11	G	13	G	11	C	11	E	9	A	9	C	7	F	6	B	5	D	4	G	3	B
19	12	E	10	A	12	A	10	D	10	F	8	B	8	D	6	G	5	C	4	E	3	A	2	C
20	11	F	9	B	11	B	9	E	9	G	7	C	7	E	5	A	4	D	3	F	2	B	1	D
21	10	G	8	C	10	C	8	F	8	A	6	D	6	F	4	B	3	E	2	G	1	C	*	E
22	9	A	7	D	9	D	7	G	7	B	5	E	5	G	3	C	2	F	1	A	*	D	29	F
23	8	B	6	E	8	E	6	A	6	C	4	F	4	A	2	D	1	G	*	B	29	E	28	G
24	7	C	5	F	7	F	5	B	5	D	3	G	3	B	1	E	*	A	29	C	28	F	27	A
25	6	D	4	G	6	G	4	C	4	E	2	A	2	C	*	F	29	B	28	D	27	G	26	B
26	5	E	3	A	5	A	3	D	3	F	1	B	1	D	29	G	28	C	27	E	25'26	A	25'25	C
27	4	F	2	B	4	B	2	E	2	G	*	C	*	E	28	A	27	D	26	F	25 24	B	24	D
28	3	G	1	C	3	C	1	F	1	A	29	D	29	F	27	B	25'26	E	25'25	G	23	C	23	E
29	2	A			2	D	*	G	*	B	28	E	28	G	26	C	25 24	F	24	A	22	D	22	F
30	1	B			1	E	29	A	29	C	27	F	27	A	25'25	D	23	G	23	B	21	E	21	G
31	*	C			*	F			28	D			25'26	B	24	E			22	C			19'20	A

When the epact of the year is known, the days on which the new moons occur throughout the whole year are shown by this table, which is called the *Gregorian Calendar of Epacts*. For example, the epact of the year 1832, as found in Table II., is twenty-eight. This epact occurs at the 3d of January, the 2d of February, the 3d of March, the 2d of April, the 1st of May, &c.; and these days are consequently the days of the ecclesiastical new moons in 1832. The astronomical new moons generally take place one or two days, sometimes even three days, earlier than those of the calendar.

There are some artifices employed in the construction of this table, to which it is necessary to pay attention. The thirty epacts correspond to the thirty days of a full lunar month; but the lunar months consist of twenty-nine and thirty days alternately; therefore in six months of the year the thirty epacts must correspond only to twenty-nine days. For this reason the epacts twenty-five and twenty-four are placed together, so as to belong only to one day in the months of February, April, June, August, September, and November, and in the same months another 25 is distinguished by an accent, or by being printed in a dif-

ferent character, is placed beside 26, and belongs to the same day. The reason for doubling the 25 was to prevent the new moons from being indicated in the calendar as happening twice on the same day in the course of the lunar cycle, a thing which actually cannot take place. For example, if we observe the line B in Table II., we shall see that it contains both the epacts twenty-four and twenty-five, so that if these correspond to the same day of the month, two new moons would be indicated as happening on that day within nineteen years. Now the three epacts 24, 25, 26, can never occur in the same line; therefore in those lines in which 24 and 25 occur, the 25 is accented, and placed in the calendar beside 26. When 25 and 26 occur in the same line of epacts, the 25 is not accented, and in the calendar stands beside 24. The lines of epacts in which 24 and 25 both occur, are those which are marked by one of the eight letters *b*, *e*, *k*, *n*, *r*, B, E, N, in all of which 25′ stands in a column corresponding to a golden number higher than 11. There are also eight lines in which 25 and 26 occur, namely, *c*, *f*, *l*, *p*, *s*, C, F, P. In the other 14 lines, 25 either does not occur at all, or it occurs in a line in which neither 24 nor 26 is found. From this it appears, that if the golden number of the year exceeds 11, the epact 25, in six months of the year, must correspond to the same day in the calendar as 26; but if the golden number does not exceed 11, that epact must correspond to the same day as 24. Hence the reason for distinguishing 25 and 25′. In using the calendar, if the epact of the year is 25, and the golden not above 11, take 25; but if the golden number exceeds 11, take 25′.

Another peculiarity requires explanation. The epact 19′ (also distinguished by an accent or different character) is placed in the same line with 20 at the 31st of December. It is, however, only used in those years in which the epact 19 concurs with the golden number 19. When the golden number is 19, that is to say, in the last year of the lunar cycle, the supplementary month contains only 29 days. Hence, if in that year the epact should be 19, a new moon would fall on the 2d of December, and the lunation would terminate on the 30th, so that the next new moon would arrive on the 31st. The epact of the year, therefore, or 19, must stand beside that day, whereas, according to the regular order, the epact corresponding to the 31st of December is 20; and this is the reason for the distinction.

As an example of the use of the preceding tables, suppose it were required to determine the moon's age on the 10th of April 1832. In 1832 the golden number is $\left(\frac{1832+1}{19}\right)_r = 9$, and the line of epacts belonging to the century is C. In Table II. under 9, and in the line C, we find the epact 28. In the calendar, Table III. look for April, and the epact 28 is found opposite the second day. The 2d of April is therefore the first day of the moon, and the 10th is consequently the ninth day of the moon. Again, suppose it were required to find the moon's age on the 2d of December in the year 1916. In this case the golden number is $\left(\frac{1916+1}{19}\right)_r = 17$, and the line of epacts is B. Under 17, in line B, the epact is 25. In the calendar this epact first occurs before the 2d of December at the 26th of November. The 26th of November is consequently the first day of the moon, and the 2d of December is therefore the seventh day.

Easter.—The next, and indeed the principal use of the calendar, is to find Easter, which, according to the regulation of the council of Nice, must be determined from the following conditions: First, Easter must be celebrated on a Sunday; second, this Sunday must *follow* the 14th day of the paschal moon, so that if the 14th of the paschal moon falls on a Sunday, then Easter must be celebrated on the Sunday following; third, the paschal moon is that of which the 14th day falls on or next follows the day of the vernal equinox; fourth, the equinox is fixed invariably in the calendar on the 21st of March.

From these conditions it follows, that the paschal full moon, or the 14th of the paschal moon, cannot happen before the 21st of March, and that Easter in consequence cannot happen before the 22d of March. If the 14th of the moon falls on the 21st, the new moon must fall on the 8th; for $21 - 13 = 8$; and the paschal new moon cannot happen before the 8th; for suppose the new moon to fall on the 7th, then the full moon would arrive on the 20th, or the day before the equinox. The following moon would be the paschal moon. But the fourteenth of this moon falls at the latest on the 18th of April, or 29 days after the 20th of March; for by reason of the double epact that occurs at the 4th and 5th of April, this lunation has only 29 days. Now, if in this case the 18th of April is Sunday, then Easter must be celebrated on the following Sunday, or the 25th of April. Hence Easter Sunday cannot happen earlier than the 22d of March, or later than the 25th of April.

Hence we derive the following rule for finding Easter Sunday from the tables. 1*st*, Find from Table II. the epact of the proposed year. 2*d*, Find in the calendar (Table III.) the first day after the 7th of March, which corresponds to the epact of the year; this will be the first day of the paschal moon. 3*d*, Reckon thirteen days after that of the first of the moon; the following will be the fourteenth of the moon, or the day of the full paschal moon. 4*th*, Find from Table I. the dominical letter of the year, and observe in the calendar the first day after the fourteenth of the moon, which corresponds to the dominical letter; this will be Easter Sunday.

Example.—Required the day on which Easter Sunday falls in the year 1840? 1*st*, For this year the golden number is $\left(\frac{1840+1}{19}\right)_r = 17$, and the epact (Table II. line C) is 26. 2*d*, After the 7th of March the epact 26 first occurs in Table III. at the 4th of April, which therefore is the day of the new moon. 3*d*, Since the new moon falls on the 4th, the full moon is on the 17th ($4 + 13 = 17$). 4*th*, The dominical letters of 1840 are E, D (Table I.), of which D must be taken, as E belongs only to January and February. After the 17th of April D first occurs in the calendar (Table III.) at the 19th. Therefore, in 1840, Easter Sunday falls on the 19th of April.

Such is the very complicated and artificial, though highly ingenious method, invented by Lilius, for the determination of Easter and the other movable feasts. Its principal, though perhaps least obvious advantage, consists in its being entirely independent of astronomical tables, or indeed of any celestial phenomena whatever; so that all chances of disagreement arising from the inevitable errors of tables, or the uncertainty of observation, are avoided, and Easter determined without the possibility of mistake. But this advantage is only procured by the sacrifice of some accuracy: for notwithstanding the cumbersome apparatus employed, the conditions of the problem are not always exactly satisfied, nor is it possible that they can be always satisfied by any similar method of proceeding. The equinox is fixed on the 21st of March, though the sun enters Aries generally on the 20th of that month, sometimes even on the 19th. It is therefore quite possible that a full moon may arrive after the true equinox, and yet precede the 21st of March. This therefore would not be the paschal moon of the calendar, though it undoubtedly ought to be so, if the intention of the council of Nice were rigidly fol-

 lowed. The new moons indicated by the epacts also differ from the astronomical new moons, and even from the mean new moons, in general by one or two days. In imitation of the Jews, who counted the time of the new moon, not from the moment of the actual phase, but from the time the moon first became visible after the conjunction, the fourteenth day of the moon is regarded as the full moon; but the moon is in opposition generally on the 16th day; therefore, when the new moons of the calendar nearly concur with the true new moons, the full moons are considerably in error. The epacts are also placed so as to indicate the full moons generally one or two days after the true full moons; but this was done purposely, to avoid the chance of concurring with the Jewish passover, which the framers of the calendar seem to have considered a greater evil than that of celebrating Easter a week too late.

We will now show in what manner this whole apparatus of methods and tables may be dispensed with, and the Gregorian calendar reduced to a few simple formulæ of easy computation. And, first, to find the dominical letter.

Let L denote the number of the dominical letter of any given year of the era. Then, since every year which is not a leap year ends with the same day as that with which it began, the dominical letter of the following year must be $(L - 1)$, retrograding one letter every common year. After x years, therefore, the number of the letter will be $(L - x)$. But as L can never exceed 7, the number x will always exceed L after the first seven years of the era. In order therefore to render the subtraction possible, L must be increased by some multiple of 7, as $7m$, and the formula then becomes $(7m + L - x)$. In the year preceding the first of the era, the dominical letter was C; for that year, therefore, we have $L = 3$; consequently for any succeeding year x, $L = (7m + 3 - x)$, the years being all supposed to consist of 365 days. But every fourth year is a leap year, and the effect of the intercalation is to throw the dominical letter one place farther back. The above expression must therefore be diminished by the number of units in $\frac{x}{4}$, or by $\left(\frac{x}{4}\right)_w$ (this notation being used to denote the quotient, *in a whole number*, that arises from dividing x by 4). Hence in the Julian calendar the dominical letter is given by the equation

$$L = 7m + 3 - x - \left(\frac{x}{4}\right)_w.$$

This equation gives the dominical letter of any year from the commencement of the era to the reformation. In order to adapt it to the Gregorian calendar, we must first add the 10 days that were left out of the year 1582; in the second place we must add one day for every century that has elapsed since 1600, in consequence of the secular suppression of the intercalary day; and lastly, we must deduct the units contained in a fourth of the same number, because every fourth centesimal year is still a leap year. Denoting therefore the number of the century (or the date after the two right-hand digits have been struck out) by c, the value of L must be increased by $10 + (c - 16) - \left(\frac{c - 16}{4}\right)_w$. We have then

$$L = 7m + 3 - x - \left(\frac{x}{4}\right)_w + 10 + (c - 16) - \left(\frac{c - 16}{4}\right)_w;$$

that is, since $3 + 10 = 13 = 6$ (the 7 days being rejected, as they do not affect the value of L),

$$L = 7m + 6 - x - \left(\frac{x}{4}\right)_w + (c - 16) - \left(\frac{c - 16}{4}\right)_w;$$

This formula is perfectly general, and easily calculated. As an example, let us take the year 1839. In this case, $x = 1839$, $\left(\frac{x}{4}\right)_w = \left(\frac{1839}{4}\right)_w = 459$, $c = 18$, $c - 16 = 2$, and $\left(\frac{c - 16}{4}\right)_w = 0$. Hence

$$L = 7m + 6 - 1839 - 459 + 2 - 0.$$
$$L = 7m - 2290 = 7 \times 328 - 2290.$$
$$L = 6 = F.$$

The year therefore begins with Monday. It will be remembered that in a leap year there are always two dominical letters, one of which is employed till the 29th of February, and the other till the end of the year. In this case, as the formula supposes the intercalation already made, the resulting letter is that which applies after the 29th of February. Before the intercalation the dominical letter had retrograded one place less. Thus for 1840 the formula gives D; during the first two months, therefore, the dominical letter is E.

In order to investigate a formula for the epact, let us make

E = the true epact of the given year;
J = the Julian epact, that is to say, the number the epact would have been if the Julian year had been still in use, and the lunar cycle had been exact;
S = the correction depending on the solar year;
M = the correction depending on the lunar cycle;

then the equation of the epact will be

$$E = J + S + M;$$

so that E will be known when the numbers J, S, and M, are determined.

The epact J depends on the golden number N, and must be determined from the fact that in 1582, the first year of the reformed calendar, N was 6, and $J = 26$. For the following years, therefore, the golden numbers and epacts are as follows:

$$\begin{aligned} &1583,\ N = 7, && J = 26 + 11 - 30 = 7; \\ &1584,\ N = 8, && J = 7 + 11 = 18; \\ &1585,\ N = 9, && J = 18 + 11 = 29; \\ &1586,\ N = 10, && J = 29 + 11 - 30 = 10; \end{aligned}$$

and in general $J = \left(\frac{26 + 11\,(N - 6)}{30}\right)_r$. But the numerator of this fraction becomes by reduction $11\,N - 40 = 11\,N - 10$ (the 30 being rejected, as the remainder only is sought) $= N + 10\,(N - 1)$; therefore, ultimately

$$J = \left(\frac{N + 10\,(N - 1)}{30}\right)_r.$$

On account of the solar equation S, the epact J must be diminished by unit every centesimal year, excepting always the fourth. After x centuries, therefore, it must be diminished by $x - \left(\frac{x}{4}\right)_w$. Now, as 1600 was a leap year, the first correction of the Julian intercalation took place in 1700; hence, taking c to denote the number of the century as before, the correction becomes $(c - 16) - \left(\frac{c - 16}{4}\right)_w$, which must be deducted from J. We have therefore

$$S = -(c - 16) + \left(\frac{c - 16}{4}\right)_w.$$

With regard to the lunar equation M, we have already stated that in the Gregorian calendar the epacts are increased by unit at the end of every period of 300 years, seven times successively, and the following increase takes place at the end of 400 years. This gives eight to be added in a period of twenty-five centuries, and $\frac{8x}{25}$ in x centuries.

Calendar.

But $\frac{8x}{25}=\frac{8x}{24}-\frac{8x}{600}=\frac{x}{3}-\frac{x}{75}=\frac{1}{3}x-\left(\frac{x}{25}\right)$. Now from the manner in which the intercalation is directed to be made (namely, seven times successively at the end of 300 years, and once at the end of 400), it is evident that the fraction $\frac{x}{25}$ must amount to unit when the number of centuries amounts to twenty-four. In like manner, when the number of centuries is $24+25=49$, we must have $\frac{x}{25}=2$; when the number of centuries is $24+2\times25=74$, then $\frac{x}{25}=3$; and, generally, when the number of centuries is $24+n\times25$, then $\frac{x}{25}=n+1$. Now this is a condition which will evidently be expressed in general by the formula $n-\left(\frac{n+1}{25}\right)_w$. Hence the correction of the epact, or the number of days to be intercalated after x centuries reckoned from the commencement of one of the periods of twenty-five centuries, is $\left\{\frac{x-\left(\frac{x+1}{25}\right)_w}{3}\right\}_w$. The last period of twenty-five centuries terminated with 1800; therefore, in any succeeding year, if c be the number of the century, we shall have $x=c-18$ and $x+1=c-17$. Let $\left(\frac{c-17}{25}\right)_w=a$, then for all years after 1800 the value of M will be given by the formula $\left(\frac{c-18-a}{3}\right)_w$; therefore, counting from the beginning of the calendar in 1582,

$$M=\left\{\frac{c-15-a}{3}\right\}_w.$$

By the substitution of these values of J, S, and M, the equation of the epact becomes

$$E=\left(\frac{N+10(N-1)}{30}\right)_r-c-16+\left(\frac{c-16}{4}\right)_w+\left(\frac{c-15-a}{3}\right)_w.$$

It may be remarked, that as $a=\left(\frac{c-17}{25}\right)_w$, the value of a will be 0 till $c-17=25$ or $c=42$; therefore, till the year 4200, a may be neglected in the computation. Had the anticipation of the new moons been taken, as it ought to have been, at one day in 308 years instead of $312\frac{1}{2}$, the lunar equation would have occurred only twelve times in 3700 years, or eleven times successively at the end of 300 years, and then at the end of 400. In strict accuracy, therefore, a ought to have no value till $c-17=37$, or $c=54$, that is to say, till the year 5400. The above formula for the epact is given by Delambre (*Hist. de l'Astronomie Moderne*, tom. i. p. 9); it may be exhibited under a variety of forms, but the above is perhaps the best adapted for calculation. Another had previously been given by Gauss, but inaccurately, inasmuch as the correction depending on a was omitted.

Having determined the epact of the year, it only remains to find Easter Sunday from the conditions already laid down. Let

P = the number of days from the 21st of March to the 15th of the paschal moon, which is the first day on which Easter Sunday can fall;

p = the number of days from the 21st of March to Easter Sunday;

L = dominical letter of the year;

l = letter belonging to the day on which the 15th of the moon falls;

then, since Easter is the Sunday following the 14th of the moon, we have

$$p=P+(L-l).$$

The value of L is always given by the formula for the dominical letter, and P and l are easily deduced from the epact, as will appear from the following considerations.

When $P=1$, the full moon is on the 21st of March, and the new moon on the eighth $(21-13=8)$, therefore the moon's age on the 1st of March (which is the same as on the 1st of January) is twenty-three days; the epact of the year is consequently twenty-three. When $P=2$ the new moon falls on the ninth, and the epact is consequently twenty-two; and, in general, when P becomes $1+x$, E becomes $23-x$, therefore $P+E=1+x+23-x=24$, and $P=24-E$. In like manner, when $P=1$, $l=D=4$; for D is the dominical letter of the calendar belonging to the 22d of March. But it is evident that when l is increased by unity, that is to say, when the full moon falls a day later, the epact of the year is diminished by unity; therefore, in general, when $l=4+x$, $E=23-x$, whence $l+E=27$ and $l=27-E$. But P can never be less than 1 nor l less than 4, and in both cases $E=23$. When, therefore, E is greater than 23, we must add 30 in order that P and l may have positive values in the formula $P=24-E$ and $l=27-E$. Hence there are two cases.

$$\text{When } E<24\ \begin{cases}P=24-E\\ l=27-E, \text{ or } \left(\frac{27-E}{7}\right)_r,\end{cases}$$

$$\text{When } E>23\ \begin{cases}P=54-E\\ l=57-E, \text{ or } \left(\frac{57-E}{7}\right)_r.\end{cases}$$

By substituting one or other of these values of P and l, according as the case may be, in the formula $p=P+(L-l)$, we shall have p, or the number of days from the 21st of March to Easter Sunday. It will be remarked, that as $(L-l)$ cannot either be 0 or negative, we must add 7 to L as often as may be necessary, in order that $(L-l)$ may be a whole positive number.

By means of the formulæ which we have now given for the dominical letter, the golden number, and the epact, Easter Sunday may be computed for any year after the reformation, without the assistance of any tables whatever. As an example, suppose it were required to compute Easter for the year 1840. By substituting this number in the formula for the dominical letter, we have $x=1840$, $c-16=2$, $\left(\frac{c-16}{4}\right)_w=0$, therefore

$$\begin{aligned}L&=7m+6-1840-460+2\\&=7m-2292\\&=7\times328-2292=2296-2292=4\\L&=4=D \ldots\ldots (1).\end{aligned}$$

For the golden number we have $N=\left(\frac{1840+1}{19}\right)_r$, therefore $N=17$ ....(2).

For the epact we have $\left(\frac{N+10(N-1)}{30}\right)_r=\left(\frac{17+160}{30}\right)_r=\left(\frac{177}{30}\right)_r=27$; likewise $c-16=18-16=2$, $\frac{c-15}{3}=1$, $a=0$, therefore

$$E=27-2+1=26 \ldots\ldots (3).$$

Now since $E>23$, we have for P and l,

$$P=54-E=54-26=28,$$

$$l=\left(\frac{57-E}{7}\right)_r=\left(\frac{57-26}{7}\right)_r=\left(\frac{31}{7}\right)_r=3;$$

consequently, since $p=P+(L-l)$

$$p=28+(4-3)=29;$$

that is to say, Easter happens twenty-nine days after the 21st of March, or on the 19th of April, the same result as was before found from the tables.

The principal church feasts depending on Easter, and the times of their celebration, are as follows:

Septuagesima Sunday	is	9 weeks	before Easter.
Ash Wednesday......	is	46 days	before Easter.
Rogation Sunday....................	is	5 weeks	after Easter.
Ascension day or Holy Thursday	is	40 days	after Easter.
Pentecost or Whitsunday.........	is	7 weeks	after Easter.
Trinity Sunday......................	is	8 weeks	after Easter.

The Gregorian calendar was introduced into Spain, Portugal, and part of Italy, the same day as at Rome. In France it was received in the same year in the month of December, and by the Catholic states of Germany the year following. In the Protestant states of Germany the Julian calendar was adhered to till the year 1700, when it was decreed by the diet of Ratisbon that the new style and the Gregorian correction of the intercalation should be adopted. Instead, however, of employing the golden numbers and epacts for the determination of Easter and the movable feasts, it was resolved that the equinox and the paschal moon should be found by astronomical computation from the Rudolphine tables. But this method, though at first view it may appear more accurate, was soon found to be attended with numerous inconveniences, and was at length, in 1774, abandoned at the instance of Frederic II. king of Prussia. In Denmark and Sweden the reformed calendar was received about the same time as in the Protestant states of Germany. Russia still adheres to the Julian reckoning.

In Great Britain the alteration of the style was for a long time successfully opposed by popular prejudice. The inconvenience, however, of using a different date from that employed by the greater part of Europe, in matters of history and chronology, began to be generally felt; and at length, in 1751, an act of parliament was passed for the adoption of the new style in all public and legal transactions. The difference of the two styles, which then amounted to eleven days, was removed by ordering the day following the 2d of September of the year 1752 to be accounted the 14th of that month; and in order to preserve uniformity in future, the Gregorian rule of intercalation respecting the secular years was adopted. At the same time, the commencement of the legal year was changed from the 25th of April to the 1st of January. In Scotland, the new style was adopted from the beginning of 1600, according to an act of the privy-council in December 1599. This fact is of importance with reference to the date of legal deeds executed in Scotland between that period and 1751, when the change was effected in England. With respect to the movable feasts, Easter is determined by the rule laid down by the council of Nice; but instead of employing the new moons and epacts, the golden numbers are prefixed to the days of the *full* moons. In those years in which the line of epacts is changed in the Gregorian calendar, the golden numbers are removed to different days, and of course a new table is required whenever the solar or lunar equation occurs. The golden numbers have been placed so that Easter may fall on the same day as in the Gregorian calendar. The calendar of the Church of England is therefore from century to century the same in form as the old Roman calendar, excepting that the golden numbers indicate the full moons instead of the new moons.

The principal works on the calendar are the following:—Clavius, *Romani Calendarii a Gregorio XIII. P. M. restituti Explicatio*; Romæ, 1603. Lalande, *Astronomie*, tom. ii. *Traité de la Sphère et du Calendrier*, par M. Revard; Paris, 1816. Delambre, *Traité de l'Astronomie Théorique et Pratique*, tom. iii. *Histoire de l'Astronomie Moderne. Methodus technica brevis, perfacilis ac perpetua, construendi Calendarium Ecclesiasticum, Stylo tam novo quam vetere, pro cunctis Christianis Europæ populis, &c*, auctore Paulo Tittel; Gœttinguæ, 1816. *Formole analitiche pel calcolo della Pasqua, e correzione di quello di Gauss, con critiche osservazioni sù quanto ha scritto del Calendario il Delambre*, di Lodovico Ciccolini; Roma, 1817. (T. G.)

CALENDER, a mechanical engine employed by cloth-lappers, for dressing and finishing cloths and stuffs of various descriptions and fabrics, before exposure to sale, or delivery to purchasers. It is also used by calico-printers, in order to extend and smooth the surface of their cloths, after they have been bleached, and before they are subjected to the operations of the printing table or copper-plate press.

In all cases two, and in many three requisites must be attained, in order to give to cloth that appearance which it is deemed necessary that it should possess, to attract the eye and gratify the fancy of the purchaser and consumer.

The *first* of these requisites consists in as perfect extension and smoothness of surface as can be attained; so that no wrinkle or doubled folding may remain in it, excepting such as shall afterwards be intentionally made, in order to the reducing of it to the proper form and shape.

The *second* requisite acquired by the calendering of cloth, is the compression of the yarn or threads of which the texture is composed, which in some degree divests them of their cylindrical shape, and reduces them to a degree of flatness, which, by bringing them more closely into contact with each other, gives to the fabric a greater appearance of closeness and strength than it would otherwise possess. The operation of the calender also improves the superficial appearance, by flattening down all knots, lumps, and other imperfections, from which no material from which cloth is fabricated can ever be entirely freed during the previous processes of spinning and weaving.

And, *thirdly*, in many fabrics it is desirable, and esteemed a great addition to the effect and beauty of the superficial appearance, that cloth should receive, by means of friction, an additional lustre or polish, which is generally distinguished by the appellation of glazing, and is chiefly required in those stuffs which are employed in the ornamental descriptions of female attire.

Such, in a strictly limited sense, are the sole and exclusive effects resulting from the mechanical operation of the calender; but, as other operations besides smoothing or glazing are necessary for the proper preparation of cloths for the market, these also are carried on by the same persons, and in the same premises. Hence by a natural, although not strictly correct, extension of its acceptation, the term calender, which really means only the chief mechanical engine employed, gives the general name to the whole establishment where all the varied operations of cloth-lapping are carried on; and it is as usual to say that goods are *packed*, as that goods are *dressed*, at a calender. In the illustration, therefore, of those operations which the limits of this article will admit, the first object will be to convey a distinct idea of the principles, construction, and operation of the principal machinery employed; and then to add such general and miscellaneous observations as may serve to elucidate how the business of cloth-lapping is carried on in its present extended form.

For the purpose of smoothing both surfaces of a piece

of cloth, it is necessary that they should be exposed to universal contact and pressure in every point, with some body of sufficient density to acquire the requisite degree of superficial polish. Such equality of surface, however, as will produce this effect, is not very easily attainable in large plane surfaces. Hence the contact of cylinders in this operation has been found to be in all respects infinitely preferable to that of planes, both in the speed and the effect of the operation. The common domestic smoothing iron is the most simple of all calendering utensils; but, even in the application of its small and limited surface, it would be difficult to procure any table or board sufficiently level to bring the whole cloth into equal contact with the iron, without the intervention of a few folds of blanket, or some other thick and soft woollen cloth.

The old and now almost entirely superseded machine termed a *mangle* gives the most simple and rude approximation towards cylindrical calendering, and the substitution of circular for plane surfaces. Its operation is that of a cylinder applied to a plane, upon which it is rolled backward and forward, until some degree of smoothness is produced by this reciprocating motion. It is, therefore, very analogous in principle to the common gardener's roller, with which land is resmoothed after having been dug up for sowing or other agricultural purposes.

The smoothing calender completes the substitution of cylindrical for plane surfaces, all the parts which operate upon the cloth being of that form. This ingenious engine, which was introduced into Britain from Flanders and Holland, during the persecution of the Huguenots, has, since its introduction and adoption here, undergone no very material or important alteration or improvement in point of theoretical principle; nor, until the extension of the cotton manufacture had introduced a general spirit of mechanical improvement, had it received any great amelioration in practical execution. Two very important improvements have, however, since that period been introduced and adopted. The first of these, which originated in Lancashire, is now almost universally employed. The second was invented at Glasgow.

The scope of the former of these improvements consists in the substitution of pasteboard in the place of wood, in constructing three out of the five cylinders of which the engine is composed. These cylinders, when previously composed of wood, were found to be liable to two serious and important objections. Calenders employed in general business are necessarily subjected to frequent alternations and vicissitudes of heat and cold. These are entirely unavoidable, because, in smoothing or dressing cloths of the denser fabrics, the effect, as in the common operation of ironing linens, is found to be greatly heightened by the application of as great a degree of heat as can safely be communicated without danger to the fabrics which are to be smoothed.

The expansion of every thread which composes a given extent of cloth, although individually indistinguishable, even with microscopic aid, produces very considerable general effect, when exerted upon eight or ten thousand of these minute cylindrical substances, all combined together in the space of one single square yard. In this expanded state, the pressure of the calender divests them more easily of their cylindrical form, and flattens them down until they come more closely into contact than before. This effect, which is in exact unison with the general theories of expansion and contraction, will at once produce an apparent increase of closeness and density to the texture, as well as of gloss to the surfaces; although the former is in fact deceptive, as no *real* acquisition of strength to the fabric can thus be obtained. The apparent density of fabric, as well as a higher accession of gloss, is also frequently obtained by impregnating and stiffening the cloth, after it has been bleached, with a mucilage of starch; and this is too frequently carried to a very unfair height, for the purposes of deception, which is not very easily detected, until the cloth be again exposed to moisture, when the delusive appearance instantly vanishes. Hence, in all dense fabrics, the calender is generally used in a heated state; whilst in flimsy fabrics, in which transparency of appearance is more the requisite than strength, the operation is conducted with the calender perfectly cold.

The effect of these frequent and sudden transitions upon wooden cylinders was necessarily productive both of *fissure* and *warping* or *twisting*; and no care in drying or seasoning the wood before turning could entirely remove these defects. The substitution of pasteboard, however, afforded a radical cure for both, as well as a collateral advantage arising from its being susceptible of a much higher degree of superficial polish, which is always transferred to the cloth.

The paper or pasteboard cylinder, besides total exemption from all defects incidental to ligneous substances, from the immense density of which it is susceptible by compression, presents a superficies capable of receiving and retaining an almost unparalleled smoothness and polish.

In order to construct cylinders of this description, an axis of malleable iron, and two circular plates of cast iron, are, in the first place, provided. In these plates, which must be at least from one to two inches thick, there are six equidistant perforations near to the circumference, each capable of admitting a rod of malleable iron at least three fourths of an inch in diameter. The entire space between the two iron plates is then to be filled with circular pieces of the strongest pasteboard, exceeding by about one inch in diameter the iron plates, and having each a correspondent perforation, through which the six iron rods may pass parallel to the axis. A cylinder is thus formed, the substance of which is of pasteboard locked together by plates of iron at the extremities, and susceptible, by means of screws on the extremities of the six connecting rods, of immense compression. After undergoing this preparation, the cylinder is exposed to strong heat in a confined apartment; and, as the pasteboard daily contracts, the screws are every day tightened for the space of six days. The density of the cylinder is thus increased, whilst it is contracted in length upon the axis, for which contraction adequate allowance must be made in its original measure, and the operation is continued until it has gradually acquired the requisite compression. It is then re-exposed to the ordinary temperature of the atmosphere, and by its re-expansion presents a body almost inconceivably compact, its specific gravity in this state being greater than even that of silver. The only operation now required is that of turning its superficies until correctly cylindrical; and this is a work of immense labour and patience.

The rotatory motion in turning does not exceed forty or fifty revolutions per minute; and the turner requires two or three assistants constantly employed in sharpening his tools. When properly finished and smoothed, a pasteboard cylinder, however, amply compensates, by its strength, its gloss, and its durability, for the great labour and expense which its construction has created.

A second practical improvement in calenders of the common description consists in the substitution of cast iron for wood in the construction of the connecting frames. This improvement is now common to almost every description of machinery; and when applied to the calender, it is of more than usual advantage, because, independently of the accession of strength and diminution of space occupied, the total exemption of iron from warping is of

Calender. peculiar advantage in an engine so rapidly exposed to alteration of temperature as the calender must be. The entire exemption of iron framing from combustion forms also another advantage of some importance in an engine frequently heated by the application of red-hot cylinders of iron. With this cursory outline of general improvement, the next object of the present article is to afford a description of the new glazing calender.

Glazing calender. Previously to the introduction of this improvement, the operation of glazing, although performed sufficiently well, was somewhat tedious, being effected almost exclusively by the mere application of manual labour. It was performed upon a table, the cover of which was oblique to the horizon, forming with it an angle of 15° or 20°. The cloth being stretched on this, and a quantity of wax being thinly spread on its surface, the glazing was effected by the reciprocation of a smoothed flint, vibrating at the end of a rod, somewhat similar to the oscillations of a pendulum. The centre of oscillation was also movable on a spring, in order to reduce the arc of vibration to a plane, and keep the flint in uniform contact with the cloth. But a man's power was competent to glaze only a few inches in breadth at once, and it was only by successive shiftings that the whole breadth was successively brought under the friction of the flint. The glazing calender produces the same effect, with increased uniformity, simply by changing the relative velocities of the cylinders to each other, and generating friction, as well as pressure, at the points of contact. The process of flint glazing is still practised in Manchester, but on a large scale, the operation being carried on by means of steam power.

The following is a description of the new glazing calender. Fig. 1, Plate CLIV. is an elevation of a five-rollered calender for finishing cloth. AA are two paper rollers, of twenty inches diameter each. BB are two cast-iron cylinders, externally turned until perfectly smooth; their diameter is eight inches, allowing the substance of iron to be two inches, and leaving a perforation of four inches diameter. C is a paper roller of fourteen inches diameter; DD is the framing of cast iron for containing the bushes in which the journals of the rollers revolve; EE are two levers by which the rollers are firmly pressed together while the cloth is passing through.

Fig. 2 is an end view of the same calender, with the wheels for glazing cloth. The wheel on the upper cylinder is ten inches diameter, the wheel on the under cylinder is thirteen inches diameter, both connected by the wheel F, which communicates the speed of the upper cylinder, so that the wheel on the under cylinder being nearly one third of an inch more in diameter, the difference of their motions retards the centre paper roller, by which means the upper cylinder passes over the cloth one third faster than the cloth passes through the calender, and polishes it in consequence.

Fig. 3 is a perspective view of a hydrostatic press. A, the piston, eight inches diameter, working in the cylinder B, and kept water-tight by passing through a collar of leather; D, a cast-iron plate raised by the piston A, between which and the entablature EE the goods to be pressed are laid; CCCC, four malleable iron columns, $2\frac{3}{4}$th inches diameter, having screwed ends, with nuts, by which the entablature and the base FF are firmly connected together. G, a cistern for holding water to supply the two force-pumps HI, the largest of which has a piston $1\frac{1}{2}$ inch diameter, and the other one of half an inch diameter, which is used to give the highest pressure; KK, weights to balance the pump-handles which fit into the sockets at *ll*. The pistons of the force-pumps are made water-tight by collars of leather, kept in their place by the screwed pieces *m* and *n*. *e e e*, a pipe communicating with the pumps and the large cylinder B; there is a stop-cock at *f*, which shuts this communication when required. Calender.

Fig. 4 is an enlarged view of the largest piston, to show the method of keeping the rod parallel.

For dressing muslins, gauzes, lawns, and other goods of the light and transparent fabrics, a smaller species of calender is employed. It consists of only three cylinders of equal diameters (generally about six inches), and is easily moved by a common winch or handle. The middle cylinder is iron, and the others are wood or pasteboard. They are of equal diameters, and are moved with equal velocities by small wheels. This machine is always used in a cold state. Small calender for light fabrics.

The folding of cloth is so entirely regulated by fashion, that no precise rules can be laid down for its regulation. In general, as all the different manufactures of cloth have been imported from other countries, the original foldings have been copied to complete the resemblance. In the infant state of imitation there was probably some policy in this, but the continuance may be ascribed almost exclusively to the power of habit. Preservation and portability are the main requisites to be attained by folding; and these are attained by subjecting the cloth, when folded, to a very powerful compression.

Water-presses upon the forcing principle of Mr Bramah, or acted upon by the pressure of a column of water, are now in general use in Glasgow and Manchester. Besides the immense power thereby procured, the labour of pressing is much lessened. No improvements that have taken place in calendering can exceed the power and facility of the water-press; one of these presses is generally wrought by two men, who can with great ease work the press so as to produce a pressure of four hundred tons; and thereby the appearance and finish of the goods, in consequence of such an immense weight acting on them, are materially improved. Not only this, but the Bramah press is also used for the purpose of packing, which has increased the method of packing in bales considerably. The bale is commonly packed, roped, &c. while in a compressed state; the dimensions are therefore greatly diminished from what they would otherwise be by any other method; for instance, the same quantity of goods packed in a bale would be one third less in size than if they were packed in a box. Bramah's water-presses.

To the mechanical art of calendering it is found expedient, in the extended states of commerce, to add many of the operations of packing, sheeting, and preparing goods for shipment; and these generally form a branch of the establishment. In order to suit the great extent and variety of manufacture practised in Britain, and to adapt these to the prevalent tastes and views of the extensive range of consumers to be supplied, a multiplicity of foldings or lappings has been necessarily adopted, few of which probably possess much claim to entire originality. The high, and perhaps pre-eminent, station which the productions of the British looms have gradually attained, seem to be rather the effect of assiduous and enterprising industry, than of great originality of invention, or precedence in mechanical improvement. Certainly she can, at the utmost, boast of only one *raw material*, from which cloth is manufactured, as peculiarly indigenous. Operations connected with calendering.

At an early period, no doubt, the British wool had attracted the peculiar attention of economists and statesmen as of paramount value; and the prohibition of its exportation became an object of legislative enactment. That manufacture, therefore, has long been the staple of England, as the linen trade, at a later period, has become that of Ireland.

The attempts to introduce both of these branches of industry into Scotland, although, during the latter part of

the last century, they engrossed much of the attention both of public bodies and of patriotic individuals, cannot be regarded as having proved eminently successful; and the progress actually made has been almost entirely superseded and extinguished by the more recent introduction of the cotton manufacture.

The latter branch of industry, since the splendid invention of spinning by the aid of machinery, has indeed made most rapid advances in every part of the united kingdom, and has attained to a height which has, perhaps, absorbed a greater portion of national industry than consumers can easily be found to employ. The extension of external commerce has constantly supplied the raw material at easy and generally moderate rates; and even the India Company have long ceased to oppose to it any very formidable competition in the market.

The silk manufactures of Britain formerly were not carried on to a very great extent; they have now, however, increased considerably. Whatever may have, directly or indirectly, tended to regulate the finishing, folding, and preparing of British goods for the various markets of consumption, will chiefly refer to the three former branches of manufacture.

Extensively as the woollen trade is carried on, it is in a great measure absorbed either by internal or colonial consumption, and does not, therefore, enter so generally into actual competition with the cloths of other nations, as to render it either peculiarly desirable that its marketable aspect should be either servilely copied from those of other countries, or very peculiarly distinguished from them. The chief object appears to have generally been, to prevent the intrusion of foreign cloths and stuffs into our own markets; and hence adopting their usual folds into such rolls as most effectually preserve the dressed surface from acute cresses, is found to be most expedient and convenient, the goods being distinguished by letters denoting them to be "British manufacture" on the ends of the pieces.

In the Irish manufactures of cambrics and linens, the case is almost entirely reversed. From the superiority of climate, the French flax is admitted to be of finer appearance; and although the importation of manufactured cambrics be strictly prohibited, the restraint during periods of peace has always been considerably evaded, in consequence of the demand experienced, and the reputation in which they are held. Indeed it was found generally most expedient, by many retailers, to sell Irish cambrics under the title of French, and hence the fold was correctly imitated. The pieces, after being folded into lengths of about twelve inches, and twice laterally doubled, until the whole breadth of thirty-four inches was reduced to about eight and a half inches, were subjected to a powerful compression in the press until fully flattened. They were then packed in purple coloured wrappers or papers, and a small engraved card or ticket was attached to each piece, specifying the length, generally about eight or eight and a half yards. The cards were attached by a silken string, so as to be easily cut away with a penknife or pair of scissors, in order to avoid seizure; and French or Irish goods were sold indiscriminately as "foreign cambrics." Custom has even carried this practice farther; and cotton cambrics, which are avowedly *British manufacture*, and subjected to no risk whatever, because easily distinguishable from any cambric manufactured from flax, are put up into the same folds, papered, and ticketed, in exactly the same manner.

In linens, hollands, and sheetings, whether of foreign or Irish manufacture, the same fold is also employed; and in cotton shirtings and sheetings it is closely imitated. The form is that of a cylindric roll, somewhat flattened by subsequent compression; and, in general, all dense fabrics, whether of linen or of cotton, are rolled up and compressed in a similar manner, the object of which is evidently safety and diminution of space in land carriage or exportation.

In others of the extensive varieties of cotton cloths of British manufacture, some are avowed imitations of the manufactures of Hindustan, whilst others profess no such imitation. Very few among the manufactures of Lancashire are either distinguished by Indian names, or copied from Indian cloths, although some of great extent are directly so. Calicoes, cossacs, and jaconets, for printing, as well as Ballusore, Bandana, and Pullicate handkerchiefs, are amongst the leading articles of the latter description; whilst among the former may be classed the very extensive manufactures of corduroys, thicksetts, velveretts, velveteens, &c. although their origin is also probably Asiatic, but because well known and manufactured by the Genoese, French, and other European nations, even before the discoveries of De Gama and other mariners had first laid open the maritime intercourse with India by the Cape of Good Hope.

When, at a period infinitely more recent, the splendid invention of spinning cotton by the agency of machinery to any degree of fineness afforded new scope to the British weaver, the imitation of the lighter Indian fabrics fell chiefly into the hands of the Scottish weavers, for executing which they had been in a considerable degree previously prepared, by their habits of weaving lawns in imitation of the French, as well as their lighter fabrics of silk and thread gauzes. To their share, in consequence, fell the bouks, mulls, and japuns, almost exclusively, as well as the lighter jaconets, designed for ornament from the needle and tambour frame. And whilst they have made no successful attempt to compete with their Lancashire brethren in the dense fabrics of corduroys, quiltings, and other ponderous articles, they have shared with them the manufacture of the middling textures of cambrics, Pullicates, and ginghams.

Indeed, whatever prepossession may, at an early period, have existed in favour of the real Indian fabrics, it has now so entirely subsided as to possess no influence whatever in swaying general opinion. The British workmanship has proved itself long ago so decisively superior to the Indian, both in spinning and weaving, as to eradicate every doubt in the minds of all who are really competent to decide the question of comparative superiority. Still, however, candour will compel us to allow that the Indian possesses advantages in the rich qualities of his cotton, and the brilliancy of some of his dyes, which, in some degree, compensate for the immense superiority of the British skill and machinery, and which, to those who examine superficially, may appear to entitle him to the preference.

Nothing, therefore, exists in the cotton manufacture which could, in general cases, prompt to a servile imitation of external appearance for the purposes of deception; and the Indian mode of lapping their cloth is too rude and laborious to admit of its being copied as a matter of convenience. Their method consists merely in doubling a piece of twenty yards, to reduce its length to ten yards, which is again doubled, in order to reduce it to five; and thus they continue to redouble, until the piece be reduced to a moderate length, capable of being contained in a chest or bale. Thus often redoubled, an Indian piece cannot be examined throughout unless the whole piece be again unfolded; and this, in large transactions, would be utterly impracticable.

British muslins are folded generally to a yard in length, with a small allowance for extra measure; and as the folding is alternately from right to left, every part can be

instantly examined upon a table or counter, every fold opening as easily as the leaves of a book in its uncut state. The piece, when folded, is reduced by doubling it longitudinally to about nineteen inches, and it is then folded across to the breadth of about thirteen inches. An ordinary sized trunk, 39 × 19 inches, thus contains three layers of pieces, in which package goods for exportation to the colonies are generally packed, the trunk there forming an article of merchandise as much in general demand as the muslins which it contains.

Even the Indian ornaments of gilt silver threads which were at first woven into one end of each piece, although they did not exceed the value of twopence each, have been either greatly curtailed, or totally given up upon principles of economy. Even the cost of this trivial ornament has been computed to have amounted annually in Glasgow and Paisley to about L.30,000.

Pullicate and other handkerchiefs are most commonly folded up in dozens. For the African and some other foreign trades, pieces containing only eight handkerchiefs are preferred. These are still imitations of Indian precedents, confined to markets where competition continues to exist, not only with the British Company, but with Americans and others trading to India. A species of pale orange-coloured India handkerchiefs, distinguished by the name of *Madras*, being in extensive reputation in the Caraccas and other Spanish settlements in South America at the period of the capture of Trinidad in 1795, patterns were procured by some British traders, who ordered very large quantities to be manufactured in Scotland of the same quality and appearance. With such effect were these imitated in texture, in dye, in finishing, and even in the packages, that some hundreds of pieces sent to London for exportation were actually seized at the customhouse as India goods, either illegally imported, or stolen from some of the Company's ships in the river. A scrutiny, however, clearly ascertained that these goods were not Indian, but British, and that no trespass against either the privileges or the property of the Company had been even attempted. The goods were of course released, and permitted to proceed to their destination, where, after examination and trial, it was found totally unnecessary longer to conceal their real origin; and a very extensive trade, through direct channels, has been since carried on for similar goods.

General observations.

From the above general and cursory sketch, it will be obvious that the management of an extensive calendering establishment will require, on the part of its conductor, not only a competent knowledge and experience of the mechanical operations and duties of his particular profession, but that a more extensive mercantile acquaintance with the demands, habits, and tastes of particular markets, will conduce equally to his own interests and those of his employers. From the variations of markets, and fluctuations of mercantile transactions, there can be no precise or definite limit to the extent of such knowledge. It is only by constant attention and sedulous inquiry that he can preserve accuracy in what is liable to almost daily change. His immediate employers will no doubt be often both able and desirous to supply him with this. But as even they must sometimes be liable to error or deception, he ought to omit no opportunity of extending his inquiries, and arriving, as nearly as he can, at the most comprehensive and unambiguous information. (J. D—N.)

CALENDERS, a sort of Mohammedan friars, so called from the santon Calenderi, their founder. They are called in Persia and Arabia *Abdals*, or *Abdallat*, that is, persons consecrated to the honour and service of God. See ABDALS.

CALENTURE, a feverish disorder incident to sailors in tropical climates, of which the principal symptom is their imagining the sea to be green fields.

CALENZIO, or CALENTIUS, ELISEO, a Latin poet and prose writer of the fifteenth century, born at Puglia in the kingdom of Naples. He was preceptor to prince Federigo, son of Fernando I. king of Naples, and was connected by ties of friendship with Sannazarius, Altilio, and other eminent scholars of that period. He seems to have anticipated many of the later improvements in penal legislation, and was the earliest writer against capital punishment except for murder. He died in 1503. There have been three editions of his works, two at Rome (one in 1503, folio), and the third at Basle, 1554.

CALEPINO, AMBROGIO, an Augustine monk, born at Bergamo in 1435, was descended of an old family of Calepio, whence he took his name. He devoted his whole life to the composition of a polyglott dictionary, first printed at Reggio in 1502. This gigantic work was afterwards augmented by Passerat and others. The most complete edition, published at Basle in 1590, comprises no fewer than eleven languages. Calepino died blind in 1511.

CALF, the young of the ox kind. See MAMMALIA.

CALF, Golden, an idol set up and worshipped by the Israelites at the foot of Mount Sinai, in their passage through the wilderness to the land of Canaan. Our version makes Aaron fashion this calf with a graving tool after he had cast it in a mould. The Geneva translation makes him engrave it first, and cast it afterwards. Others, with more probability, render the whole verse thus:—"And Aaron received them (the golden ear-rings), and tied them up in a bag, and got them cast into a molten calf;" which version is authorized by the different senses of the word *tzur*, which signifies to tie up or bind, as well as to shape or form; and of the word *cherret*, which is used both for a graving tool and a bag. Some of the ancient fathers have been of opinion that this idol had only the face of a calf, with a human body from the neck downwards, in imitation of the Egyptian Isis; while others have thought it was only the head of an ox without a body. But the most general opinion is, that it was an entire calf, in imitation of the Apis worshipped by the Egyptians; among whom, no doubt, the Israelites had acquired their propensity to idolatry. This calf Moses is said to have *burnt with fire*, reduced to powder, and strewed upon the water which the people were to drink. How this could be accomplished has been a question. M. Stahl conjectures that Moses dissolved it by means of liver of sulphur. The rabbins tell us that the people were made to drink of this water, in order to distinguish the idolaters from the rest; for that as soon as they had drunk of it the beards of the former turned red. The Cabbalists add, that the calf weighed 125 quintals; which they gather from the Hebrew word *massekah*, whose numerical letters make 125.

CALI, a town of New Granada, South America, near the river Cauca, in a fertile and populous plain, abounding in mines, vegetable productions, and cattle. It is 60 miles north of Popayan, and has a population of about 4000. Long. 76. 33. W., Lat. 3. 24. N.

CALIAN, a town of Hindustan, in the British district of Tannah, presidency of Bombay. It was formerly of larger size and of greater importance than it is at present. It was exposed to many sieges during the wars which were carried on between the Mohammedans and the Mahrattas, and is now surrounded by the ruins of numerous forts. It is 32 miles N.E. from Bombay; and being situate on the line of the Great Indian Peninsula railway, will in all probability shortly regain its ancient prosperity. Long. 73. 12. E., Lat. 19. 14. N.

CALIBER, or CALIBRE, the diameter of any body, as the calibre of a column, of a bullet, &c. It also denotes the size of the bore of a gun.

CALIBER *Compasses*, or *Callipers*, compasses made with arched legs, to measure the diameter of round or swelling bodies. See COMPASSES.

CALIBER *Rule*, or *Gunner's* CALLIPERS, is an instrument in which a right line is so divided that the first part being equal to the diameter of an iron or leaden ball of one pound weight, the other parts are to the first as the diameters of balls of two, three, four, or more pounds are to the diameter of a ball of one pound. It is used by engineers to determine, from the weight of the ball given, its diameter or caliber, or *vice versa*.

The gunner's callipers consist of two thin plates of brass joined by a rivet, so as to move quite round each other. Its length from the centre of the joint is between six inches and a foot, and its breadth from one to two inches; that of the most convenient size is about nine inches long. Many scales, tables, and proportions, &c. may be introduced on this instrument; but none is essential to it except those for taking the caliber of shot and cannon, and for measuring the magnitude of salient and re-entering angles.

CALICO, so called from Calicut in India, a sort of cotton cloth. In England, white or unprinted cotton cloth is called calico. In the United States, calico is printed cotton cloth of not more than two colours.

CALICO-PRINTING. See DYEING.

CALICUT, a seaport-town of Hindustan, in the British district of Malabar, presidency of Madras. It was formerly an extensive and magnificent city, but now exhibits few vestiges of its original splendour. It was at this city that Vasco de Gama arrived in May 1498, ten months and two days after he had departed from Lisbon, being the first place in India visited by any European navigator. It then contained several stately buildings, and among them a Brahminical temple, not inferior to the largest monastery in Portugal. The town stands on the sea-shore in a low and unsheltered situation, and its streets are narrow and dirty. It is however populous, and though there is neither river nor haven, and ships are compelled to anchor in the open sea, it is nevertheless the seat of considerable trade. The port is frequented by vessels from the Red Sea and the Persian Gulf, which return with freights of rice, cocoa-nuts, pepper, ginger, and sandal-wood. In 1510, the Portuguese, commanded by Albuquerque, attacked Calicut with 3000 troops, burned the town and plundered the palace, but were finally repulsed and fled to their ships after sustaining heavy loss. Shortly after they concluded a peace with the zamorin, who permitted them to erect a fortified factory here. This town was taken in 1773 by Hyder Ali, who expelled all the merchants and factors, destroyed the cocoa-nut trees, sandal-wood, and pepper vines, that the country, reduced to ruin, might present no temptation to the cupidity of Europeans. In 1782, the troops of Hyder were driven out from Calicut by the British; but in 1782 it was taken and destroyed by his son Tippoo, who carried off the inhabitants to Beypore, and treated them with detestable cruelty. In the latter part of 1790 the country was occupied by the British; and under the treaty concluded in 1792, whereby Tippoo was deprived of half his dominions, Calicut fell to the British, and was formally incorporated with their dominions. After this event the inhabitants returned and rebuilt the town, which in the year 1800 consisted of 5000 houses. Distant from Bombay S.E. 566 miles; Mangalore, S.E. 130; Madras, S.W. 335. N. Lat. 11. 15., E. Long. 75. 50.

CÂLIDÂSA, an Indian poet, whose drama, *Sacuntalâ*, was first made known to Europe by Sir William Jones' translation, published at Calcutta in 1789. The discovery of a Sanscrit copy of this poet's works in the Royal Library at Paris, published in 1832, showed that the drama translated by Jones was from the interpolated and corrupted text, which has long been circulated in Bengal. Several other poems by Câlidâsa have since been published; all of which show an elevation of sentiment, and purity of feeling, rarely seen in Asiatic poetry; while his fervid descriptions and vivid imagery have procured for him the highest admiration in the East.

CALIFORNIA, an extensive region of North America, extending along its western coast from 22. 48. to 42. N. Lat. and lying between 106. and 124. W. Long. It is bounded on the north and east by the United States' territories and the Gulf of California, and on the south and west by the north Pacific Ocean. It is divided into Old or Lower, and New or Upper California. Previous to the treaty of 1848, by which Upper California was ceded to the United States, they both formed part of the territory of the Mexican Republic. Lower California still belongs to that republic.

LOWER CALIFORNIA is a long narrow peninsula, extending from 22. 48. to 32. 30. N. Lat., and separated from the mainland by the Gulf of California. On the north it is bounded by Upper California, east by the Gulf of California, and on the south and west by the ocean. It is about 700 miles in length, and from 30 to 100 miles in breadth; with an estimated area of about 60,000 square miles, and a population of probably not more than 20,000.

This peninsula is traversed from north to south by a chain of rocky mountains varying in height from 1000 to 5000 feet above the level of the sea. These are entirely destitute of verdure, with the exception of here and there a cluster of briars, small shrubs, or dwarf trees, and some few spots in the ridges where the soil is protected from being washed away by the tornadoes, which every few years sweep over the country with such violence, and bearing with them such floods of rain, that whatever of soil has been in any manner previously formed is swept into the sea. The spots so protected are, if well watered, very fertile; but they are rare and of small extent. The rest of the country is interspersed with extensive tracts of sandy soil nearly as barren and unproductive as its rocky mountains, but near the coast there are some few places which are well adapted for cultivation. Altogether, however, this country is one of the most barren and unattractive to be found in the temperate or hotter regions of the earth. According to Farnham, the products of the soil will never maintain 500,000 people in a state of comfort ordinarily found in the civilized condition.

The scarcity of water is one of the great disadvantages under which this region labours. Like other countries of volcanic origin, the porousness of the rocks allows the water to pass underground to the sea, so that few streams or springs are found in Lower California. From Cape San Lucas, its most southern point, to the mouth of the Colorado, 600 miles, there are only two streams entering the gulf. One of these is the San Josef del Cabo, which passes through the plantations of the mission of the same name, and discharges itself into the bay of San Barnabas. The other is the Mulege, which waters the mission of Santa Rosalia, and enters the gulf in Lat. 27° N. These are not navigable. The streams on the ocean coast are also few and small, none of them being navigable. In the interior are several large springs, which send out copious currents along the rocky beds of their upper courses, but which, on reaching the loose sands and porous rocks of the lower country sink and enter the sea through subterraneous channels. There are some tolerable harbours, but these, from the state of the country, are useless except as places of refuge. The country is said to be rich in minerals, but no mines are wrought except the gold and silver mines of San Antonio, in about 24° N. Lat., and even these afford only a trifling supply. Lead is said to be found towards the southern extremity of the peninsula.

The climate is very hot and dry. The rains fall in the winter months, and are very severe, but of short duration. Summer rains seldom occur north of Loretto, in Lat. 26° N. For the space of 20 or 30 leagues from Cape San Lucas,

the air is rendered mild and agreeable by the sea-breezes, and the ground in many parts is very fruitful, being watered by numerous little streams from the high lands. Thence to Loretto the heat is excessive, the soil dry and barren, and the surface of the country extremely craggy and forbidding. From Loretto northward the air is more temperate; the water in the mountains sometimes freezes, and the soil though not so rugged and full of rocks, is barren and desolate as that around Loretto. In summer the mean temperature of the country ranges from 60° to 74° Fahr. On the shores of the Pacific the temperature is rendered agreeable by the sea-breezes, and the humidity which they carry with them. On this coast the temperature during summer ranges from 58° to 71° Fahr., and during the rainy season it falls as low as 50°. On the Gulf coast there is a still greater variation; while at the Cape the mercury stands between 60° and 70° degrees, near the head of the Gulf it is down to the freezing point. Violent hurricanes are frequent, but earthquakes seldom occur.

Besides maize, wheat, peas, &c., the few fertile spots of this region produce a variety of fruits, such as grapes, dates, figs, quinces, peaches, pears, and olives. The dates, figs, &c., are preserved; some wine is made; and a kind of spirit is distilled from the mescal. The cattle are numerous, and feed in part on the leaves of the musquito, a species of acacia. Wolves, foxes, deer, goats, several lizards and scorpions, are among the wild animals. Pearls, tortoiseshell, a few hides, dried fruits, dried beef, cheese, soap, &c., constitute its exports, and are mostly sent to San Blas, Mazatlan, and Guayamas, in small coasting vessels. The imports are provisions, clothing, agricultural and domestic utensils, supplies for the ceremonies of the church, and a small amount of the ordinary luxuries of life.

Though the land is thus barren and unproductive, the sea is stored with an incredible abundance and variety of fish. Among these may be mentioned the halibut, salmon, turbot, skate, pilchard, mackerel, sole, lobster, cod, anchovy, and pearl-oyster. The immense beds of pearl-oysters in the gulf have long been a source of attraction to adventurers, and employ several hundreds of Indian divers.

The peninsula of Lower California was discovered by Hernandez de Grijalva in 1534, but no settlement was made by the Spaniards till about the end of the next century, when some Jesuits established themselves there with the view of converting the natives. Loretto, the capital, and the other towns, were founded by the Jesuits, who instructed the natives in agriculture, and persuaded many of them to adopt fixed habitations.

California, *Upper*, as ceded to the United States by the treaty of 1848, comprises the region between 32. 30. and 42. N. Lat. and 106. and 124. W. Long.; having an area of 448,691 square miles, or 287,162,240 acres. To give some idea of its extent, we may mention that it contains 1202 square miles more than the States of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Iowa, and Wisconsin combined. This territory is bounded on the north by Oregon, the 42d parallel of N. Lat. being the boundary line between the two territories; on the east by the Rocky Mountains, and the Sierra de los Mimbres, a continuation of the same range; on the south by Sonora and Lower California; and on the west by the ocean. It is 700 miles in length, and 800 miles in breadth.

This extensive territory is naturally divided into two unequal portions lying on either side of the Sierra Nevada range of mountains. The eastern division comprises two portions, the southern being that part of the country drained by the Colorado and its numerous affluents. The other, or N.W. portion of inland California, is known as the "Great Basin," and lies between the Rocky Mountains and the Sierra Nevada, at an elevation of between 4000 and 5000 feet above the sea. It is about 500 miles in diameter, either from north to south, or from east to west; and is surrounded on all sides by mountains, its lakes and rivers having no outlet to the ocean. Its steep interior hills and mountains are covered with forests, and rise abruptly from a base of ten or twenty miles to a height of from 7000 to 10,000 feet. It contains many large bodies of water, among which are the Utah and Great Salt lakes. The plains are arid and sterile, and the greater part of the country is desert; but many parts of it are capable of cultivation. In one of these the Mormons have lately established themselves.

Upper California has, by act of congress, been subdivided to form the State of California, the Territory of Utah, and part of the Territory of New Mexico,—all of which will be found described under their proper heads.

The history of California, previous to its annexation to the United States, presents little of interest to the general reader. It was discovered by Cobrillo, a Spanish navigator, in 1542, but was not colonized by the Spaniards until the latter half of the eighteenth century. The northern part was visited in 1578 by Sir Francis Drake, who gave it the name of New Albion. The first colonies were planted by the Roman clergy, under whose direction missions were established in various parts with the view of converting the Indians to the Catholic faith, and by blending agriculture and trade under the tutelage of the church, to render the Indians valuable subjects of the Spanish crown. The revolution which separated Mexico from Spain, annexed California to that republic; and on the adoption of the federal constitution in 1824 the Californias were erected into territories with power to send a member to the general congress, who, however, was not allowed to vote in its decisions. This was followed by the secularization of the missions. In 1833 the salaries of the monks were suspended, the Indians were relieved from servitude, the funds of the church confiscated, and the division of property among natives and settlers decreed. These blows fell heavily upon the monastic farmers and herdsmen, the missions were speedily deserted, and their edifices and establishments fell into decay. Agriculture had always been most carelessly conducted, and their implements were little improved from those used by the earliest settlers; and notwithstanding the fertility of the country, the productions were only equal to the wants of the inhabitants. In 1831, shortly before the close of the missions, the whole cereal productions of Upper California did not exceed 63,000 bushels of wheat, 28,000 bushels of corn, 4200 bushels of *frijoles* or brown beans, 2800 bushels of *garbanzos* or peas, and 18,500 bushels of barley. The number of missions at that time was 21; the Indian population in these was 18,683; the number of other classes, that is, of the garrison and free settlers, was 4342; making a total of 23,025. A pastoral life seems to have been more accordant to the tastes of the Californians; and accordingly we find that in 1831 there were 216,727 black cattle, 32,100 horses, 2844 mules, 177 asses, 153,455 sheep, 1873 goats, and 839 swine. In addition to these, there were vast numbers of cattle roaming at large, which were not marked or branded according to the Californian laws as belonging to any of the jurisdictions or missions. Yet from all this multitude but little profit was gained, except from hides and tallow, which then formed their only articles of trade; the dairy was altogether neglected, and butter and cheese almost unknown. The natives and settlers soon became dissatisfied with the national government that succeeded the milder sway of the clergy, and more than once the people declared themselves independent, but as often rejoined the confederation. Its distance from the metropolis tended to render its subjection to Mexico of a very nominal character. In 1846 California was occupied by the United States forces; and by the

treaty of Guadalupe Hidalgo on 2d February 1848, the whole country was ceded to that government. In the latter part of the same month, a mechanic named Marshall, employed in building a saw-mill for Captain Sutter, on the south branch of a river known as the American Fork, while cutting a mill-lead, discovered scales of gold in the soil. Pieces of considerable size were taken out, and in a few days gold to the amount of $150 was gathered. The news spread rapidly through the country, and examinations were prosecuted at other points along the stream, and almost everywhere with success. The towns were forthwith deserted by their male population, and a complete cessation of the whole industrial pursuits of the country was the consequence. Commerce, agriculture, mechanical pursuits, professions—all were abandoned for the purpose of gathering the glittering treasure which lay buried in the ravines, gorges, and rivers of the Sierra Nevada. In the mean time, news of the discovered *El Dorado* crossed the continent; and although its marvels were regarded by many as fabulous, there were others who either abandoned their homes for the wilderness, or sent hither valuable cargoes, from the sale of which they drew enormous profits. Under the temptations of trade and discovery, an immense emigration, chiefly of males, poured into California, not only from the United States, but also from Mexico, Chili, Peru, China, the Sandwich Islands, and other parts. Within a year after this wonderful discovery, the Californians felt that they were no longer outlying colonists of the American Union requiring pecuniary support and military protection against savages. Immense fleets arriving from all parts of the world poured large revenues into the national coffers. Intelligent and industrious men thronged the towns that sprang up as if by enchantment at every advantageous point. Property in land and moveables became suddenly valuable beyond the hopes or dreams of the early settlers. In 1849, in consequence of the disorganized condition of society, and the insecurity which generally prevailed, the people by their delegates met in convention at Monterey, on 1st of September, and drew up a constitution, which met with general approval. The main feature of this document is its exclusion of slavery from the state—otherwise it does not differ much from the generality of those of the older states. After a warm discussion in congress at Washington, California was admitted as a state of the Union, on the 9th of September 1850.

California, *State of*, is bounded on the north by Oregon, east by Utah and New Mexico, south by Old California, and on the west by the ocean. The boundary-line, as sanctioned by the act of congress, extends from the ocean along the 42° N. Lat. to its intersection by the 120° W. Long., then southward along the latter to Lat. 39°, thence S.E. to the point where the Rio Colorado intersects the parallel of 35°, thence down the middle of the channel of that river to the boundary-line between the United States and Mexico, along which it continues to the ocean. Its area, exclusive of the islands adjacent to the coast, is 155,550 square miles, or 99,552,000 acres.

It is traversed from north to south by two great ranges of mountains, called respectively the Sierra Nevada and the Coast Range; the former separating this region from the Great Basin, and from 150 to 200 miles distant from the coast; the latter running almost parallel to and at a short distance from the coast. Between these is the great valley of the Sacramento and the San Joaquin rivers, the former traversing the northern and the latter the southern part of the valley; they meet near the centre and pour their united waters into the bay of San Francisco. This valley is about 500 miles in length and 50 in breadth, and presents the appearance of having been at one period the bed of a lake. These two rivers have numerous affluents, many of them of considerable size. Lateral ranges of mountains parallel to the Sierra Nevada and the coast, and varying in height from 2000 to 4000 feet above the sea, diversify the surface of the country. These form greater masses, and become more elevated in the north, where some peaks, as the Shaste, enter the region of perpetual snow. The plains and valleys have only a general elevation of a few hundred feet above the sea. The coast is generally precipitous and rugged, having few good harbours, with the exception of those of San Diego, Monterey, and San Francisco. The bay of San Francisco is indeed one of the finest in the world. It is separated from the sea by low mountain ranges, with an entrance only about a mile wide at its narrowest part, and five miles long from the sea to the bay. Passing through this narrow entrance the bay opens to the right and left, extending in each direction about 35 miles, having a total length of 70, and a coast of 275 miles. It contains numerous islands, some mere rocks, others covered with grass, and rising to the height of from 300 to 800 feet. The surrounding country is picturesque and fertile. A few miles from the shore, and directly fronting its entrance, mountains crowned by forests of lofty cypress rise to the height of 2000 feet, and form a conspicuous landmark for vessels entering the bay. A delta of 25 miles in length, divided into islands by deep channels, connects the bay with the Sacramento and the San Joaquin, both of which are navigable for a considerable distance.

The climate varies considerably in different parts of the country. It is divided into two distinct seasons of wet and dry; the former, at San Francisco, extending from the middle of November to the middle of May. In the southern parts of the country the dry season commences earlier and continues longer than in the northern. The rains, though by no means continuous, are frequent and heavy. During the dry season the prevalence of cold winds and fogs from the sea render the district along the coast very unpleasant to strangers. But in the interior, particularly in the valleys of Sacramento and San Joaquin, the climate is delightful,—the heat during the day not being so intense as along the coast, while the nights are cool and pleasant. On the Sierra Nevada, where the influence of the sea-breeze ceases to be felt, the thermometer frequently ranges from 110° to 115° in the shade during two or three hours of the day; the nights, on the other hand, are cool and invigorating. Mr King remarks, "Those who take up their residence in the valleys which are situated between the great plain of the Sacramento and San Joaquin and the coast range of hills, find the climate, especially in the dry season, as healthful and pleasant as it is possible for any climate to be which possesses sufficient heat to mature the cereal grains and edible roots of the temperate zone."

Westward of the rivers Sacramento and San Joaquin, the soil is chiefly dry and unproductive; but on the east side the country is well-watered and luxuriantly fertile, being intersected by numerous fine streams, and wooded principally with white oaks. The lowest hills of the Sierra which line the valley present a woodland country diversified with undulating grounds and pretty vales. Near the Tulare lakes, and on the margins of the Sacramento and San Joaquin rivers, the surface is composed of level plains, gradually changing into undulating land toward the mountains. The region from the coast range to the ocean has long been the seat of numerous missions; and around these, generally situated in the most lovely vales, agriculture has converted the country into a perfect garden. All the cereals of temperate regions are cultivated, and the olive and vine grow luxuriantly. Wild oats grow in great profusion along the coast, and as far inland as the sea-breeze has any material influence. The grasses are very luxuriant and nutritious, affording excellent pasture. As the heat and drought of summer are excessive, artificial irrigation, where employed, greatly increases the natural fertility of the soil.

California.

The diversities of climate and soil in different parts of the state render its vegetation of a very heterogeneous character—from the luxuriant productions of the tropics, to the stunted and scanty productions of the frozen regions. Of the pine and oak there are several noble and useful varieties; one of the former is occasionally found growing to the height of 240 feet, with a girth at the base of nearly 60 feet: its seeds are as large as a good-sized bean, and furnish a common article of food to the Indians, who collect large quantities of them in the autumn, and pound them into a kind of cake, which is baked on heated stones. Another variety of the pine is frequently found 110 feet high, and from 10 to 12 feet in diameter. The white oak grows on the low and level parts of the country. It is not generally a large tree, being from 40 to 50 feet high, and from 2 to 3 feet in diameter at the base. It is in some places very abundant. The *Quercus nivalis* is found on the prairies, river banks, and lower hills, and is 4 or 5 feet in diameter, with branches of corresponding dimensions, extending horizontally from the trunk. The *Quercus virens* grows only on the highlands, and is from 60 to 70 feet in height, and from 2 to 5 in diameter. The maple, ash, beech, and chestnut, in several varieties, compose a great part of the forests. The flowering shrubs and plants of California are of great variety and beauty. A species of currant (*Ribes speciosum*), with its long crimson stamens and dark-green leaves, is one of the most beautiful of the flowering shrubs, and is exceedingly abundant in some localities. In many places are found several species of *Mimulus*, one of which is from 3 to 4 feet in height, and very beautiful. The coast abounds with various species of *fuci*.

The animal kingdom of California includes several species of bear, the raccoon, American badger, otter, wolf, fox, cougar, lynx, weasel, ermine, mink, martin, skunk, beaver, musk-rat. Large herds of elks are often seen, and other species of deer are common. The mountain sheep is also common. This animal in its general appearance resembles the domestic sheep, but is much larger, and is covered with a coarse short hair of a dingy brown colour, which can scarcely be called wool. Hares, rabbits, squirrels, marmots, as well as rats and mice, are very abundant in all parts of the country.

The feathered tribes are not found in great variety in California. Among these is the great vulture (*Sarcoramphos Californianus*), which is found along the coast: it is of a brownish-black colour, solitary in its habits, rapacious, and of enormous size, being, when full grown, about 4 feet 8 inches from the beak to the extremity of the tail, and from 9 to 10 feet from tip to tip of its wings. The Turkey buzzard is found, though not frequently; but the black vulture is common in all parts of the country. The golden and whiteheaded eagles, and several species of hawk, are found here, as well as ravens, magpies, jays, woodpeckers, crossbills, larks, robins, swallows, &c. In some parts of the south humming-birds are numerous. American grouse are very plentiful, and in great variety. The bays, inlets, and rivers, swarm with water-fowl; and the lowlands near the outlets of some of the streams are most abundant in geese, ducks, widgeons, teal, cranes, curlews, snipes, &c. The swan is the largest swimming bird of the country. The white pelican is frequently met with on the coast.

The waters of California afford a great variety of fish. Salmon are found in almost incredible numbers in all the rivers and streams connected with the sea. Sturgeons, some of them from 8 to 10 feet in length, porpesses, mackerel, halibut, pilchard, skate, turbot, bonito, &c., are common in various parts. The shell fish are plentiful and valuable, as oysters, mussels, &c.

Though the gold mania in California dates only from 1848, yet the existence of that metal in the country has been long known to travellers. Richard Hakluyt, who accompanied Drake in his expedition in 1577–79, in describing this region, says, "There is no part of earth here to be taken up wherein there is not a reasonable quantity of gold and silver." Captain George Shelvock, who visited the country in August 1721, states, that "The eastern coast of that part of California which I had sight of appears to be mountainous, barren, and sandy; but, nevertheless, the soil about Puerto, Segure, and very likely in most of the valleys, is a rich black mound, which, as you turn it fresh up to the sun, appears as if mingled with gold dust, some of which we endeavoured to wash and purify; but though we were a little prejudiced against the thought that it should be possible that this metal should be so promiscuously and universally mingled with common earth, yet we endeavoured to cleanse and wash the earth from some of it; and the more we did the more it appeared like gold." "It is very probable that this country abounds in metals of all sorts, although the inhabitants had no utensils or ornaments of any metals whatever, which is no wonder, since they are so perfectly ignorant in all arts." Antonio de Alcedo, in his *Diccionario Geografico Historico de Las Indias Occidentales o America*, Madrid, 1786–89, as translated by Thompson, says, "All the ravines, and even plains (of California) contain gold scattered up and down the alluvious land. *Pepitas*, lumps of pure gold of the weight of from two to three kilogrammes (from 5 lb. to 8 lb. troy) have been found there." An article in Hunt's *Merchants' Magazine* for April 1847, by Mr Sloat, who was there in 1845 or 1846, states, that from all the information he was enabled to obtain during his stay, there is not the least doubt that gold, silver, quicksilver, copper, lead, sulphur, &c. are to be found in all that region; and adds, "I am confident that when it becomes settled (as it soon will be) by Americans, that its mineral developments will greatly exceed in richness and variety the most sanguine expectations."

The *Gold Region* of California is between 400 and 500 miles long, and from 40 to 50 miles broad, following the line of the Sierra Nevada. It embraces those extensive ranges of hills which, rising on the eastern border of the plain of the Sacramento and San Joaquin, and extending eastward from 50 to 60 miles, attain an elevation of about 4000 feet, and terminate at the base of the main ridge of the Sierra Nevada. Farther discoveries will probably extend the area of this region.

It is watered by numerous rivers and streams, which take their rise in the Sierra Nevada, and after flowing through the hills at the foot of that range enter the Sacramento and San Joaquin. The principal rock formation in these hills is talc slate; above it, and sometimes penetrating to a great depth, is quartz rock, which however does not cover extensive tracts of country, but occurs massive and in veins, and is found in fragments scattered on the surface. Gold is found only in particular localities in the bars and shoals of the rivers, in ravines, and in what are called the "dry diggings." The rivers in their courses coming in contact with the quartz containing gold, by constant attrition wash out the gold in small particles, which are afterwards found among the sand and gravel of their beds at those places which are left exposed in the dry season.

The dry diggings are places where veins of quartz containing gold have cropped out and been disintegrated, crumbled to fragments, gravel, and dust, by the action of water and the atmosphere. The gold has been left in pieces of all sizes from one grain to several pounds in weight. A very large proportion of the pieces of gold found in these situations have more or less quartz adhering to them. This gold, not having been exposed to the attrition of a strong current of water, retains in a great degree its original conformation. These diggings, in some places, extend over valleys of considerable extent, which have the appearance of an alluvion of decomposed quartz and slate, earth, and ve-

California. getable matter, formed by washings from the adjoining hills. Several vein mines have also been discovered in the quartz, from which numerous specimens have been taken. In these veins the gold, which is generally alloyed with silver, is combined with the quartz in all imaginable forms and degrees of richness. The grain gold of California averages as follows:—Gold, 90·33; silver, 6·90; oxide of iron, 1·08; earthy matter, 1·69; = 100. The rivers present very striking, and it would seem conclusive, evidence respecting the quantity of gold remaining undiscovered in the quartz veins. The latest news from California state that the exports of gold recorded at the custom-house amounted, in 1853, to $67,873,505. The whole yield for that year is calculated at nearly $70,000,000; and in five years and ten weeks to the end of 1853, the quantity produced is estimated at $260,000,000. There are now 125,000 persons engaged in mining. During this year they have prosecuted their great enterprise with industry and skill—have made canals, built aqueducts, turned rivers from their beds, tunnelled the hills, &c. New machinery and new methods have been employed—amongst them, that of washing the ores by water thrown from a great height. Comparatively few new mines have been discovered, but some old ones have been found richer than was expected. The valley of the Klamath has been most attractive, and has been more developed than any other part of the state. Quartz-mining makes but little progress. Various other branches of industry are carried on successfully. There are probably 80,000 persons engaged in cultivating the soil; but labour being very dear, roads bad, and communication altogether very imperfect, farming has not been so profitable as mining. Trade has been prosperous. The assessor's roll of St Francisco showed in August a valuation of $30,000,000. The navigation was as follows, as derived from the books of the custom-house of the entrances and clearances for 1853 to the 27th December:—

	Entered from.		Cleared for.	
	Vessels.	Tonnage.	Vessels.	Tonnage.
Domestic Ports	449	351,144	750	164,124
Foreign Ports	569	232,105	935	469,612
Whaling voyages......	10	2,545	6	1,753
Total.......	1028	555,794	169	635,489
Total for 1852 ...	1104	513,266	1535	462,094
Total for 1851 ...	847	245,566	1315	423,063

The quicksilver mines of California are believed to be numerous, extensive, and very valuable. The best known of these is that near San Jose. The cinnabar ore lies near the surface, is easily procured, and believed to be remarkably rich. Discoveries of other mines are reported, but no certain information respecting them has been made public. It is believed, however, that quicksilver will eventually be found in sufficient quantities for all the purposes of extensive gold-mining operations, if not for export. It is also believed that California is rich in silver, copper, lead, iron, and coal. At a short distance from Monterey, a silver mine has been discovered which affords a very rich ore; and bituminous coal is abundant in the neighbourhood of San Francisco.

The population of Upper California was estimated by Humboldt in 1802 at no more than 16,862, of whom 15,562 were converted Indians; and, as already mentioned, by Forbes in 1831 at 23,025. In 1847 the white inhabitants amounted only to about 16,000. From the state of the country, any census reports must necessarily be very incomplete. That of 1850, which gives the population at 117,538, can scarcely be considered an approximation. General Douglass is probably more nearly correct in estimating the population in the autumn of that year at 180,000. W. Van Voorhies, secretary of state, in his report upon the census of 1852, dated 25th January 1853, says, "Immediately after the adjournment of the last legislature, active measures were commenced, which have been prosecuted up to the present time, for the purpose of making a correct and complete exhibit of the population and resources of the state. This object, however, has been but imperfectly accomplished, in consequence in some degree of the intrinsic difficulties of so complicated and extensive an undertaking in a new and comparatively unknown country, but mainly owing to the mixed, unsettled, and fluctuating character of our population, the difficulty of thoroughly exploring the mountain counties, the hostile tribes of Indians infesting some sections, and the mistaken supposition on the part of many that the business of the census agent was in some way connected with taxation. Believing that the occasion of taking this census afforded an opportunity (which might not be again soon enjoyed) of procuring interesting geographical, geological, mineralogical, and other information pertaining to the natural curiosities and features of the state, I embraced it, and instructed each of the census agents to collect whatever of notable objects might come within their observation. These instructions, not having been received by some of them until they were far advanced in their labour, were only carried out in a portion of the counties." "A large number of the most important counties having failed to furnish any information on these subjects, we are left to conclude that much of the most useful and interesting matter in this branch remains yet to be developed." The population of the state as returned amounted to 224,435; no returns, however, had been made for the county of El Dorado, which is admitted to be one of the most populous and productive in the state; estimating it therefore at 40,000, the entire population would amount to 264,435. "There can be no doubt, however," says the secretary, "that, in consequence of the difficulties previously mentioned, not more than five-sixths of the whole population of the state has been taken. The reports of all the census agents who have made returns set forth the fact of their inability to obtain the whole population of their respective counties. Adding then one-sixth to the population returned, and that estimated for El Dorado county, gives the population of the state at 308,507, which is believed to be about correct."

The following particulars of the various counties are extracted from the census report of 1852:—

Butte County extends 100 miles from north to south, and 250 from east to west. The Butte mountains, from which the county takes its name, are situated on the Sacramento. Of these, Mount Hood, in the northern part of the county, is the most striking, towering far above its neighbours, and presenting an apex covered with perpetual snow. The scenery is grand and picturesque. It has many beautiful and fertile valleys well fitted for pasture and agriculture; water is abundant, and irrigation easy. Majestic pines and cedars occupy the mountains. Platina and iron abound in all the mining districts, but not in sufficient quantities to require machinery. Fine lead ore is found on the head waters of the Middle Fork. Quicksilver is abundant, and silver is found in small quantities. There are many fine sites for mills:—fifteen quartz mills, eleven water, and three steam saw-mills, are in operation. The cultivated land amounts to 2144 acres. Pop. 8572, of which the whites number 6174 males, and 206 females.

Calaveras County.—The principal rivers are the Stanislaus, on its southern boundary; the Moquelumne, equidistant from its northern and southern boundaries; and the Calaveras, 8 miles south of the Moquelumne; taking their rise in the Sierra Nevada, and falling into the San Joaquin. The most important town is Moquelumne Hill, situated 1½ miles south of the Moquelumne river, and having a large trade; besides which it contains a number of small towns or camps. Pop. 20,192; whites, 17,069 males and 973 females.

Colusi.—Though not a mining county, yet gold has been found within its limits. Cultivated land, 1962 acres. Pop. 620; whites, 400 males and 63 females.

Contra Costa County contains limestone of excellent quality; gypsum is found in one place; and excellent building

stone and red freestone have been discovered. There are a number of saline springs; and sulphureous springs, mostly tepid, are abundant. Many springs, and plenty of water for cattle. The towns are, Martinez (the seat of justice), Oakland, and Squatterville. Cultivated land, 9093 acres. Pop. 2745; whites, 1937 males and 550 females.

Klamath County.—A great part of this county is eminently fitted for agriculture. The rivers Klamath, Trinity, and Salmon, all abound in gold. The Salmon mountain, between the Salmon and Klamath, is covered with snow for nine months in the year; and Mount Prospect, on the Klamath, rising 5000 feet above the sea. Cultivated land, 109 acres. Pop. 530; whites, 458 males and 9 females.

Los Angeles County is well watered and wooded, and capable of producing every variety of vegetables. San Bernardino valley, 60 miles east of Los Angeles city, is rich and well watered. It is occupied by Mormons. San Bernardino rises to a great height. Mount San Gorgonio is 20 miles S.E. of the preceding, on the boundary between this county and the desert. The climate is remarkably salubrious and genial. The rivers are Santa Ana, San Gabriel, Rio de Los Angeles, and tributaries. Port San Pedro has good anchorage, and is perfectly safe, except during the prevalence of the S.E. winds in winter. Limestone and building-stone are found in abundance. There are also a number of salt springs. A spring of petroleum, six miles from Los Angeles, covers about two acres of ground. *Placer* gold is found; and 200 miles from Los Angeles there is a vein of quartz-bearing gold. There are great facilities for agriculture, which, however, has been neglected. The mission lands are principally cultivated under the direction of the priests. Hemp and tobacco, though not grown now, were formerly raised in considerable quantities. Cotton and sugar-cane succeed well. There are many fine orchards producing almost all tropical fruits. Cultivated land, 5587 acres. There are 105 vineyards (all, except twenty, at the city of Los Angeles). Pop. 7831; white, 2496 males and 1597 females.

Marin.—Although not a mining county, yet gold-bearing quartz, *placer* gold, silver and copper ores, have been found. Iron ore is abundant. Cinnabar, steatite or soapstone, lime, asphaltum, marble, brick clay, and granite, are abundant and of good quality. The towns are, San Rafael (the seat of justice), Saucelito, and Corta Madera. One-half of the land is susceptible of cultivation, and the other well adapted for grazing. Garden vegetables of all kinds are abundant. Cultivated land, 1250 acres. Marin possesses four large steam saw-mills. Pop. 1036; white, 652 males and 160 females.

Mariposa County.—Here agriculture, though still in its infancy, has lately been making rapid advances, and abundant proofs are shown of its adaptation to all kinds of produce. Wild oats, clover, and other rich grasses are abundant in the San Joaquin valley, and the lower hills of the Sierra Nevada. Wild horses and game of all kinds are plentiful. There are extensive forests of red wood, cedar, and pine, along the lower hills of the Sierra Nevada There are two saw-mills in operation, and many desirable sites for others. The San Joaquin passing through this county abounds in salmon and other kinds of fish, and is navigable for moderate-sized steam-boats to within a few miles of Fort-Miller. The Mercede river also abounds in fish. Between the San Joaquin and the Mercede are numerous streams of minor importance, rising in the lower hills of the Sierra Nevada, and affording supplies of water for mining purposes. Gold is abundant. There are six quartz mills in operation, and many erecting. Immense deposits of gold are known to exist in the beds of the San Joaquin and Mercede rivers, and other streams, but could only be obtained by a heavy expenditure of capital and labour. Minerals of every kind are found. The extent of the gold region is perhaps a hundred miles in breadth, extending back into the unexplored regions. The finest kind of marble exists at the North Fork of the Mercede and elsewhere. There are various kinds of mineral springs in different parts. Fort-Miller is situated at the entrance of the San Joaquin river into the plains. Pop. 8969, of whom 2782 are Americans.

Mendocino County.—Pop. 416; white, 169 males and 28 females.

Monterey County has an average length of 90, and a width of 38 miles, with an area of 420 square miles. It is divided into three valleys, known as the San Juan, Salinas, and Carmel. It is watered by the Salinas or San Buenaventura, and other streams. In the upper end of the Salinas valley are sulphureous springs. Gold has been found at San Antonio and in Carmel valley; silver has also been found in small quantities; much of the land is rich and productive. Stock-raising is extensively carried on. Cultivated land 3117 acres. Pop. 2728; white, 1152 males and 791 females.

Napa County has 10,584 acres in cultivation. Mount St Helen, at the head of the valley of Napa, is 3500 feet in height. Gold is found, but not in sufficient quantities to encourage mining. A mine of quicksilver, about 14 miles above the town of Napa, is supposed to be very rich. The country is celebrated for its medicinal springs. The Napa river rises in the northern part of the Napa valley, and flowing in a southern direction, empties itself into Pablo bay. It is navigable for vessels of five feet draft for 12 miles above its mouth. Las Putas rises in the north part of the county, runs in an easterly direction through the beautiful Berryessa valley, thence through the mountains into the Sacramento valley, and afterwards loses itself in the Tule marshes. Napa city stands on the west bank of the river of that name, about 12 miles from its mouth. Pop. 300. Suscol is on the same river, about 6 miles from its mouth. The hot sulphureous springs in the mountains about 70 miles above Napa city in a northerly direction, are from 1 to 8 or 9 feet in diameter, and constantly in a boiling state, the water being ejected to the height of ten or fifteen feet. Hundreds of fissures in the sides of the mountain emit strong currents of heated vapour, making deep hissing noises. Pop. 2116; white, 523 males and 252 females.

Nevada County has 1587 acres in cultivation. There are 33 quartz mills. Pop. 21,365; white, 12,448 males and 920 females.

Placer County has 679 acres in cultivation. Pop. 10,784, mostly engaged in mining; of these, the whites number 6602 males and 343 females.

Sacramento County is rich in cereal and vegetable productions. Pop. 12,589; white, 9457 males and 1739 females.

San Joaquin County is essentially agricultural, being situated in the heart of a fertile valley hundreds of miles in extent, with fine grazing; 4000 acres are cultivated. Mining is but little carried on. The roads and bridges are excellent. The chief town is Stockton, with a population of 3000, one of the principal cities of the state, on the Stockton slough or channel (about three miles from its junction with the San Joaquin), navigable for vessels at all seasons; the streams are San Joaquin, Moquelumne, Calaveras, Stanislaus, and Dry creek. Settlers are rapidly establishing themselves on the banks of these rivers. Pop. 5029; white, 3582 males and 987 females.

San Luis Obispo County.—The mineral, agricultural, and commercial resources of this county are great. It has rich silver mines, and a fine coal-mine. Lime rock is abundant; copper and iron are supposed to exist on the bay of San Simeon. There are many large petroleum springs, and a warm sulphureous spring about ten miles south of San Luis Obispo. Wild horses are found in large numbers on the plains in the N.E. part of the county. The cultivated land is 2538 acres. Pop. 984; white, 331 males and 163 females.

Santa Clara County has 19,066 acres in cultivation. Pop. 6664; white, 5813 males and 2062 females.

Santa Cruz County has 5472 acres of cultivated land, and 1219 inhabitants; white, 723 males and 374 females.

Santa Barbara County has 2131 inhabitants; whites, 834 males and 682 females. It has 699 acres in cultivation. The soil is very productive, especially where it admits of irrigation. The coast range of mountains here attains the height of 4000 feet; one of these is a volcano. The rivers are, the Santa Clara, the San Buenaventura, and the Santa Inez. The waters of the coast abound in many species of excellent fish. A bed of large and well-flavoured oysters, 150 yards in length, 25 feet wide, and 2 or 3 feet thick, has been discovered near Santa Barbara. The islands are much frequented by otters, bottle-nose and other seals, and beavers. There is a hot sulphureous spring, temperature above 100° Fahr., near the village of Santa Barbara. In the neighbourhood are one or two petroleum springs. For leagues along the coast the sea throws up bitumen. The Salinas afford abundance of salt, which is gathered in August and September. Gold is found in the southern part of the county.

California.

San Diego County has 304 acres of cultivated land. Pop. 2932; white, 397 males and 140 females.

San Francisco County.—The soil is rich and productive, and farming is rapidly extending, but its agricultural resources have as yet been little developed. Cultivated land 1297 acres. San Francisquita creek, dividing this county from Santa Clara, rises in the Sierra Morena, runs eastward, and empties itself into San Francisco bay. Gold in small quantities has been found in this creek. Of the Sierra Morena or Brown Mountains, the most remarkable commence at a point about 10 miles south of San Francisco, and run along the coast until they unite with the range of the same name in the county of Santa Clara. These mountains, which rise above 2000 feet, protect the inhabitants of the valley from the coast winds. Pop. 36,151; white, 30,156 males and 5375 females. The city of San Francisco has 34,876 inhabitants; the whites numbering 29,166 males and 5154 females.

Shasta County has numerous mines. There is not a river, creek, or ravine, that does not contain gold. The principal stream is the Sacramento river; besides which there are numerous small streams and creeks that are particularly valuable for the purposes of the miner. There are numerous mineral springs strongly impregnated; the most celebrated is the soda spring, near the Sacramento river, 60 miles north of Shasta city; and the salt springs, 12 or 15 in number, which would produce salt enough to supply the state. There are 908 acres in cultivation. Pop. 4050; white, 3448 males and 252 females.

Sierra County has 168 acres of cultivated land. Saddle Peak rises to the height of 7200 feet; Table Mountain 8000; and Buttes, at the head of South Fork, to the height of 9000 feet. The towns are, Downieville, with 810 inhabitants; Pine Grove, with 504; Windsor, with 210; Coxe's and Snake Bars, with 346; and Goodyear's Bar, with 356 inhabitants. Pop. 4855; white, 3630 males and 62 females.

Liskiyou County has 309 acres in cultivation. Pop. 2240; white, 1874 males and 82 females.

Solano County.—In the eastern part of the county is a double mountain peak very conspicuous at the head of Green valley; the next in magnitude is a double peak between Green valley and Suscol. Puta river, 10 miles north of Ulattis valley, rises in the mountains, winds through a rich and fertile plain, and loses itself in the extensive Tules which lie between the plains and the Sacramento river. The western part of the county is mountainous, and very interesting; many of the small valleys are well adapted for raising stock. Three large soda springs rise in these valleys. Suscol valley, west of the Suscol hills, runs from the city of Vallejo to the northern part of the county, is 8 miles in length and 3 in breadth, and washed through its entire length by Napa bay. The valleys form an interesting portion of this county; they are well adapted for farming, producing wild oats of luxuriant growth. Cultivated land 5049 acres. Pop. 2835; white, 2324 males and 402 females.

Sonoma County has 9387 acres of cultivated land, and 2337 inhabitants, the whites numbering 1309 males and 511 females.

Sutter County has 1401 acres of cultivated land, and 1207 inhabitants, the white population being 590 males and 85 females.

Trinity County has 275 acres in cultivation, and 1764 inhabitants; white pop. 1741 males and 23 females.

Tuolumno County has 1870 acres of cultivated land, and 17,657 inhabitants; whites 15,967 males and 958 females.

Tulare County has 8575 inhabitants; whites, 142 males and 32 females; 8400 Indians.

Yolo County has 1307 inhabitants, of whom 1085 are males and 189 females. Cultivated land, 3846 acres.

Yuba County has 22,005 inhabitants; whites, 16,666 males and 633 females. Cultivated land, 7008 acres. This county is very rich in gold and quicksilver. The principal stream is the Bear river, forming the county boundary line on the south, and falling into the Feather river 31 miles below Marysville; besides which there are numerous small streams and creeks, which abound in gold. On the Middle Yuba is Oregon Hill, which, according to Dr Frost, rises to the height of 2800 feet. The towns and villages are, Marysville on the Yuba river, 1 mile above its confluence with the Feather river, pop. 4500; Ousley's Bar, 13 miles above Marysville, pop. 390; Kennebeck, 14 miles above Marysville, pop. 120; Long's Bar, 16 miles above Marysville, pop. 450.

El Dorado County, from which no returns have been obtained, is supposed to have a population of about 40,000, of whom about 30,000 are whites.

California || Caliga.

California sends two members to the congress of the United States, and two members to the house of representatives. The legislative power is vested in a general assembly, consisting of a senate of sixteen members, elected for two years; and a house of representatives of thirty-six members, elected for one year. The sittings of the general assembly are held annually. The supreme court consists of a chief-justice and two associate justices. It has appellate jurisdiction where the matter in dispute exceeds 200 dollars, and where the legality of certain acts is questioned, as well as in certain criminal cases. The justices are elected by the people for six years, and are so classified that one goes out of office every two years. The senior judge in office is the chief justice. The district courts have jurisdiction in law and equity where the amount in dispute, exclusive of interest, exceeds 200 dollars. The constitution provided that at the first election the judges should be chosen by the legislature, but afterwards by the people, and for a term of six years. A county judge is elected in each county for four years to act as judge of probates, to hold the county court, and with two justices of the peace to hold courts of session for criminal business. Clerks of courts, district attorneys, sheriffs, coroners, &c., are elected by the people.

The constitution provides for the election of a superintendent of public instruction, to hold office for three years, and that the legislature shall establish a system of common schools to be taught at least 3 months in each year. A superintendent has been elected, but as yet there are but few schools. The capital of the state is, for the present, Vallejo, but the question of its future locality is still unsettled.

California promises at no distant day to be one of the first states in the Union. The bold and enterprising character of her present inhabitants cannot fail of rendering it a great, wealthy, and powerful state. In the ordinary elements of wealth and power, it is not behind the older states, while it far surpasses the most favoured in her inexhaustible supplies of the precious metals. In many of its productions it is (as shown by the census of 1852) already in advance of many of the other states. Though agriculture has yet been comparatively little attended to, the fact that it excels most of them in the productions of the soil shows the fertility and productiveness of the land. The counties of Yolo, Trinity, Sutter, Santa Cruz, San Diego, Sacramento, and Nevada, have reported merchandise to the amount of $400,000,000. The many interesting geological developments made by the census places this far in advance of all the other states in the variety and importance of its mineral productions.

California, *Gulf of*, an arm of the Pacific Ocean, separating the peninsula of Lower California from the mainland. It lies between Lat. 23. and 32. N. and Long. 107. and 114. W.; and is about 700 miles in length, with a breadth varying from 40 to 150 miles. Its western shores are generally high and rocky, with few places of shelter; its eastern shores are lower and less rocky. It contains numerous islands; and at its northern extremity receives the rivers Colorado and Gila.—See California, Lower.

CALIGA, in *Roman Antiquity*, the strong and heavy shoe of the common soldier. It was made in the sandal fashion, without upper leather to cover the superior part of the foot, though otherwise reaching to the middle of the leg, and fastened with thongs. The sole was of wood, like the sabot of the French peasants, and studded with *clavi* or nails, which by some are supposed to have been of considerable length in the shoes of the scouts and sentinels; whence they were called *caligæ speculatoriæ*—as if, by elevating the wearer, they extended the range of his view. Others, however, suppose that the *caligæ speculatoriæ*

were made soft and light. The emperor Caligula received his cognomen from having originally served in the army as a common soldier. According to Du Cange, a sort of *caliga* was also worn by monks and bishops when they celebrated mass pontifically.

CALIGATI, an appellation of the common soldiers in the Roman armies, derived from *caliga*, a peculiar kind of shoe worn by them. See CALIGA.

CALIGULA, the Roman emperor, A.D. 37–41, was the son of Germanicus and Agrippina, and was born A.D. 12. He began his reign with every appearance of becoming the real father of the people; but eight months after he assumed the purple, he was seized with a fever, which probably weakened his mental faculties; for his disposition totally changed, and he became a sanguinary and licentious tyrant. After having murdered many of his subjects with his own hand, and caused others to be put to death without trial, he was assassinated by a tribune of the people as he was leaving the amphitheatre. See ROMAN HISTORY.

CALIPH, or KHALIF, the sovereign dignitary among the Mohammedans, vested with absolute authority in all matters relating to religion and civil policy. In the Arabic it signifies *successor* or *vicar;* the caliphs bearing the same relation to Mohammed that the popes pretend they bear to St Peter. It is at this day one of the titles of the Grand Seignior or Sultan, as successor of Mohammed; and of the Sophi of Persia, as successor of Ali. One of the chief functions of the caliph, in his quality of imaum or chief priest of Islamism, was to begin the public prayers every Friday in the chief mosque, and to deliver the *khootba* or sermon. In after times they had assistants for this latter office; but the former was always performed by the caliph in person. The caliph was also obliged to lead the pilgrims to Mekka in person, and to march at the head of the armies of his empire. He granted investiture to princes, and sent swords, standards, gowns, and the like, as presents to princes of the Mohammedan religion; who, though they had thrown off the yoke of the caliphate, held of it as vassals. The caliphs usually went to the mosque mounted on mules; and the sultans Selgiucides, though masters of Baghdad, held their stirrups, and led their mules by the bridle some distance on foot, till the caliphs gave them the sign to mount on horseback. At a window of the caliph's palace there always hung a piece of black velvet twenty cubits long, which reached to the ground, and was called the *caliph's sleeve;* which the grandees of his court kissed daily with great respect. After the destruction of the caliphate by Hulaku, the Mohammedan princes appointed a particular officer in their respective dominions to sustain the sacred authority of caliph. In Turkey this officer is called *mufti*, and in Persia *sadne.*

CALIPHATE, the office or dignity of caliph. The successions of caliphs continued from the death of Mohammed till the 655th year of the Hegira, when Baghdad was taken by the Tartars. After this, however, there were persons who claimed the caliphate, as pretending to be of the family of the Abassides, and to whom the sultans of Egypt rendered great honours at Cairo, as the true successors of Mohammed; but this honour was merely titular, and the right allowed them only in matters of religion; and though they bore the sovereign title of *caliphs*, they were subjects and dependents of the sultans. In the year of the Hegira 361, a kind of caliphate was erected by the Fatemites in Africa, and lasted till it was suppressed by Saladin. Historians also speak of a third caliphate in Yemen or Arabia Felix, erected by some princes of the family of the Jobites. The emperors of Marocco assume the title of *grand scherifs*, and pretend to be the true caliphs, or successors of Mohammed, though under another name.

CALIPPIC PERIOD. See CALENDAR, p. 79.

CALIPPUS, or CALLIPPUS, an astronomer of Cyzicus, who invented the period or cycle of 76 years, which is called after his name the *Calippic.* He went to reside at Athens, where he became acquainted with Aristotle, and engaged with that philosopher in rectifying the discoveries of Eudoxus. See CALENDAR, p. 79.

CALISTHENICS (καλος beautiful, σθένος strength), the science or practice of exercising the body and limbs for the purpose of promoting strength and graceful deportment.

CALITRI, a town of Italy, in the Neapolitan province Principato-Ulteriore, near the river Ofanto. Pop. about 5000.

CALIXTINES, the followers of George Calixtus, a learned Lutheran divine, and professor at Helmstadt, who died in 1656. Calixtus opposed the opinions of St Augustin on predestination, grace, and free will, and endeavoured to form a union among the various members of the Romish, Lutheran, and Reformed churches; or at least to unite them in the bonds of mutual forbearance and charity.

CALIXTINES, a sect in Bohemia, derived from the Hussites, about A.D. 1420. They maintained that the use of the cup was essential to the eucharist; and hence their name, from *calyx* a cup.

The Calixtines were not ranked by Romanists in the list of heretics, since in the main they still adhered to the doctrines of Rome. The reformation they aimed at was comprehended in these four demands: 1, that the cup should be restored to the laity; 2, that criminal clerks should be subject to punishment; 3, that the clergy be reclaimed from the pursuit of wealth and power; 4, that the word of God be preached to the people in purity and simplicity.

CALIXTUS, the name of three different popes or bishops of Rome. The first ascended the chair of St Peter A.D. 219; the second in 1119; the third in 1455.

CALIXTUS, *Georgius*, a celebrated Lutheran divine, born at Middelburg in Holstein in 1586. After studying at Helmstadt, Jena, Giessen, Tübingen, and Heidelberg, he had an opportunity of travelling through France and England, where he became acquainted with the leading reformers, and saw the different forms which the Reformed church had assumed. On his return he was appointed professor of divinity at Helmstadt by the Duke of Brunswick, who had admired his abilities in a contest which he had when a young man with the Jesuit Augustine Turrianus. After becoming a master of arts he published a book, *Disputationes de Præcipuis Religionis Christianæ Capitibus*, which provoked the hostile criticism of several learned men; and on his elevation to the professorship he published his *Epitome of Theology*, and soon after his *Epitome of Moral Theology*, which gave so great offence as to induce Statius Buscher to charge him with a secret leaning to Romanism. Scarcely had he refuted the accusation of Buscher, when, on account of his intimacy with the Reformed divines at the conference of Thorn, and his desire to unite them with the Lutherans, a new charge was preferred against him, principally at the instance of Calovius, of a secret attachment to Calvinism. The disputes to which this gave rise, known in the church as the Syncretistic controversy, lasted during the whole lifetime of Calixtus, and distracted the Lutheran church, till a new controversy arose with Spener and the Pietists of Halle. Calixtus died in 1656. He was among the first who attempted to systematize theology, but was too much fettered by the method of Aristotle.

CALLAN, a market-town in the county of Kilkenny, Ireland, 82 miles S.S.W. from Dublin. N. Lat. 52. 33., W. Long. 70. 23. It stands on a level *strath*, watered by the King's river, a tributary of the Nore, and was a walled town of considerable strength, till dismantled by Cromwell. The smaller portion of the town stands on the north side of the river, and contains the remains of an Augustinian friary, connected by a bridge with a chapel and convent, on the opposite side. On the southern side there are no buildings

of importance, except the parish church—an ancient edifice—and the Roman Catholic chapel. It is laid out in four principal streets, which intersect each other at right angles. Callan was once a municipal and parliamentary borough, but was disfranchised at the Union. It gives the title of Viscount to the Fieldings, Earls of Denbigh. Pop. in 1841, 3111; in 1851, 2368, besides 2102 inmates of the workhouse.

CALLANDER, a village on the Teith, Perthshire, 30 miles W.S.W. from Perth. It is chiefly frequented by tourists on their way to the Trosachs, and contains several good hotels. The population of the parish, which includes the villages of Callander and Kilmahog, in 1851 was 1716.

CALLAO, a town of Peru, six miles west from Lima, of which it is the port. Lat. 12. S., Long. 77. 12. W. It is built on a flat point of land in the recess of a spacious bay formed by the isles of San Lorenzo and Fronton, and communicates with Lima by an excellent carriage road. The original site of the town is now covered by the sea, and the ruins of the houses which were demolished by an earthquake in 1746 are still visible in calm weather in the bay. The modern town consists chiefly of houses made of wicker-work, and plastered with mud, stronger buildings being rendered unnecessary by the mildness of the climate, and dangerous from the frequency of earthquakes; but the fortifications and government buildings are both massive and well-mounted with cannons. Callao was the last stronghold in possession of the Spaniards which held out against the insurgent patriots, but was compelled to surrender in 1821. The bay of Callao is well sheltered, and affords the best anchorage on the Peruvian coast. Below the city a mole has been constructed, at which vessels of considerable burden may discharge their cargoes. The trade of Callao, consisting of exports and imports, is carried on chiefly with Great Britain and the Western States of America. The principal exports are bullion, copper, cotton, soap, bark, Vicuna and Alpaca wool, and hides; the imports are cotton, linen, and woollen stuffs, hardware, fish, flour, indigo, spices, timber, &c. The declared value of British imports alone in 1846 was L.820,535. Pop. estimated at about 20,000.

CALLAO, so called by its inhabitants, but more generally known to Europeans under the name of Campello, lies off the coast of Cochin-China, about eight miles to the eastward of the mouth of a considerable river, on the banks of which stands the town of Faifoo, a place of some note. The only inhabited part of the island is on the S.W. coast, upon a slip of ground rising gently to the east. This small spot, when the Chinese embassy visited the island, was beautifully laid out with neat houses, temples, clumps of trees, and small hillocks richly decorated with shrubbery. The houses, which amounted to about sixty, were very clean and well-kept; a few were built with stone, and covered with tiles. The depth of water in the bay and roadstead is sufficient for ships of any burden; and there is perfect shelter from every wind except the S.W. It is thirty miles S.E. of the harbour of Turon. The extreme points of the island lie in Long. 108. 30. E., and Lat. 15. 53. N.

CALLCOTT, JOHN WALL, a celebrated composer of music, was born at Kensington in 1776. When nineteen years of age he was admitted bachelor of music at Oxford, and having studied under Haydn for about a year, he obtained the degree of doctor in 1800. Besides his *Musical Grammar*, he composed a great number of original works, and is especially celebrated for his glees. They were collected and published after his death, which took place in 1821.

CALLCOTT, *Sir Augustus*, an eminent landscape-painter, brother of the preceding, was born in 1779. His small pictures possess a clearness, depth, and breadth which have seldom been attained by any of the British school. He was admitted an associate of the Royal Academy in 1807, and elected an academician in 1810. His merits as an artist, and his estimable character, obtained for him the honour of knighthood in 1837; and in 1844, a few months before his death, he was appointed conservator of the royal pictures. He married Mrs Maria Graham, well known for her travels in India and America. She predeceased him by a short time.

CALLICRATES, a Lacedæmonian sculptor, who made an ivory chariot that might be concealed under the wing of a fly, and an ant of the same material, so small that its limbs could not be distinguished. Ælian justly censures him for exerting his talents on such useless things. (Ælian. *V. H.* i.; Plin. *H. N.* vii. 21, xxxvi. 5.)

CALLIGRAPHUS (κάλλος beauty, γραφω I write) anciently denoted a copyist or scrivener, who transcribed fair and at length the notes or minutes taken by the notaries. The minutes of acts, &c., were always taken in a kind of short-hand, by which means the notarii (the σημειογράφοι and ταχυγράφοι of the Greeks) were enabled to keep pace with a speaker, or person who dictated. These notes were copied out at length by the *calligraphi*.

CALLIMACHUS, a celebrated Greek poet, was a native of Cyrene, and a descendant of the illustrious house of the Battiadæ, whence by Ovid and others he is called Battiades. He flourished under the Ptolemies Philadelphus and Euergetes, and probably succeeded Zenodotus as chief librarian of the famous Alexandrian library, an office he held from about B.C. 260 till his death, which took place about B.C. 240. He was regarded, according to Quintilian, as the prince of Greek elegiac poets. His style is elegant and nervous, yet his excellencies are rather the result of excessive elaboration than of genuine poetic power: hence Ovid (*Am.* i. 15) says of him—*Quamvis ingenio non valet, arte valet.* Perhaps the *Hymn to Apollo* should be excepted from this criticism.

Callimachus was a learned critic and grammarian, and the instructor of Eratosthenes, Aristophanes of Byzantium, and Apollonius Rhodius. He wrote in prose and in verse on a great variety of subjects; but his only existing works are six hymns, seventy-three epigrams, and some fragments of elegies. Of the various imitations of Callimachus by the Roman poets, the small poem by Catullus, *De Coma Berenices*, is the most celebrated. Among the numerous editions of his works the following may be noticed:—By Spanheim, Ultraj. 1697, re-edited by Ernesti, Lugd. Batav. 1761; by Blomfield, Lond. 1815; by Volzer, Lips. 1817.

CALLIMACHUS, an architect and statuary, the inventor of the Corinthian column, was probably a native of Corinth. He is said to have derived the idea of the Corinthian capital from observing an acanthus plant surrounding a tile-covered basket which had been placed over a tomb. His era is uncertain; but as the Corinthian column was used in B.C. 396 by Scopas, the architect of the temple of Athena Alea at Tegea, he must have lived before that time. Though Callimachus worked admirably in marble, he is said to have spoiled his original conceptions by excessive elaboration, which rendered his style artificial. (Plin. *H. N.* xxxiv. 8. s. 19.)

Pliny mentions a painter named Callimachus, who is generally identified with the statuary, though without sufficient authority.

CALLINGAPATAM, a town of Hindustan, on the sea-coast of the Northern Circars, 70 miles N.E. from Vizagapatam. Long. 84. 15. E. Lat. 18. 25. N.

CALLINGER, a strong and celebrated fortress of Hindustan, in the British district of Banda in Bundelcund. Distant S.E. from Banda, 34 miles; S.W. from Allahabad 112 miles; N.W. from Calcutta 607. Lat. 25., Long. 80. 32. It is built of stone on the top of a lofty mountain, is five miles in circumference, and is well supplied with water from several tanks which are inclosed within it. This fort has been often besieged, but generally without success. The celebrated Mahmoud of Ghizne attempted its capture in

1024, but, probably doubtful of the result, permitted himself to be appeased by rich presents, and withdrew. In 1543 Sher Shah, the Afghan who expelled the emperor Humayon from the throne of Hindustan, was slain in attempting to take it. It held out for ten years against Ali Behadur, the Mahratta invader of Bundelcund, who at length died without having made himself its master. At the commencement of the present century it was governed by a commandant appointed by the rajah of Punna, but who subsequently disclaimed the authority under which he served and assumed dominion of the place. His successor caused much annoyance to the British government by affording shelter to the banditti of the country; and in consequence the fortress, early in 1812, was besieged by the British. On the 20th February, the breach being considered practicable, a storming party attempted the ascent of the steep and rugged face of the hill, but though the assailants pushed their enterprise with amazing intrepidity they were repulsed with great slaughter. So intimidated, however, was the garrison by the pertinacity of the besiegers, that its success was followed by overtures for peace; and eight days afterwards the commandant surrendered the fort on condition of receiving an equivalent in lands in the adjacent plain. The elevation of Callinger above the level of the sea is 1230 feet.

CALLINGTON, a market-town in the middle division of the eastern hundred of Cornwall, 7 miles S.S.W. from Tavistock. It has an ancient parish church, and several dissenting places of worship. Callington formerly returned two members to parliament, but was disfranchised by the Reform act. Pop. of parish (1851) 2146.

CALLINO, a town of Italy, in the Neapolitan province Abruzzo Ulteriore, with 1400 inhabitants.

CALLINUS of Ephesus, the earliest Greek elegiac poet, flourished about B.C. 700. One of his elegies has been preserved by Stobæus. (Bergk's *Poetæ Lyrici Græci.*)

CALLIOPE, the muse of epic poetry. She was thus named from the sweetness of her voice, and was the last of the nine sisters. Her distinguishing office was to record heroic actions; and she is represented with a tablet and style, or a roll of paper in her hand. See MUSES.

CALLIPÆDIA, the name of a Latin poem in four books, by Claude Quillet de Chinon, a French abbot, who published it under the fictitious name of *Clavides Lætus.* Its full title is *Callipædia, seu de pulchræ prolis habendæ ratione.* This work was translated into English verse by Nicholas Rowe.

CALLIPHON, an Epicurean philosopher, who is censured by Cicero for maintaining that the union of virtue (*honestas*) with corporeal gratification constitutes the chief good of man.

CALLIRRHOE, in *Ancient Geography* (surnamed *Enneacrunos* from its nine springs or channels), a fountain near Athens, greatly adorned by Peisistratus. There were several other wells in the vicinity, but this was the only running spring. This name was also applied to a considerable stream of hot water, which rises from several springs on the eastern side of the Jordan, and falls, after a short course, into the Dead Sea.

CALLISTEIA, in *Grecian Antiquity,* a Lesbian festival, at which the women assembled in the sanctuary of Juno, where the prize of beauty was adjudged to the fairest. A similar contention took place among the Parrhasians at the festival of Ceres Eleusinia; and there was another among the Eleans, in which the most beautiful man received a complete suit of armour which he consecrated to Minerva; to whose temple, after being adorned with a myrtle wreath and with ribbons, he was accompanied by his friends.

CALLISTHENES, a philosopher of Olynthus, and a relation and pupil of Aristotle, through whose recommendation he was appointed to attend Alexander in his Asiatic expedition, B.C. 334. He had the imprudence to censure the conqueror's adoption of Oriental customs, inveighing especially against the servile ceremony of adoration. Having by the boldness of his censures rendered himself highly obnoxious to the king, he was accused of being privy to a treasonable conspiracy; and after being kept in chains for seven months he died, either by torture, or of a disease arising from excessive obesity. Callisthenes wrote an account of Alexander's expedition, a history of Greece, and other works, all of which have perished.

CALLISTO, in ancient fable, the daughter of Lycaon, king of Arcadia, and one of Diana's attendants. She bore a son, Arcas, to Jupiter, who endeavoured to conceal his amour from Juno by metamorphosing the nymph into a she-bear. In this disguise, through the artifice of Juno, Callisto was slain by Diana; and under the name of Arctos she was placed among the stars. The story of Callisto is variously related by different authors. (See Ovid. *Met.* ii.; Hygin. *Fab.* 176, 177; Apollod. iii.)

CALLISTRATUS, an Athenian orator, whose eloquence and high reputation made so deep an impression on Demosthenes that he abandoned Plato, and resolved thenceforward to devote himself to oratory. On account of the undue influence that Callistratus exercised in the state, he was condemned to death, B.C. 361; and retiring to Methone in Macedonia, he founded, it is said, the city of Datum, afterwards Philippi. Having returned to Athens, he was put to death.

CALLISTRATUS, an Athenian poet, whose works have nearly all perished. He is now only known as the author of the hymn in honour of Harmodius and Aristogeiton, who fell in their attempt to put down the dynasty of the Pisistratidæ at Athens. This ode has been beautifully translated by Thomas Moore.

CALLON, a Greek sculptor, born in the island of Ægina in the first year of the 65th Olympiad. His statues were executed in wood, bronze, and marble, and though not of the highest order of merit, were sufficiently esteemed in their day.

CALLOSA DE ENSARRIA, a town of Spain, on the left bank of the Guadalest, district of Alicante, province of Valencia. It contains about 1000 houses, and is the centre of a fine agricultural district, which is, however, very subject to earthquakes. The principal productions are raisins, pulse, wheat, maize, olives, almonds, and figs. Pop. 4328.

CALLOSA DE SEGURA, a small town near the river Segura, in the district of Alicante, Valencia, Spain, situated on the western slopes of the Sierra Callosa, 27 miles S.W. from Alicante. Its trade is limited to the exportation of the produce of the district, and the importation of manufactured articles for home consumption. Pop. 2904.

CALLOT, JACQUES, an eminent French engraver, was born in 1593 at Nancy in Lorraine, where his father was a herald-at-arms. He early discovered a very strong predilection for art, and at the age of twelve quitted the paternal abode without his father's consent, and set out for Rome, where he intended to prosecute his studies. Being utterly destitute of funds he joined a troop of Bohemians, and arrived in their company at Florence. In this city he had the good fortune to attract the notice of a gentleman of the court who supplied him with the means of study; but he removed in a short time to Rome, where, however, he was recognised by some relatives, who immediately compelled him to return home. Two years after this, and when only fourteen years old, he again left France contrary to the wishes of his friends, and reached Turin before he was overtaken by his elder brother, who had been despatched in quest of him. As his enthusiasm for art remained undiminished after these disappointments, he was at last allowed to accompany the Duke of Lorraine's envoy

to the papal court. His first care was to study the art of design, of which in a short time he became a perfect master. Philip Thomasin instructed him in the use of the graver, which, however, he ultimately abandoned, substituting the point as better adapted for his purposes. From Rome he went to Florence, where he remained till the death of Cosmo II., the Mæcenas of these times. On returning to his native country, he was warmly received by the then Duke of Lorraine, who admired and encouraged him. As his fame was now spread abroad in various countries of Europe, many distinguished persons gave him commissions to execute. By the Infanta Isabella, sovereign of the Low Countries, he was commissioned to engrave a design of the siege of Breda; and at the request of Louis XIII. he designed the siege of Rochelle, and the attack on the Isle of Ré. When, however, in 1631, he was desired by that monarch to execute an engraving of the siege of Nancy, which he had just taken, Callot refused, saying, "I would rather cut off my thumb than do anything against the honour of my prince and of my country;" to which Louis replied—that the Duke of Lorraine was happy in possessing such subjects as Callot.

Shortly after this he returned to his native place, from which the king failed to allure him with the offer of a handsome pension. He died in 1635 at the age of 42. He engraved in all about 1600 pieces, the best of which are those executed in aquafortis. No one ever possessed in a higher degree the talent for grouping a large number of figures in a small space, and of representing with two or three bold strokes the expression, action, and peculiar features of each individual. Freedom, variety, and naïveté characterize all his pieces. His Fairs, his Miseries of War, his Sieges, his Temptation of St Anthony, and his Conversion of St Paul, will be sought after and admired as long as there are artists to learn and a public to appreciate.

CALLY, Pierre, a distinguished French theologian and philosopher, was born at Mesnil Hubert near Argentan, in the department of Orne, about the middle of the seventeenth century. Though destined for the church, he devoted himself at an early age to the study of philosophy, and was the first person in France to adopt in their totality the doctrines of Descartes. The boldness of this step procured for him many enemies, and even interrupted his intercourse with his personal friends, amongst others with Huet, the illustrious bishop of Avranches. When Louis XIV. was organizing the Delphin classics, Cally was appointed to edit the *De Consolatione Philosophiæ* of Boethius. His edition of that work appeared in 1680, and has now become extremely rare. In 1674 he published his *Institutio Philosophica*, which he subsequently enlarged and republished about twenty years after, and in the following year became principal of the college of arts at Caen. In 1684 he became curate of the church of St Martin, and ingratiated himself with the Protestants of that city so successfully, that he converted many of their number. His enemies, however, jealous of his increasing fame, revived against him the old charge of Cartesianism, and procured his banishment. He then settled at Moulins, where he remained for two years. Finding that his popularity with the Protestants of Caen had not been diminished by his absence, he wrote them a letter on the Harmony of Theology with Philosophy, a work which was publicly condemned, apparently with such good reason, that he himself made an open retractation of it, and caused it to be suppressed. Shortly after this event he died in 1709.

CALM Latitudes, or Region of Calms, the tract of the Atlantic Ocean situated between the tropic of Cancer and latitude 29° north.

CALMAR, or Kalmar, a maritime province of Sweden, between N. Lat. 56. 20. and 58. 20. and E. Long. 15. 30. and 17. 0; and bounded east by the Baltic, N.W. by Linköpink, south by Carlskrona, west by Iönkoping and Wexio. Area, including the island of Oeland, 4258 square miles. Pop. (1845) 196,116.

Calmar, or *Kalmar*, the capital of the above province, on Calmar Sound opposite the island of Oeland. N. Lat. 56. 40., E. Long. 16. 20. It is built on the island of Quarnholm, and communicates with the suburbs on the mainland by a bridge of boats. Most of the houses are built of wood; but the cathedral, the castle, the Hôtel-de-Ville, and other public edifices, are of stone, of which there are good quarries in the island of Oeland. It has an academy, and several smaller educational establishments. The harbour is safe and commodious, but a large part of the trade has been transferred to Stockholm. It has manufactories of woollen stuffs, tobacco, and potash; and carries on an export trade in flax, timber, iron, alum, pitch, &c. Calmar was once a flourishing and strongly-fortified town; and gives name to the treaty by which Sweden, Denmark, and Norway were in 1397 erected into one kingdom under Queen Margaret. Pop. about 5500.

CALMET, Augustine, a distinguished scholar and biblical critic, born at Mesnil-la-Horgne in Lorraine, in 1672. In his fifteenth year he went to the university of Pont-a-Mousson, which he attended for a single session. In 1688 he joined the Benedictines at the abbey of St Mansin, into whose order he was publicly received in the following year. His theological and philosophical studies he completed at the abbey of Munster, to which he was sent in 1704 with the rank of sub-prior. He here organized an academy of eight or ten monks, the sole business of whose life was to assist him in preparing his Commentary on the Bible. The publication of this voluminous work, begun in 1707, was not completed till 1716. Two years after this latter date he was rewarded for his services with a presentation to the abbey of St Leopold at Nancy, and ten years after to that of Sénones, where he died in 1757. His attachment to his country and congregation was such, that he refused a bishopric *in partibus* offered to him by the pope, Benedict XIII. Besides his Commentary, he wrote many other works, of which the most important are his *Histoire de l'Ancien et du Nouveau Testament*, an introduction to the Ecclesiastical History of Fleury; *Dictionnaire, historique, critique, et chronologique*, an extremely learned, but by no means judicious work; and *Histoire universelle sacrée et profane*, 15 vols. 4to.

CALNE, a market-town in the hundred of Calne, Wiltshire, 87 miles west from London. It stands in a valley intersected by the little brook of Calne, and is surrounded by the high table-land of Marlborough Downs and Salisbury Plain. The town is clean and well-paved, and contains an ancient church with a tower by Inigo Jones; besides a fine new church in the neighbourhood, and several dissenting chapels. Its educational establishments include a grammar-school, founded in 1660, to which two exhibitions in Queen's College, Oxford, are attached; national and infant schools; and a school for training female servants. It is a vicarage in the archdeaconry of Wilts and diocese of Salisbury. It is also the seat of the county courts, and returns one member to parliament. The municipal borough is governed by a mayor, four aldermen, and twelve councillors. The principal trade of Calne is in corn, although formerly it carried on a considerable manufacture of cloth. Pop. of the municipal borough (1851) 2544; of the parliamentary borough (1851) 5195.

From the remains found in the vicinity, Calne seems to have been an important Roman station. It was the occasional residence of the West Saxon kings; and is celebrated in legendary ecclesiastical history for the miraculous escape of Dunstan at the synod held there in 997.

CALOGERI, or Caloyers, monks of the Greek church, of three orders,—the *archari*, or novices; the ordinary pro-

fessed, or *michrochemi;* and the more perfect, called *megalochemi*. They are also divided into *cœnobites*, who are employed in reciting their offices from midnight to sunrise; *anchorets*, who retire and live in hermitages; and *recluses*, who shut themselves up in grottos and caverns, and subsist by alms furnished to them by the monasteries.

CALOMEL, a preparation of mercury, much used in medicine. See CHEMISTRY.

CALORIC, the principle or matter of heat, or the simple element of heat. See CHEMISTRY, and HEAT.

CALORIMETER, an instrument invented by Lavoisier and Laplace for measuring the heat given out by bodies in cooling, by the quantity of ice they melt.

CALORIMOTOR. See VOLTAIC ELECTRICITY.

CALOTTE, a cap or coif of hair, satin, or other stuff, worn in Popish countries as an ecclesiastical ornament.

CALOTYPE (καλος and τύπος), the name given by Mr H. Fox Talbot to his photogenic process for obtaining copies of natural objects and pictures; in which paper prepared in a particular manner is used, instead of the silvered plates employed for that purpose by M. Daguerre. It is also sometimes called Talbotype, in honour of the inventor. See PHOTOGRAPHY.

CALOVIUS, ABRAHAM, a celebrated Lutheran divine, was born at Mohrungen in Brunswick in 1612. He studied at Rostock and Königsberg, and was professor of theology at Wittemberg when he died in 1686. He took a prominent part in the Socinian and other controversies of the day, but especially distinguished himself in the syncretistic controversy with Calixtus. He carried on his disputes with so great vehemence that his *Historia Syncretistica* was confiscated by the elector of Saxony.

CALPE, a mountain of Andalucia, in Spain, at the foot of which, towards the west, stands the town of Gibraltar. Its extreme length from north to south is 14,700 feet, or a little more than $2\frac{3}{4}$ miles. It is nearly perpendicular on the east and north, and slopes rapidly to the west. Its greatest height is 1450 feet.

CALPURNIUS, TITUS, a Latin Sicilian poet, who lived under the Emperor Carus and his son. Seven of his eclogues are extant.

CALTANISETTA, a province of Sicily, bounded north by the province of Palermo, east by Catania, south by Syracuse and the Mediterranean, west by Girgenti. It is divided into three districts,—viz., Caltanisetta, Piazza, and Terranova,—and has an area of about 1200 square miles, and a population (1851) of 180,791. The soil of the province is somewhat hilly, but well watered and fertile.

CALTANISETTA, the capital of the above province, situated in an extensive and fertile plain near the right bank of the Talso, 62 miles S.E. of Palermo. It is well-built, and contains several handsome edifices. It is defended by a castle, and is the seat of judicial courts. In the neighbourhood, at Terra Pilata, are several springs emitting hydrogen gas, and also extensive sulphur-works. Pop. about 16,000.

CALTROP (the ancient *tribulus*), a small instrument of iron, with four prongs so arranged that when thrown on the ground one of them is always perpendicular. From ancient times this implement has been employed in strategy to impede the progress of cavalry.

CALTURA, a small sea-port town in the district of the same name in Ceylon. It stands on the Kalu Ganga river, about 26 miles south from Colombo, in the centre of a fertile and salubrious district, and is much resorted to by invalids. It was formerly the station of a garrison, and is still the seat of an inferior judicial court. It enjoys a considerable share in the coasting-trade, with Madras and the Eastern ports.

CALUMBA, the root of the *Cocculus palmatus*, a climbing plant resembling bryony, belonging to the Linnean class and order Hexandria Digynia, and to the natural order Menispermaceæ. The root, which is perennial, consists of numerous spindle-shaped tubers which have an intensely bitter taste; and to prepare them for the market they are cut in slices and dried on cords. Calumba is solely used in medicine, and is one of the best pure bitter tonics, being quite free of astringency, and is especially serviceable in dyspepsia, and in affections of the stomach and bowels, often acting as a calmative when irritability exists, as indicated by pain or vomiting after meals.

CALUMET, a symbolical instrument of great importance among the American Indians. The calumet is a pipe made of a soft red marble, and a long reed, ornamented with the wings and feathers of birds. No affair of consequence is transacted without the calumet. It always appears in meetings of commerce or exchanges; in congresses for determining of peace or war; and even in the midst of battle. The acceptance of the calumet is a mark of concurrence with the terms proposed, as the refusal is a mark of rejection. When they treat of war, the pipe and all its ornaments are usually red. The size and decorations of the calumet are for the most part proportioned to the rank of the person to whom it is presented, and to the importance of the occasion. The calumet of war consists of a red stone, like marble, and the tube is a hollow reed. They adorn it with feathers of various colours, and name it the calumet of the sun. From the winged ornaments of the calumet, and its uses, writers compare it to the ancient caduceus, which was carried by the caduceatores, with terms to the hostile states.

CALUMNY, slander, or false accusation made wittingly.

Oath of CALUMNY, *Juramentum*, or rather *Jusjurandum, Calumniæ*, or *de Calumnia*, among civilians and canonists, was an oath which both parties in a cause were obliged to take; the plaintiff that he did not bring his charge, and the defendant that he did not deny it, with a design to abuse the other, but because they believed their cause was just and good; that they would not deny the truth, nor create unnecessary delays, nor offer the judge or evidence any gifts or bribes. If the plaintiff refused this oath, the complaint or libel was dismissed; if the defendent, he was held *pro confesso*. This custom was taken from the ancient athletæ, who, before they engaged, were bound to swear that they had no malice, nor would use any unfair means for overcoming each other. The *juramentum calumniæ* is much disused, as a great occasion of perjury.

CALVADOS, a department in the north of France, extending from 48. 46. to 49. 25. N. Lat., and from 0. 26. E. to 1. 10. W. Long., formed out of that part of Lower Normandy which comprised Bessin, Bocage, the Champagne de Caen, Auge, and the western part of Lieuvin. It received its present name from a ledge of rocks stretching along the coast for a distance of about 15 miles between the mouths of the rivers Orne and Vire, on which the *Calvados*, a vessel belonging to the Spanish Armada, was wrecked in 1588. It is bounded north by the English Channel; east by the department of Eure; south by that of Orne; west by that of Manche; and has an area of 2143 square miles. The southern part of the department is somewhat elevated, being crossed by a mountain range, and forms a continuation of the great water-shed between the basins of the Seine and Loire; but the rest of the surface is gently undulating, and consists of extensive valleys watered by numerous streams which fall into the English Channel. The coast is high, and generally inaccessible except at the mouths of the principal rivers, such as the Touque, the Dive, the Orne, and the Vire, which are navigable at high tide for several miles inland, and are indicated by lighthouses at their mouths. The valleys, which generally slope in a direction from south to north, afford abundant pasturage for horses and cattle, and the agriculture of

the district is superior to that of most of the other departments. Wheat, potatoes, and all kinds of vegetables are raised in great quantities for the markets of the interior and for exportation. The orchards of the Auge district produce a very superior kind of cider, of which upwards of 30,000,000 gallons are made in the department; while Isigny is the centre of a large domestic and export trade in butter, cheese, and other dairy produce. Poultry is reared to a considerable extent for the Paris market. In the larger towns, of which, on account of the agricultural pursuits of the inhabitants there are very few, there are manufactories of lace, (employing upwards of 50,000 persons), woollen yarn and cloth, linen, calicoes, flannel, shawls, cutlery, and earthenware. Besides these the paper-mills, oil-mills, tanneries, refineries of beet-root and foreign sugar, distilleries and bleach-fields scattered throughout the department, give employment to a great number of hands. Although seams of coal are found and wrought at Ligny, most of the coal used in the department is imported from England or Belgium. The fisheries along the coast are extensively prosecuted for Parisian consumpt, and consist chiefly of lobster, oyster, herring, and mackerel fishing. The imports of the department are principally iron, wool, raw cotton, hides, and colonial produce, which form the raw materials for home manufacture. The principal towns are Caen (the capital), Lisieux, Bayeux, Falaise, Honfleur, and Vire, which communicate with each other by excellent roads. The first three stand on the great road from Paris to Cherbourg.

Calvados is divided into six arrondissements, which are peopled and divided as follows: viz.—

Arrondissements.	Cantons.	Communes.	Pop. (1851.)
Caen	9	188	139,922
Falaise	5	121	60,534
Bayeux	6	145	79,976
Vire	6	97	87,075
Lisieux	6	125	67,059
Pont-l'Evêque	5	116	56,644
Total	37	792	491,210

CALVART, Denis, an eminent Flemish painter, born at Antwerp in 1553. After studying for some time in his native city he went to Bologna, where he perfected himself in the anatomy of the human form under Prospero Fontana. From Bologna he went to Rome, where he assisted Sabbatini in his works for the papal palace, and devoted much of his time to copying and studying the works of Raphael. He ultimately returned to Bologna, and founded a school, of which the greatest ornaments are Guido and Domenichino. His works are especially admired for the power of grouping and colouring which they display. He died at Bologna in 1619.

CALVARY, the place where Christ was crucified. In three of the Gospels the Hebrew name Golgotha (*place of a skull*) is given; and in Luke (xxiii. 33), where we find Calvary in the authorized version, the original is not Calvary, but Cranion (κρανίον), a diminutive of κρᾶνον (*a skull*). Calvaria is the Latin translation of this word, adopted by the Vulgate, from which it found its way into our version. For the particulars connected with the site of the Crucifixion, see Jerusalem.

Calvary, a term used in Catholic countries, denotes a chapel of devotion, erected on a hillock near a city, in memory of the place where our Saviour suffered.

Calvary, in *Heraldry*, a cross set upon steps, supposed to resemble the cross of our Saviour.

CALVERT, George, Lord Baltimore, one of the principal secretaries of state under James I., was born at Kipling in Yorkshire in 1582. He retained office for five years, at the end of which term he resigned, alleging as a reason, that he had recently adopted the Catholic faith. He still continued at court, however, in the capacity of a privy-councillor. Among the other rewards he received for his services was a patent as lord of the province of Avalon in Newfoundland. As this colony was much exposed to the attacks of the French he left it, and obtained another patent for Maryland, in the north of Virginia. He died in 1632 before the grant was confirmed, but in that year it was made out in the name of his son Cecil. The city of Baltimore derives its name from the title of this family.

CALVI, a seaport-town of Corsica, on an elevated peninsula in a gulf of the same name. N. Lat. 42. 34. E., Long. 8. 44. Calvi is furnished with a good and well-sheltered harbour, but its trade has greatly decayed, part of it having been transferred to Isola Rossa on the N.E. The citadel is a place of great strength, and under the Genoese, held out for 51 days against the English in 1794. Pop. of the arrondissement of Calvi, 24,390; of the town, 1750.

CALVIN, John, was born at Noyon, in Picardy, on the 10th of July 1509. His father, Gerard Calvin or Cauvin,[1] was a notary-apostolic and procurator-fiscal for the lordship of Noyon, besides holding certain offices in connection with that diocese. The name of his mother was Jeanne Lefranc; she was the daughter of an innkeeper at Cambray, who afterwards came to reside at Noyon. Gerard Cauvin is described as a man of considerable sagacity and prudence, and on this account held in esteem by the leading men of the district. His wife added to considerable personal attractions the graces of a vivid and earnest piety. Their family consisted of four sons, of whom John was the second, and two daughters.

Of Calvin's early years only a few notices remain. His father destined him from the first for theological studies, being moved to this by the evidences afforded in his boyhood of a religious tendency, and perhaps also by a shrewd apprehension of the kind of pursuits in which he was most fitted to excel. The esteem in which the father was held opened for the boy a place in the household of the noble family of De Montmor, where he received his elementary education along with the children of the house, though at his father's expense. In his thirteenth year his father, whose circumstances were not affluent, procured for him from the bishop a benefice in the Chapelle de Notre Dame de la Gesine. In this office he was installed on the 29th of May 1521, and the income thence derived, enabled him to accompany the young De Montmors to Paris, and to prosecute his studies there. His first school was the Collége de la Marche, at that time under the regency of Maturin Cordier, a man of excellent character, of sound learning, and high repute as a teacher. From this institution he removed to the Collége Montaigu, where he had for instructor a Spaniard, who is described as a man of learning, and to whom Calvin was indebted for the culture of his already acute intellect, by the study of dialectics and the scholastic philosophy. Whilst at school the future reformer distinguished himself by his superior abilities, and his indefatigable assiduity. He speedily outstripped all his competitors in grammatical studies, and by his skill and acumen

[1] The family name of Calvin seems to have been written indifferently Cauvin, Chauve, Chauvin, Calvus, Calvinus. In the contemporary notices of Gerard and his family, in the capitular registers of the cathedral at Noyon, the name is always spelt Cauuin. At one time the reformer appeared inclined to adopt Alcuinus as the Latinized form of his name, for in two editions of his *Institutio* this name appears as that of the author (Audin, *Vie de Calvin*, i., 520). The syndics of Geneva address him in a letter written in 1540, and still preserved, as "Docteur Caulvin." In his letters written in French he usually signs himself "Jean Calvin." He affected the title of "Maître," for what reason is not known.

as a student of philosophy, gave fruitful promise of that consummate excellence as a reasoner, in the department of speculative truth, which he afterwards displayed.

In his nineteenth year he, through the influence of his father, obtained the living of Marteville, to which he was presented on the 27th of September 1527. After holding this preferment for nearly two years, he exchanged it in July 1529 for the cure of Pont-l'Evêque, a village near to Noyon, and the place to which his father originally belonged. He appears to have been not a little elated by his early promotion, and although not ordained, he preached several sermons to the people. But though the career of ecclesiastical preferment was thus early opened to him, Calvin was destined not to become a priest of the Church of Rome. A change came over the mind both of his father and himself respecting his future career. Gerard Calvin, looking at things only from a worldly point of view, began to suspect that he had not chosen the most lucrative profession for his son, and that the law offered to a youth of his talents and industry a more promising sphere.[1] His son, on the other hand, had come under an influence of a very different kind, but which, with still more decisive impulse, inclined him to relinquish the ecclesiastical life. Through the counsels of his relation, Pierre Robert Olivetan, the first translator of the Bible into French, he had been led for the first time to study the sacred volume, and to test his religious opinions and practices by its dictates. The result was that, though not yet detached from the faith of the Romish church, he was very willing to relinquish all thoughts of becoming a priest in that communion. He accordingly readily complied with his father's suggestion, and having resigned his benefice, removed from Paris to Orleans, in order to study law under Pierre de l'Etoile, a distinguished jurisconsult, and at that time professor there. On this new pursuit Calvin entered with characteristic ardour, and such was his progress in legal knowledge, that he frequently occupied the chair of the professor, while his general reputation for ability and scholarship stood so high, that on leaving Orleans, he received the grade of doctor without payment of the usual fees, as a compliment to his merits. Other studies, however, besides those of law had occupied him whilst in this city. God, who had destined him for a very different career, was in his providence preparing him for the work he had to do. His mind, at first hardened by the influence of early superstition, was, he himself tells us, brought by a sudden conversion into a state of docility.[2] An ardent desire to attain proficiency in sound knowledge took possession of him, and though this did not lead him to renounce other studies, it rendered him frigid in the pursuit of them. At all times, indeed, a diligent student, he seems at this time to have been impelled by his zeal beyond those bounds which a wise regard to health would impose. It was his wont, after a frugal supper, to labour till midnight, and in the morning when he awoke, he would, before he arose, recal and digest what he had read the previous day, so as to make it thoroughly his own. "By these protracted vigils," says Beza, "he secured indeed a solid erudition, and an excellent memory; but it is probable he at the same time sowed the seeds of that disease which occasioned him various illnesses in after life, and at last brought upon him premature death."[3]

From Orleans Calvin went to Bourges to prosecute his studies under a learned Italian of the name of Alciati, whom Francis I. had invited into France, and settled as a professor of law in that university. Here he became acquainted with Melchior Volmar, a German, then professor of Greek at Bourges, and a man of sound erudition as well as exemplary character. By him Calvin was taught Greek, and introduced to the study of the New Testament in its original language, a service which he gratefully acknowledges in one of his printed works.[4] The conversation of Volmar also seems to have been of use to him in deepening his religious convictions, and confirming him in his attachment to the doctrines of the Reformation. These were now beginning to be widely diffused through France. Twelve years had elapsed since Luther had published his theses against Indulgences; twelve years of intense excitement and anxious discussion, not in Germany only, but in almost all the adjacent kingdoms. In France there had not been as yet any overt revolt against the Church of Rome, but multitudes were lending a friendly ear to the reformed doctrines, and a few were in secret rejoicing in having heartily embraced them. To such Calvin united himself whilst at Orleans, and after his removal to Bourges he became a teacher, both in private conference with inquirers and by discourses in more public assemblies. "Before a year had elapsed," says he, speaking of his conversion, "all who were desirous of a purer doctrine were in the habit of coming to me, though a novice and a tyro, for the purpose of learning."[5] And Beza tells us, that he not only fortified the few believers who were in the town, but preached often in some of the neighbouring mansions and hamlets, whereby he wonderfully advanced the kingdom of God in many families, among which he specifies that of the lord of Lignières, who with his lady heard with approval the new doctrines.[6] In engaging in such efforts, Calvin appears to have yielded to a constraining sense of duty rather than to have followed the bias of his own inclinations. "By nature," says he, "somewhat clownish (*subrusticus*), I always preferred the shade and ease, and would have sought some hiding place; but this was not permitted, for all my retreats became like public schools."[7] Nor did he infuse any of the enthusiasm which usually marks the young reformer into his addresses. "He taught the truth," says Beza, "not with affected eloquence; but with such depth of knowledge, and so much solid gravity of style, that there was not a man who could hear him without being ravished with admiration."[8]

His residence at Bourges was cut short by the sudden death of his father, which occasioned his return to his native place. Immediately after his father's decease, he seems to have paid a hasty visit to Paris, and then to have returned to Noyon, where he resided for a couple of years or so. At the close of this period he appears to have taken up his abode permanently in the capital. Here he associated with the friends of evangelical truth, and frequented their assemblies, where he frequently preached. To the great joy of all such, he at length relinquished his legal pursuits, and devoted himself afresh to theology. He now gave himself up wholly to the work of the Lord, preaching with great energy, and using all the means in his power to win converts to the truth, as well as to confirm those by whom it had been already embraced. By this time the Reformation had attracted so many adherents in France, that the upholders of the established system became infuriated, and attempted to stay its further progress by the most cruel persecutions. In the hope of working upon the better feelings of those in power, and especially of the king, who was known to be favourable to literature, Calvin published an edition of Seneca's book *De Clementia*, accompanied by a commentary, in which he not only illustrates his author, but gives utterance to sentiments evidently intended to bear upon the conduct of the king in suffering his subjects to be tortured and burnt for their religious opinions. This book he published at his own cost, and dedicated to Claude Hangest, abbot of St Eloi, a member

1 Calv., *Præf. ad Comment. in Psalmos.*
2 *Præf. ad Psalmos.*
3 *Jo. Calvini Vita, sub insit.*
4 *Epist. Ded., Comment. in Ep. II. ad Corinthios præfix.*
5 *Præf. ad Psalmos.*
6 *Hist. Eccles.* t. i., p. 6, 7. Lille, 1841.
7 *Præf. ad Psalmos.*
8 *Hist. Eccles. ubi. sup.*

of the De Montmor family, with whom Calvin had been brought up. The commentary displays extensive acquaintance with ancient literature, though the author has fallen into the ridiculous mistake of running the two Senecas, father and son, into one, and making the philosopher die 115 years old.

This work was published in April 1532. Calvin was now in his 24th year, and was already recognised as at the head of the Reformation movement in France. An occasion soon occurred which brought him into open collision with the dominant party. Nicholas Cop, the newly elected regent of the Sorbonne, had to deliver an oration according to custom in the Church of the Maturins, on the feast of All Saints. Being intimate with Calvin, he pronounced an oration which the latter had prepared for him, "of a totally different sort," says Beza, "from what was customary."[1] It was in fact a defence of the reformed opinions, especially of the doctrine of justification by faith alone. This was more than the Sorbonnists could bear, and Cop being summoned to appear before the parliament, found it necessary to make his escape from Paris to Basle. An attempt was at the same time made to seize Calvin, but being forewarned of the design by his friends, he also made his escape. His lodgings, however, were searched, and his books and papers seized, to the imminent peril of some of his friends, whose letters were found in his repositories. He himself took refuge at the court of the queen of Navarre, the only sister of Francis I., who then favoured the reformed party, and through whose intercession the storm which had broken out against them at this time was quieted. Calvin after this retired to Saintonge, where, at the request of a friend, he prepared some short discourses, which were circulated in the surrounding parishes, and read in public to the people. He subsequently removed to Nerac, the residence of the queen of Navarre, where he became acquainted with the venerable Jacques Lefevre d'Estaples, a scholar and man of science, whom the queen had rescued from the fury of the Sorbonnists, and engaged as tutor to her children. By him Calvin was warmly received, and his future eminence as a reformer of the church predicted.

It is believed that it was whilst resident at Saintonge that Calvin prepared the first sketch of his *Institutio Christianæ Religionis*. But his residence in that retirement continued only for a very few months, for in 1534 we find him again in Paris. Here he was compelled to remain concealed, in consequence of the measures which the enemies of the gospel were still pursuing against its adherents. At the risk of his life, however, he came forth to meet one whom he was afterwards to encounter under very different circumstances, the Spanish physician, Servede or Servetus, who was even then engaged in propagating his heretical notions concerning the Trinity. Him, vaunting his desire for a conference, Calvin challenged; but though time and place were fixed, Servetus failed to fulfil his boast. Calvin's design in proposing this colloquy seems to have been a kindly one towards Servetus. "Not without danger to my life," he himself says, "I offered to deliver him from his errors; and it would not have been my fault, had he manifested repentance, if all pious men had not given him their hands."[2] Nor was Servetus the only errorist whom Calvin endeavoured at this time to confute. The Anabaptists of Germany had spread into France, and were disseminating many wild and fanatical opinions among those who had seceded from the Church of Rome. Among other notions which they had imbibed, was that of a sleep of the soul after death. To Calvin this notion appeared so pernicious, that he composed and published a treatise in refutation of it, under the title of *Psychopannychia*. In this work he chiefly dwells upon the evidence from Scripture in favour of the belief that the soul retains its intelligent consciousness after its separation from the body; passing by questions of philosophical speculation, as tending on such a subject only to minister to an idle curiosity.

The *Psychopannychia* was published in 1534 at Orleans, whither Calvin had been constrained, in consequence of the violence of the persecution at Paris, to retreat. He soon after found it necessary to leave France entirely, and with this view set out with his friend Louis Fillet for Basle. On their way they were robbed by one of their servants, who so entirely stripped them of their property, that it was only by borrowing ten crowns from their other servant that they were enabled to get to Strasburg, and thence to Basle. Here Calvin was welcomed by the band of scholars and theologians who had conspired to make that city the Athens of Switzerland, and especially by the learned Simon Grynæus, and by Wolfgang Capito, the leader of the Reformation at Basle. Under the auspices and guidance of the latter, Calvin applied himself to the study of Hebrew.

Francis I., desirous to continue the persecution of the Protestants, but anxious at the same time not to break with the Protestant princes of Germany, resorted to the unworthy expedient of instructing his ambassador to assure the latter that it was only against the Anabaptists, and other parties who called in question all civil magistracy, that his severities were exercised. Calvin, indignant at the calumny which was thus cast upon the reformed party in France, hastily prepared for the press his Institutes of the Christian Religion, which he published as a confession of the reformed faith, and dedicated to the king. Of this edition, which appeared in 1535, no copy is known to be extant. It is described by the author as a mere outline of what afterwards appeared under the same title, and he says he published it anonymously, having in view nothing beyond furnishing a statement of the faith of the persecuted Protestants, whom he saw cruelly cut to pieces by impious and perfidious court parasites.[3] It is supposed to have been written in French. In the year following the work was republished in an enlarged form in Latin, and with the author's name.[4] In this work, though produced when the author was only twenty-five years of age, we find a full development of that theological system which has since borne his name. In none of the later editions, nor in any of his later works, do we find reason to believe that he ever changed his views on any essential point from what they were at the period of its first publication. Such an instance of maturity of mind and of opinion at so early an age, would be remarkable under any circumstances; but in Calvin's case it is rendered peculiarly so, by the shortness of the time which had elapsed since he gave himself to theological studies. It may be doubted also if the history of literature presents us with another instance of a book written at so early an age, which has exercised such a prodigious influence upon the opinions and practices both of contemporaries and of posterity.

After a short visit to the court of the Duchess of Ferrara, which at that time afforded an asylum to several learned and pious fugitives from persecution, Calvin returned to France to arrange his affairs before finally taking farewell of his native country. His intention was to settle at Basle, and to devote himself to study. But being unable, in consequence of the disturbed state of the country, to reach Basle by the ordinary route, he had to take the route through Geneva. Whilst in this city his further progress was arrested, and his resolution to pursue the quiet path of studious research was dispelled, by what he calls the "formidable ob-

[1] *Hist. Eccles.* vol. i. p. 9. [2] *Calvini Refut. Errorum Serveti Opp.*, t. viii. p. 511.; Ed. Amstel. [3] *Præf. ad Psalmos.*

[4] This edition forms a small 8vo of 514 pages, and 6 pages of index. It appeared at Basle from the press of Thomas Platter and Balthasar Lasius in March 1536.

testation" of Farel.[1] After many struggles and no small suffering, this energetic spirit had succeeded in planting the evangelical standard at Geneva; and anxious to secure the aid of such a man as Calvin, he entreated him on his arrival to relinquish his design of going farther, and to devote himself to the work in that city. Calvin at first declined, alleging as an excuse his need of securing some more time for personal improvement than could be obtained were he engaged in ministerial work. To the ardent Farel this seemed a mere pretext for indolence. "I tell you," he continued, "in answer to this pretence of your studies, in the name of Almighty God, that if you will not devote yourself with us to this work of the Lord, the Lord will curse you as one seeking not Christ so much as himself." Startled by this denunciation, and feeling as if God had laid his hand on him to detain him, Calvin consented to remain at Geneva, where he was immediately appointed teacher of theology. He was also elected preacher by the magistrates with the consent of the people, but this office he would not accept until it had been repeatedly pressed upon him. His services seem to have been rendered for some time gratuitously, for in February 1537 there is an entry in the city registers to the effect that six crowns had been voted to him, "since he has as yet hardly received anything."

Calvin was in his twenty-eighth year when he was thus providentially arrested at Geneva; and in this city the rest of his life, with the exception of a brief interval, was spent. The post to which he was thus called was not an easy one. Though the people of Geneva had cast off the yoke of Rome, they were still "but very imperfectly enlightened in divine knowledge; they had as yet hardly emerged from the filth of the papacy."[2] This laid them open to the incursions of those fanatical teachers, whom the excitement attendant upon the Reformation had called forth, and who hung mischievously upon the rear of the reforming body. To obviate the evils thence resulting, Calvin, in union with Farel, drew up a condensed statement of Christian doctrine, and prepared an elementary catechism to accompany it. These the citizens were summoned, in parties of ten each, to profess and swear to as the confession of their faith—a process which, though not in accordance with modern notions of the best way of establishing men in the faith, was gone through, Calvin tells us, "with much satisfaction." As the people took this oath in the capacity of *citizens*, we may see here the basis laid for that theocratic system which subsequently became peculiarly characteristic of the Genevan polity. Of the troubles which arose from fanatical teachers, the chief proceeded from the efforts of the Anabaptists; but these Calvin and his colleagues so effectually silenced by means of a public disputation held on the 18th of March 1537, that they never afterwards appeared at Geneva. In the course of this year also, the peace of Calvin and his friends was much disturbed, and their work interrupted, by a turbulent and unprincipled preacher named Peter Caroli, who, after many changes of religious profession (with none of which, however, had he associated anything of true religion, or even much of ordinary morality), had assumed the character of a stickler for orthodoxy. In this character he accused the Geneva divines of Sabellianism and Arianism, because they would not enforce the Athanasian creed, and had not used the words *Trinity* and *Person* in the confession they had drawn up. In a synod held at Berne the matter was fully discussed, when a verdict was given in favour of the Geneva divines, and Caroli deposed from his office and banished. Thus ended an affair which seems to have occasioned Calvin much more uneasiness than the character of his assailant, and the manifest falsehood of the charge brought against him, would seem to justify. Two brief tracts, intended to expose the evils and warn against the seductions of Popery, one entitled *De Fugienda Idolatria*, the other *De Papisticis Sacerdotiis*, must be added to the labours of Calvin this year.

Hardly was the affair of Caroli settled, when new and severer trials came upon the Genevan Reformers. The severe simplicity of the ritual which Farel had introduced, and to which Calvin had conformed; the strictness with which the ministers sought to enforce not only the laws of morality, but certain sumptuary regulations respecting the dress and mode of living of the citizens; and their determination in spiritual matters not to submit to the least dictation from the civil power, led to such violent dissensions that Calvin and his colleagues refused to administer the sacrament to the people. For this they were banished from the city. They went first to Berne, and soon after to Zürich, where a synod of the Swiss pastors had been convened. Before this assembly they pleaded their cause and stated what were the points on which they were prepared to insist as needful for the proper discipline of the church. They declared that they would yield in the matter of ceremonies so far as to employ unleavened bread in the eucharist, to use fonts in baptism, and to allow festival days, provided the people might pursue their ordinary avocations after public service. These Calvin regarded as matters of indifference, provided the magistrates did not make them of importance, by seeking to enforce them; and he was the more willing to concede them, because he hoped thereby to meet the wishes of the Bernese brethren, whose ritual was less simple than that established by Farel at Geneva. But he and his colleagues insisted, on the other hand, that for the proper maintenance of discipline, there should be a division of parishes—that excommunications should be permitted, and should be under the power of elders chosen by the council, in conjunction with the clergy—that order should be observed in the admission of preachers—and that only the clergy should officiate in ordination by the laying on of hands. It was proposed also, as conducive to the welfare of the church, that the sacrament of the Lord's Supper should be administered more frequently, at least once every month, and that congregational singing of psalms should be practised in the churches. On these terms the synod interceded with the Genevese to restore their pastors; but through the opposition of the Bernese this was frustrated, and a second edict of banishment was the only response.

Calvin and Farel betook themselves, under these circumstances, to Basle, where they soon after separated, Farel to go to Neufchatel, and Calvin to Strasburg. At the latter place Calvin resided till the autumn of 1541, occupying himself partly in literary exertions, partly as a preacher in the French church, and partly as a lecturer on theology. In 1539 he attended the convention at Frankfort as the companion of Bucer, and in the following year he appeared at that at Hagenau and Worms, as the delegate from the city of Strasburg. He was present also at the diet at Ratisbon, where he became personally acquainted with Melanchthon, and formed with him a friendship which lasted through life. It is to this period of his life that we owe the completed form of his *Institutio*, his commentary on the Epistle to the Romans, and his tract on the Lord's Supper. Notwithstanding his manifold engagements, he found time to attend to the tenderer affections; for it was during his residence at Strasburg that he married Idelette de Bures, the widow of a person named Stórder, whom he had converted from Anabaptism.

During his absence, disorder and irreligion had prevailed in Geneva. An attempt was made by Sadolet, Bishop of Carpentras, to take advantage of this so as to restore the papal supremacy in that district; but this design Calvin, watchful over the interests of his ungrate-

[1] *Præf. ad Psalmos.*

[2] Beza, *Vit. Calv. an.* 1536.

ful flock, though exiled from them, completely frustrated by writing such a reply to the letter which the bishop had addressed to the Genevese, as constrained him to desist from all further efforts. He seems also to have kept up his connection with Geneva by addressing letters of counsel and comfort to the faithful there who continued to regard him with affection. It was whilst he was still at Strasburg that there appeared at Geneva a translation of the Bible into French, bearing Calvin's name, but in reality only revised and corrected by him from the version of Olivetan. Meanwhile providence was opening the way for his return to the post whence he had been driven in that city. In the summer of 1541, the decree of his banishment was reversed, and in the following September he yielded to the earnest entreaties of his now penitent flock, and returned to Geneva, where he was received with the utmost enthusiasm. He entered upon his work with a firm determination to carry out those reforms which he had originally purposed, and to set up in all its integrity that form of church policy which he had carefully matured during his residence at Strasburg. He now became the sole directive spirit in the church at Geneva. Farel was retained by Neufchatelois, and Viret soon after Calvin's return removed to Lausanne. His duties were thus rendered exceedingly onerous, and his labour became excessive. Besides preaching every day in each alternate week, he taught theology three days in the week, attended weekly meetings of his consistory, read the Scriptures once a-week in the congregation, carried on an extensive correspondence on a multiplicity of subjects, prepared commentaries on the books of Scripture, and was engaged repeatedly in controversy with the opponents of his opinions. "I have not time," he writes to a friend, "to look out of my house at the blessed sun, and if things continue thus, I shall forget what sort of appearance it has. When I have settled my usual business, I have so many letters to write, so many questions to answer, that many a night is spent without any offering of sleep being brought to nature." We cannot in this sketch follow him through all the details of his brief but busy life after he returned to Geneva; we can only afford to notice slightly the leading events.

Of the controversies in which Calvin embarked, one of the most important was that in which he defended his doctrine concerning predestination and election. His first antagonist on this head was Pighius, a Romanist, who, resuming the controversy between Erasmus and Luther on the Freedom of the Will, violently attacked Calvin for the views he had expressed on that subject. Calvin replied to him in a work published in 1543, in which he defends his own opinions at length, as well by general reasonings as by an appeal to both Scripture and the Fathers, especially Augustine. So potent were his reasonings in the esteem of his opponent, that the latter, though owing nothing to the gentleness or courtesy of Calvin, was led to embrace his views. A still more vexatious and protracted controversy on the same subject arose in 1551, in which Calvin was called to defend his views against Bolsec, a Protestant physician, resident at Geneva, and in which ultimately several others, including Castellio, Fabri, and even Bullinger and Melanchthon, took part against him, and only Beza appeared as a zealous coadjutor. But the most memorable of all the controversies in which Calvin was engaged, was that into which he was brought in 1553, with his old antagonist Servetus. After many wanderings, and after having been condemned to death for heresy at Vienne, from which he was fortunate enough to make his escape, this restless adventurer arrived in June 1553 at Geneva. He appears to have remained in quiet here for a month, and was about to leave it for Zürich when he was arrested and conveyed to prison on the charge of blasphemy. He had long been looked upon with dislike by the Reformers, not only as a teacher of doctrines repugnant to all their convictions of truth, but as a mischievous disturber of the peace of the churches and an enemy of the good. At Geneva Calvin appeared as his accuser, and the conflict was conducted between the two with much ability on both sides, and at the same time with much rancour and scurrility, especially on the part of Servetus. After a protracted trial, the accused was condemned to be burnt to death. For so severe a sentence Calvin does not seem to have been prepared. He had engaged in the prosecution at first in the earnest hope that Servetus might be led to see the error of his opinions, and recal at least some of his blasphemous speeches; and though, on finding that all his efforts at confutation were not only thrown away upon the accused, but tended to make him only the more furious and blasphemous, he—in accordance with the common belief of the age, and with the approval of all his contemporaries among the Reformers—gave his suffrage for his being punished with death, he yet wished that what was horrible in the punishment might be spared, and made efforts to induce the senate to inflict a milder death than that by fire. These, however, proved in vain, and Servetus was accordingly burned at Champel near Geneva, on the 27th of October 1553. Farel attended him in his last hours and accompanied him to the place of execution. He had an interview also with Calvin on the morning of the fatal day, when he asked his forgiveness, but refused to retract any of his expressions. Calvin has been much censured, not to say vituperated, for his share in this unhappy transaction; but he was not more to blame than were the rest of the Reformers, all of whom approved of the prosecution, and concurred in the equity of the sentence as far as Calvin did; and, in judging of them in this matter, we must bear in mind that the unanimous opinion of their age pronounced death to be the proper penalty of blasphemy—the offence for which Servetus was condemned. According to modern opinions such a sentence was detestable; but when it is remembered that only a few years have passed since, in the most enlightened countries of Christendom, it was deemed proper to inflict capital punishment for such offences as forgery or robbery to a small amount, it will not perhaps appear so surprising that pious and earnest men, three centuries ago, should have thought it right to deal in the same way with an offence greatly more wicked in itself, and more injurious to society, than any act of dishonesty however great.

The heresy of Servetus was not extirpated by his death, but as it was his gross and insulting blasphemies, and not his heretical opinions, for which he had been doomed to suffer the last penalty of the law, none of his followers were visited with severer penalties than that of banishment from Geneva. The trials of several of these, with the conferences and controversies connected with them, occupied much of Calvin's time for several years. He was also involved in a protracted and somewhat vexing dispute with the Lutherans respecting the Lord's Supper, which ended in the separation of the evangelical party into the two great sections of Lutherans and Reformed; the former of whom hold that in the eucharist the body and blood of Christ are substantially present, and so are actually partaken of by the communicants, whilst the latter maintain that there is only a virtual presence of the body and blood of Christ, and consequently only a spiritual participation thereof through faith. In connection with these controversies on points of faith, Calvin was for many years greatly disquieted and sometimes even endangered by the opposition offered by the libertine party in Geneva to the ecclesiastical discipline which he had established there. His system of church polity was essentially theocratic; it assumed that every member of the state was also under the discipline of the church; and he asserted that the right of exercising this discipline was vested exclusively in the consistory or body of preachers and elders. His attempt to carry out these views brought him into collision both with the authorities and with the mob; the

latter being enraged at the restraints imposed upon the disorderly by the exercise of church discipline, and the former being inclined to retain in their own hands a portion of that power in things spiritual which Calvin was bent on placing exclusively in the hands of the church rulers. His dauntless courage, his perseverance, and his earnestness at length prevailed, and he had the satisfaction, before he died, of seeing his favourite system of polity firmly established, not only at Geneva, but in other parts of Switzerland, and of knowing that it had been adopted substantially by the Reformers in France and Scotland.

Amidst these multitudinous cares and occupations, Calvin found time to commit to writing a number of works besides those provoked by the various controversies in which he was engaged. The most important and numerous of these were of an exegetical character. Including discourses taken down from his lips by faithful auditors, we have from him expository comments or homilies on nearly the whole of the books of Scripture, written partly in Latin and partly in French. In the estimation of many, these constitute the most valuable of his works. His candour and sincerity as an inquirer into the meaning of Scripture —his judiciousness, penetration, and tact in eliciting his author's meaning—his precision, condensation, and concinnity as an expositor—the accuracy of his learning, the closeness of his reasoning, and the elegance of his style, all conspire to confer a high value on his exegetical works, and to make them at once rich sources of biblical knowledge and admirable models of biblical exposition.

Labours so incessant and so exhausting could not but tell on the strongest constitution: how much more on one so fragile as that of Calvin! Amid many sufferings, however, and frequent attacks of sickness, he manfully pursued his course for twenty-eight years; nor was it till his frail body, torn by many and painful diseases—fever, asthma, stone, and gout, the fruits for the most part of his sedentary habits and unpausing activity—had, as it were, fallen to pieces around him, that his indomitable spirit relinquished the conflict. In the early part of the year 1564 his sufferings became so severe that it was manifest his earthly career was rapidly drawing to a close. On the 6th of February of that year he preached his last sermon, having with great difficulty found breath enough to carry him through it. He was several times after this carried to church, but never again was able to take any part in the service. With a noble disinterestedness, he refused to receive his stipend, now that he was no longer able to discharge the duties of his office. In the midst of his sufferings, however, his zeal and energy kept him in continual occupation: when expostulated with for such unseasonable toil, he replied, "Would you that the Lord should find me idle when he comes?" After he had retired from public labours he lingered for some months, enduring the severest agony without a murmur, and cheerfully attending to all the duties of a private kind which his diseases left him strength to discharge. A deep impression seems to have been made on all who visited him on his deathbed; they saw in him the noble spectacle of a great spirit that had done its life-work, calmly and trustfully passing through the gate of suffering into the long-desired and firmly-expected repose of heaven. He quietly expired in the arms of his faithful friend Beza, on the evening of the 27th of May, in the fifty-fifth year of his age.

Calvin was of middle stature; his complexion was somewhat pallid and dark; his eyes, to the latest clear and lustrous, bespoke the acumen of his genius. He was sparing in his food and simple in his dress; he took but little sleep, and was capable of extraordinary efforts of intellectual toil. His memory was prodigious, but he used it only as the servant of his higher faculties. As a reasoner he has seldom been equalled, and the soundness and penetration of his judgment were such as to give to his conclusions in practical questions almost the appearance of predictions, and inspire in all his friends the utmost confidence in the wisdom of his counsels. As a theologian, he stands on an eminence which only Augustine has surpassed; whilst in his skill as an expositor of Scripture, and his terse and elegant style, he possessed advantages to which Augustine was a stranger. His private character was in harmony with his public reputation and position. If somewhat severe and irritable, he was at the same time scrupulously just, truthful, and steadfast; he never deserted a friend or took an unfair advantage of an antagonist; and on befitting occasions could be cheerful and even facetious among his intimates. "I have been a witness of him for sixteen years," says Beza, "and I think I am fully entitled to say that in this man there was exhibited to all an example of the life and death of the Christian, such as it will not be easy to depreciate, such as it will be difficult to emulate." [1] (W. L. A.)

CALVINISM, the doctrine and sentiments of Calvin and his followers. See THEOLOGY.

CALVISIUS, SETHUS, a German astronomer and chronologer, born at Groschleben in Thuringia in 1556. He studied at Helmstadt, where he made great progress in classical literature as well as in the sciences, in which he afterwards became so distinguished. He was offered a professorship of mathematics at Frankfort, and afterwards at Wittemberg, both of which he declined. He agreed, however, to conduct the school of music, established at Pforte; an office which he afterwards exchanged for a similar situation at Leipzig. At Frankfort he published, in 1585, his *Opus Chronologicum*, a work compiled on astronomical principles. He likewise organized a system of chronology, embodying the history of the world, upon an ingenious and original plan, highly commended by Casaubon and Scaliger. This work, though strongly condemned in the *Index Expurgatorius*, has been frequently reprinted. In 1612, Calvisius published his *Elenchus Calendarii Gregoriani, et duplex Calendarii melioris forma*, in which he attempts to prove the inadequacy of the Gregorian calendar, and proposes to introduce a new system based upon astronomical principles. The only proof now extant of his musical knowledge is his treatise entitled *Melodiæ condendæ ratio.* He died at Leipzig in 1617.

CALVUS, CAIUS LICINIUS, a Roman orator and poet, born B.C. 82. At a very early age he devoted himself to study with such intensity, that his constitution was prematurely broken, and he died before proper means had been taken for transmitting his various works to posterity. As an orator, he is generally classed with Cæsar and Pollio, and has sometimes been compared with Cicero himself. What he really was as an orator cannot now be ascertained, as of the 21 orations which he left behind him at his death only the titles and some small fragments of five have been preserved. One of these against Vatimius is said by Seneca to have produced so strong an effect upon the accused, that before the orator had finished his speech he cried out, "I ask you, judges, if I am to be condemned because my accuser is eloquent?" As a poet he took rank with Catullus, and distinguished himself by his elegies, his epigrams directed against Cæsar and Pompey, and his fugitive pieces of wit and humour. These, unfortunately, have all shared the fate of his orations. The year of his death is unknown;

[1] *Vit. Calv. sub. fin.* This is the principal source for the facts of Calvin's life. Beza's narrative has been expanded and illustrated from other sources by Dr Henry in his *Leben Calvins*, of which an English translation has appeared in 2 vols. 8vo, by the Rev. H. Stebbing. Audin has written a life of Calvin in French full of misrepresentations and blunders. A highly respectable work has recently appeared on the same subject from the pen of Mr Dyer in 1 vol. 8vo.

but we gather from Cicero, that he had not completed his thirty-sixth year.

CALX properly signifies lime; but among chemists it is used to denote the friable mass or powder which remains after a metal or mineral has been subjected to the process of calcination, solution by acid, or detonation by nitre. Metallic calxes are now termed oxides. See CHEMISTRY.

CALYCISTÆ, the name given by Linnæus to those botanists who have arranged all vegetables from the different species, structure, &c. of the calyx or flower-cup. The only systems of this kind are the *Character Plantarum Novus*, by Magpolius, published in 1720; and Linnæus's *Methodus Calycina*, published in his *Classes Plantarum*, at Leyden, in 1738.

CALYDON, in *Ancient Geography*, a town of Ætolia, situated seven miles and a half from the sea, and divided by the river Evenus. It is said to have been founded by Calydon, the son of Ætolus, and was the scene of the famous hunt of the Calydonian boar.

CALYPSO, in Grecian fable, was a daughter of Oceanus and Tethys, or of Nereus, or of Atlas, and reigned in the mythical island of Ogygia. When Ulysses was shipwrecked on her shores, Calypso entertained the hero with great hospitality; and by the united influence of her love and spells, she prevailed on him to remain and share her honours. In this manner seven years had elapsed, when Ulysses was seized with an irresistible desire to revisit his native country. Calypso tried every expedient, and even the promise of eternal youth, to induce the hero to remain; and when all her efforts had proved unavailing and he set sail, grief at his departure occasioned her death. (Hesiod, *Theog.* 359; Hom. *Od.* i. 50, v. 28, vii. 254; Apollod. i. 2, § 7.)

CALYX (κάλυξ, a cup), the outer covering of a flower, or that part which in most plants surrounds and supports the bottom of the corolla. See BOTANY.

CAM, a contrivance of several kinds for converting a rotatory into a reciprocating motion. See MECHANICS.

CAMAIEU, or CAMEO, a peculiar kind of onyx; also a stone, on which are found various figures or representations of landscapes, a kind of *lusus naturæ*, exhibiting pictures without painting. It is of these *camaieux* that Pliny is understood to speak when he says of the manifold pictures of gems, and the particoloured spots of precious stones, *Gemmarum pictura tam multiplex lapidumque tam discolores maculæ.*

CAMEO is also frequently applied to any kind of gem on which figures are sculptured, either indentedly or in relievo. The shell of large univalves is now much used for making cameos; the subject being wrought on the outer or white layer of the shell, and the pink or brown under one serving for the ground.

CAMEO is also used for a painting of only one colour, where the lights and shadows are of gold, wrought on a golden or azure ground. When the ground is yellow the French call it *cirage;* when gray, *grissaile.* This kind of work is chiefly used to represent basso relievos. The Greeks called such works μονοχρωματα.

CAMALDULIANS, CAMALDUNIANS, or CAMALDOLITES, an order of religious persons, founded by Romuald, an Italian, in 1023, in the desolate waste of Camaldoli, or Campo Malduli, on the lofty heights of the Apennines. Their rule is that of St Benedict; and their houses, by the statutes, can never be less than five leagues from cities. They are divided into cœnobites and eremites. The *Camaldulians*, till the close of the eleventh century, were called *Romualdins:* previously, *Camaldulian* was a particular name for those of the desert Camaldoli. Guido Grandi, a Camaldulian monk, and mathematician to the grand duke of Tuscany, published *Camaldulian Dissertations* on the origin and establishment of this order

CAMALODUNUM, the capital of the Trinobantes, the first Roman colony in Britain. From the Itineraries it appears to have stood where Malden now stands; but according to some it occupied the site of the modern Colchester. It continued to be an open town under the Romans, a place of pleasure rather than strength. It was adorned with a Roman theatre and a temple, the building of which the Britons considered as badges of slavery, and resented by several seditions and commotions.

CAMANDOO, a town of Hindustan, in the territory of the Sikhs, province of Lahore, situated on the east side of the Beyah river, 124 miles N.E. from the city of Lahore. E. Long. 75. 50., N. Lat. 32. 26.

CAMARGUE, an island formed by the alluvial soil deposited at the mouth of the Rhone. See BOUCHES-DU-RHÔNE.

CAMARINA, a Syracusan colonial town in the south of Sicily, near the sea, founded about 600 B.C. The ruins are now insignificant; but it was once a place of note, and fine silver coins of this city are extant in the British Museum and other collections.

CAMASSEI, ANDREA, a celebrated historical and landscape painter and engraver, born in 1602, at Bevagna, near Foligno. He studied at Rome under Domenichino and Andrea Sacchi. His principal works are to be seen in the Pantheon, the church of the Capuchins, and the Baptistery of St John Lateran. They are remarkable for sweetness of colouring, elegance of design, and delicacy of execution. He was also the author of a fine engraving of the Holy Family. Camassei died at Rome in 1648.

CAMBAY, a town of Hindustan, in the province of Guzerat, situated on the river Myhee, at the upper part of the Gulf of Cambay, and supposed to be the Camanes of Ptolemy. It was formerly a very flourishing city, the seat of an extensive trade and celebrated for its manufactures of silk, chintz, and gold stuffs; but its commerce has long since fallen away, and the town has become poor and dilapidated. Among the causes assigned for its decay is the gradually increasing difficulty of access to the town by water. The tides rise upwards of thirty feet, and at high water ships anchor near the town, but at low water the river seems almost dry, yet with so rapid a current, that if a vessel take the ground it must inevitably overset. The trade has in consequence decreased, and is now chiefly confined to the export of cotton. The town is celebrated for its agates and carnelians, which are there cut and polished, and wrought into a great variety of trinkets. The chief demand for these ornaments is from China. The houses in many instances are built of stone, a circumstance indicating the former wealth and grandeur of the city, as the quarries from which the material was hewn are situate at a very considerable distance. A brick wall, three miles in circumference, surrounds the town, inclosing four large reservoirs of good water, and three bazaars. To the S.E. of the town there are very extensive ruins of subterranean temples and other buildings half buried in the sand, with which the ancient town was overwhelmed. These temples belong to the Jains, and contained two massive statues of their deities, the one black, the other white. The principal one, as the inscription intimates, is Pariswanath, or Parswanatha, carved and consecrated in the reign of the Emperor Akbar; the black one has the date of 1651 inscribed. It is supposed that Cambay about the fifth century was the capital of the Hindu emperors of Western India; and Osorio, a Portuguese writer of the sixteenth century, says, that when Francis D'Almeida landed near Cambay, he saw the ruins of sumptuous buildings and temples, which seemed to be the remains of an ancient city. In 1780 it was taken possession of by the army of General Goddard, and restored to the Mahrattas in 1783, who imposed on the Nawaub a tribute of L.6000 per annum, and was afterwards ceded to the British by the Peishwa under the treaty of 1803. The military esta-

blishment of the Nawaub consists of 1700 horse and foot, who are employed indiscriminately in revenue, police, and miscellaneous duties. A few pieces of ordnance complete the military resources of the chief. Cambay is distant north from Bombay 230 miles. N. Lat. 22. 18., E. Long. 72. 39.

The Gulf of Cambay, which is shallow, and abounds in shoals and sand-banks, penetrates the N.W. coast of India in the province of Guzerat about 80 miles. It is supposed that the depth of water in this gulf has been decreasing for more than two centuries past. The tides, which are very high, run into it with amazing velocity, but at low water the bottom is left nearly dry for some distance below the latitude of the town of Cambay. It is, however, an important inlet, being the channel by which the valuable produce of central Guzerat and the British districts of Ahmedabad and Broach is exported. The gulf extends between N. Lat. 21.—22. 10., E. Long. 71. 50.—72. 40.

CAMBAYES, cotton cloths made at Bengal, Madras, and elsewhere on the coast of Coromandel.

CAMBER, according to our monkish historians, one of the three sons of Brute, who, on his father's death, received as his inheritance that part of Britain called from him *Cambria*, now Wales.

CAMBERED DECK, among ship-builders, is one which is higher in the middle of the ship's length, and droops towards the stem and stern.

CAMBERT, ROBERT, the earliest composer of French comic operas, was born at Paris about 1628. He was organist of the church of St Honoré, and musical superintendent to Queen Anne of Austria, mother of Louis XIV. His earlier works, in which he was assisted by the Abbé Perrin, continued to be performed before the court at Vincennes, till the death of his patron Cardinal Mazarin. Enraged at his subsequent neglect, and jealous of the favour shown to Lulli, who was musical superintendent to the king, he retired to London, where he was appointed inspector of music to Charles II. His operatic pieces were entitled *Ariadne ou les Amours de Bacchus*, *Pomone*, and *Les Peines et les Plaisirs de l'Amour*. Cambert died in London about 1677.

CAMBERWELL, a village and parish in the county of Surrey, and one of the suburbs of London, being about two miles south from St Paul's. The population of the parish in 1851 amounted to 54,667. See LONDON.

CAMBIO, a Spanish word signifying *exchange*, used in Holland and some other countries.

CAMBIST (Italian *cambio*, exchange), a banker; one who deals in notes and bills of exchange.

CAMBODIA, or CAMBOJA, a kingdom of Asia formerly independent, but now partitioned between the kingdoms of Anam and Siam. It consists of a flat alluvial plain, traversed by the river Maekhaun or Camboja, and inclosed by two mountain ridges which separate it from the kingdom of Cochin-China proper on the east, and Siam on the west. On the north it is bounded by the kingdom of Laos; on the south by the Chinese Sea. Of the interior very little is known by Europeans. Near the coast the country is overgrown with wood, a little further inland the soil is fertile and well-cultivated, but beyond there seems to be only a vast jungle, where elephants, lions, tigers, and buffaloes find shelter, and are hunted by the natives for their ivory and skins. Deer, hogs, goats, and wild fowl abound in the forests and more cultivated districts. The principal productions are rice, betel, spices, sandal, ivory, eagle and rose woods, gamboge, and numerous other dye-stuffs. The principal tree that produces gamboge is the *Garcinia gambogioides;* and in Ceylon a similar gum-resin is the concrete juice of the *Hebradendron gambogioides*. The river Maekhaun falls into the sea by numerous mouths, which are navigable when in flood. In its course it sends off several branches on the eastern side, which, after inclosing large and fertile districts, return further down to the main stream. On the river Sai-gon, which intersects the eastern part of the province, stands the modern capital Sai-gon, while on the Maekhaun is the ancient capital Pontaipret or Camboja. The foreign commerce of the country is limited to China, and consists in the importation, for the most part in Chinese bottoms, of tea, china, and silk goods. Various attempts have been made by European merchants to establish a friendly intercourse with the inhabitants, but these have hitherto been attended with little success. The climate resembles that of Bengal. See COCHIN-CHINA.

CAMBORNE, a small town in the hundred of Penwith, county Cornwall. It is a neatly built place, and stands in the immediate neighbourhood of some of the most productive tin and copper mines in the county, which afford employment to most of the inhabitants. It has a handsome parish church, built in the later Gothic style, and several dissenting chapels principally belonging to the Wesleyan Methodists. Pop. 6547.

CAMBRAY, a fortified town of France, in the department of the Nord, and situated on the right bank of the Scheldt, 32 miles south of Lille. N. Lat. 50. 10., E. Long. 3. 14. The houses are pretty well built, and the fortifications have been improved according to Vauban's plan. The principal edifice is the cathedral church of St Sepulchre, a modern building erected on the site of the one which was destroyed at the French Revolution. It contains a monument by David raised to the memory of Fénélon, who was archbishop of Cambray, and consisting of three bas-reliefs illustrative of the various incidents of his life. He was buried in the ancient cathedral, but at the revolution his tomb was broken open and his coffin melted into bullets. Besides the cathedral there is the church of St Géry, the Hôtel de Ville, the public library containing upwards of 30,000 volumes, the archiepiscopal palace, and several other public buildings. It is the seat of a college, of a medical and ecclesiastical seminary, and of judicial and commercial tribunals of the first instance. Cambray is principally famous for the manufacture of fine muslin, called cambric, after the name of the town; but it also contains extensive manufactories of cotton and linen yarn, tulle, lace, black soap, sugar, brandy, saltpetre, &c. Its principal trade is in corn, wine, wool, flax, butter, hops, &c. The Scheldt begins to be navigable at Cambray, and communicates with St Quentin by means of a canal. Pop. 18,987.

Cambray is the ancient Nervian town of Camaracum, and was at one time the capital of an independent kingdom. It was fortified by Charlemagne; and the citadel was built in the middle of the sixteenth century by Charles V. It was taken by assault by the English in 1815 after the battle of Waterloo.

CAMBRIA, the ancient name of Wales.

CAMBRIC, a very fine linen fabric. It derived its name from Cambray in Flanders, where it was first manufactured. An excellent imitation of this fabric is woven from fine cotton yarn.

CAMBRIDGE, the chief town of the English county of the same name, is situated upon the banks of the river Cam, which is navigable to the sea by means of the river Ouse, falling into the sea at the port of Lynn. It is situated in an extensive and moderately fertile plain, and considered as very salubrious. Like most ancient towns it consists chiefly of narrow and winding streets, the houses in which differ very remarkably in their architecture. Several of the streets have recently been widened and improved by the removal of many ancient but picturesque houses, but some few singular mediæval habitations still remain, and it is hoped may be retained in future without interfering with the alterations required for modern convenience and the adoption of the measures for sanitary improvement. The most remarkable of the alterations has been the removal of

Cambridge. a long range of old buildings by which King's College was hidden from view, and the destruction of a mass of houses for the enlargement of the market-place. The beauty of the town has also been greatly increased by the numerous additions that have been made to the collegiate buildings during the last thirty years. There was certainly a Roman town upon a part of the site of modern Cambridge, but it is not certain by what name it was then called. The celebrated antiquary Dr Stukeley suggested that its name was Granta, but he seems to have had no good reason for that opinion, although some have believed it to have been the Caer Graunt of Nennius. It seems more probable that it is the place called Camboritum or Camboricum, in the Antonine Itineraries (Babington's *Ancient Cambridgeshire*). Some slight remains of its Roman fortifications may still be traced, but the greater part has long since been destroyed. The Roman town was situated on the north side of the river, but after being deserted during some part of the Saxon period the present town sprung up on the south side of the Cam.

Most of the public buildings belong to the university, which is a corporation having separate jurisdiction from the borough, and returns two members of its own to the House of Commons. The constitution of the university and its several colleges will be noticed separately under the head of universities. The principal buildings may, however, be noticed here. A few of them are, King's, Trinity, St John's, and Jesus Colleges, the university library, the Fitzwilliam Museum, and the Pitt Press. Of these the chapel of King's College is the most deserving of notice, both from its great beauty, and also as being one of the few perfect buildings in the florid form of the perpendicular style of architecture. A new set of county courts has recently been erected, which, although making considerable pretensions, is not a very successful specimen of architectural skill. The churches are numerous, and a few of them interesting. St Benedict's (or Bennet) church has a tower of true Romanesque architecture; St Sepulchre's, which is one of the few round churches in England, and is in the Norman style, has been very successfully restored; St Mary's, which is used by the university, is a fine building in the perpendicular style.

The town is governed by a mayor, 10 aldermen, and 30 common councillors, under the Municipal Reform act, but was formerly under a very ancient corporation. It has returned two members to parliament from the time of Edward I. There is a grammar-school founded by Dr Perse, in which a number of the sons of burgesses are educated gratuitously. There are several alms-houses of ancient foundation. The two fairs, once of much note and use, are now greatly neglected, and might probably be discontinued without any inconvenience. The trade of the town is almost wholly that resulting from its situation in the centre of an agricultural district; and the presence of the great number of students attending the university. It is a chief station upon the Eastern Counties railway, and at the head of the navigation for barges from the port of Lynn. It is the centre of a county court and excise district. The principal market is held on Saturday, and is well attended. There are two weekly newspapers published there. Pop. (1851) 27,815, of whom 13,347 were males, and 14,342 females. (C. C. B.)

CAMBRIDGE, a town in the county of Middlesex, state of Massachusetts, North America. It stands on the Charles river, three miles N.W. of Boston, with which it is connected by railway. It is the seat of Harvard University, formerly called Harvard College, the oldest and best endowed institution of the kind in the Union. See MASSACHUSETTS. Mount Auburn cemetery here is noticed in the article BOSTON. The town contains a court-house, jail, state arsenal, and numerous churches. Its observatory is in Lat. 42. 22. 48. N., Long. 71. 8. W. Pop. (1850) 15,215.

Cambridgeshire. CAMBRIDGESHIRE a county in the South Midland Division of England, is of a form which has been considered as somewhat resembling the human ear. The concave part is occupied by the county of Huntingdon. Its boundary is not easily traced in traversing the country, owing to the want of any marked natural features in the upland part, and the great change that has taken place in the course of the rivers and drains in the fen districts. It is divided by a part of the old course of the river Ouse into two nearly equal portions, constituting the county of Cambridge proper and the Isle of Ely, and by the last survey is found to contain about 548,480 acres, of which 248,430 belong to the Isle. Most of the land is arable, but the several parts differ from each other materially in character.

The whole of the Isle, and some portion of the other lands, form part of the great level of the fens, called the Bedford Level from the efforts made by the last earl and the successive dukes of Bedford to promote its drainage. During the Roman dominion in Britain this extensive district seems to have consisted chiefly of wet forests, intersected by stagnant rivers and marshes. That it was not altogether a morass at that time is shown by the great roads formed through it by that enterprising people. These are now covered in most places by many feet of peat soil, so that they are only to be seen when deep drains are cut in the mosses. Afterwards, during the Saxon, and especially the Norman periods, the whole was flooded by the silting up of the outfall of the rivers. This state of things became worse and worse, until, in the reign of Charles I., the whole district had become a number of islands, surounded by an almost constant flood of water. Since that time continual endeavours have been made to reclaim the flooded lands; and this has been pretty completely effected by embanking the rivers and other streams that convey the upland waters, and pumping the fen water into them by the aid of steam, which has superseded the numerous windmills formerly less effectively employed for the purpose. The singular changes which took place in the district during its neglected state may be illustrated by the fact, that at one period the rivers Nen, Ouse, and Cam, which poured their waters on to the level, all found their way to the sea at Wisbech; that subsequently, by the formation of a cut which still conveys the latter two conjointly by the Little Ouse to Lynn, the three took their course to that last mentioned town, and the Nen became so sluggish as to have no definite channel, but found its way through various and tortuous drains. At the present time, the Nen alone flows by an artificial course to Wisbech; and the old channel of the Great Ouse from Littleport to Wisbech is so completely filled up as to be only traceable by a bed of silt, and a slight but broad depression of the land. The Ouse formerly flowed from Earith, near which place it enters the county, to a spot some miles to the south of Ely, to be joined by the Cam; but is now conducted by a great artificial cut, called the Bedford river, in a direct course of more than twenty miles to Denver, in Norfolk; thus leaving many miles of its ancient channel nearly dry.

This fen country is now so well drained that almost the whole of it has become highly valuable land, much of which bears heavy crops of wheat. Few things can be more interesting to the observant traveller than a journey across this district by the Eastern Counties railway, which either by its main line or its branches passes through the fens in several directions. The fields divided by wet ditches, the constantly recurring bridges over the great drains, the passing of the artificial rivers, the high state of cultivation, the almost absolutely level country, present such a scene as is not to be found elsewhere in Britain. When contemplating it, we cannot avoid being struck by the success which has attended the application of great skill and con-

summmate energy and perseverance to the work of rendering available for agricultural purposes this extensive and once nearly useless tract.

Most of the fen country is based upon a bed of clay of great thickness, consisting of what are denominated by geologists the Gault, Oxford clay, and Kimmeridge clay. These, by the almost total absence of the strata of stone that usually separate them, have become only distinguishable by their imbedded fossils. Above the clay there is a deposit of peat of variable thickness, but usually of many feet. In those parts which formerly constituted the fen islands, there are great masses of gravel, sand, and sometimes drift-clay. The chief of these islands is that upon which the city of Ely is placed; and it is deserving of remark, that that city, which is now a central railway station, was at no distant date so inaccessible by land that the bishop always employed a boat when he was desirous of visiting Cambridge.

The drainage of the peat has deprived it of its former spongy character, and the underlying clay having been raised and mixed with it, they have together formed a highly fertile soil. With the exception of a very few and small pieces of unreclaimed land, the whole fen district is now as well farmed as almost any part of Britain.

We have not space to enter upon the highly interesting history of the drainage works, and must refer for full information upon the subject, to Dugdale's "Embarking," Wells's "Bedford Level," and a valuable paper in the 8th volume of the Journal of the Royal Agricultural Society of England. See Bedford Level.

Until a recent period the Isle of Ely was a separate jurisdiction, forming a palatinate belonging to the bishop of that see, but it is now combined in all essential particulars with the other part of the county.

Formerly ague was very prevalent in the fens, but drainage has much diminished its frequency, although attacks of it are still not uncommon, both there and in the bordering villages. Otherwise, it is far from being an unhealthy district.

The upland parts of Cambridgeshire, or the "Highlands" as they are called by the inhabitants, form a tolerably level tract, only broken by low hills of chalk on the side adjoining Essex and Suffolk. At the foot of the hills the lower bed of chalk is still quarried under the name of clunch. It was formerly much used for building purposes, as being easily worked, and very durable when protected from the weather. Much of the elaborate sculpture in Ely Cathedral is formed of it. The district adjoining these hills is based on a shallow bed of clunch, lying over the Gault, but separated from it by a thin layer of the upper greensand formation, in which there are many nodules of phosphate of lime. The surface of this tract is also varied by extensive deposits of gravel, and is generally fertile and well cultivated. The sheep-walks which formerly occupied the chalk-hills are now converted into arable land, and only those small portions of Newmarket Heath are left unbroken which are required for racing and training grounds.

The country extending from near Cambridge to the western edge of the county, lies at a rather higher level than the district intervening between it and the chalk-hills. It consists of a cold, wet, and unprofitable drift-clay not forming part of any of the regular strata. Much of this land was brought under the plough during the prevalence of a high price for wheat, but is now (1854) scarcely found to repay the expense of cultivation.

There is nothing peculiar in the agriculture of Cambridgeshire; for the local crops of hemp, flax, and saffron, for which it was once noted, have nearly or quite disappeared. The drainage of wet meadows near Cottenham has tended greatly to reduce the quantity of cheese made there. The same cause has lessened the quantity and injured the quality of the butter supplied to Cambridge market.

The whole of the upper district, or county proper of Cambridge, is traversed by numerous brooks, which combine to form the river Cam. One of the chief tributaries of this river (called the Ree) rises on the borders of Hertford, Bedford, and Cambridge shires, the other (named the Grant) has its source in Essex. These waters combine at a short distance above Cambridge, and flowing by Ely to Littleport, in the ancient channel of the Great Ouse, are thence conducted by the artificial cut already mentioned into the Little Ouse, and together with that stream reach the sea at Lynn. Even in the higher parts of the country many of the brooks do not run in their natural channels, for the fall is so slight that without careful and constant attention to them they would often stagnate and flood the land.

We have already spoken under the head of Cambridge of the buildings in that town, but must not omit to mention the beautiful cathedral at Ely. That church has been recently restored nearly throughout. Its nave is in the Norman, the quire is in the early English and decorated styles. Although the monastery was founded at Ely in the year 673, and restored in 970, it is confidently believed that no traces of buildings older than the Norman part of the cathedral now exist. The so-called conventual church is certainly not Saxon, and has been shown by Professor Willis to have probably been the infirmary of the monks. There are many highly interesting parish churches scattered over the county.

Cambridgeshire seems to have been rather thickly inhabited by the Romans. Numerous remains of their roads and villas, as well as many coins and much pottery, have been found. Several of their great lines of road passed through the county, and may still be faintly traced. Two of these crossed each other in the Roman station at Cambridge, and are usually called by antiquaries "The Akeman Street" and "The Via Devana." Another traversed the fens from Denver in Norfolk to near Peterborough. The "Erming Street" and "Icknield Way" pass for some distance through the county, but they are probably tracks used by the ancient Britons. The Romans formed great embankments against the sea along the shore of the Wash, from Lynn by Wisbech into Lincolnshire, which are still very conspicuous, although now usually at a considerable distance from the coast. They also seem probably to have had a navigable canal along the edge of the fens, in continuation southwards into this county of the "Car Dyke."

Whilst mentioning the antiquities, it would not be right to omit all notice of the four great boundary ditches, formed apparently before the time of the Romans, each of which extends for several miles across the open chalk district, from the fens to the ancient woodland. Of these, the Devil's Ditch, upon Newmarket Heath, is the best known It is also the largest, although one of the others is longer. Its length is about seven miles, and it consists of a ditch with a rampart on one side, formed of the excavated soil. The height of the bank is about eighteen feet above the level of the county, thirty above the bottom of the ditch, and twelve feet in width at the top. (Babington's *Ancient Cambridgeshire.*)

Much emigration has taken place from this county, and it is believed that the population is not now superabundant, although there are a few unemployed men in some of the country parishes and in the town of Cambridge.

In 1831 the population was 143,955, of whom 72,031 were males, and 71,924 females; in 1841 it amounted to 164,459, of whom 81,611 were males, and 82,848 females; and in 1851, to 185,405, of whom 92,699 were males, and 92,706 females. (C. C. B.)

CAMBYSES, a Persian noble, father of Cyrus the founder of the Persian empire. See Cyrus.

Cambyses, son and successor of Cyrus the Great. See Persia and Egypt.

CAMDEN, William, a celebrated antiquary, was born

in the Old Bailey, London, May 2, 1551. His father, who was a native of Lichfield, settled in London, where he became a member of the company of paper-stainers. His mother was of the ancient family of Curwen of Workington in Cumberland. Young Camden received his early education at Christ's Hospital and St Paul's school; and in 1566 he entered as a servitor of Magdalen College, Oxford; but being disappointed of a demi's place, he removed to Broadgate Hall, and, somewhat more than two years afterwards, to Christ Church, where he was supported by his kind friend and patron Dr Thornton. About this time he became a candidate for a fellowship at All Souls College, which he lost through the intrigues of the Popish party. In 1570 he supplicated the regents of the university to be admitted bachelor of arts, but in this also he was disappointed. The following year Camden came to London, where he prosecuted his favourite study of antiquity, under the patronage of Dr Goodman, dean of Westminster, by whose interest he was made, in 1575, second master of Westminster school. From the time of his leaving the university to this period, he made the tour of great part of England, with a view to make observations and collect materials for his celebrated *Britannia*, on which he was now seriously engaged. In 1581 he became intimately acquainted with the learned President Brisson, who was then in England, and in 1586 he published the first edition of his *Britannia*, a survey of the British isles, written in elegant Latin. This work which, though much enlarged and improved in future editions, was even then esteemed as an honour to its author and the glory of its country. In 1593 he succeeded to the head mastership of Westminster school, on the resignation of Dr Grant. In this office he continued till 1597, when he was promoted to be clarencieux king at arms. In 1600 Camden made a tour to the north, as far as Carlisle, accompanied by his friend Mr (afterwards Sir Robert) Cotton. In 1606 he began his correspondence with the celebrated President de Thou, which continued to the death of that faithful historian. In the following year he published his last edition of the *Britannia*, which is that from which the several English translations have been made; and in 1608 he began to digest his materials for a history of the reign of Queen Elizabeth. In 1609, after recovering from a dangerous illness, he retired to Chislehurst in Kent, where he continued to spend the summer months during the remainder of his life. The first part of his annals of the queen did not appear till 1615, and he determined that the second volume should not appear till after his death.[1] The work was entirely finished in 1617; and from that time he was principally employed in collecting more materials for the further improvement of his *Britannia*. In 1622, being now upwards of seventy, he determined to lose no time in executing his design of founding a history lecture in the university of Oxford. His deed of gift was accordingly transmitted by his friend Mr Heather to Mr Gregory Wheare, who was by himself appointed the first professor. Camden died at Chislehurst, Nov. 9, 1623, in the seventy-third year of his age, and was buried with great solemnity in Westminster Abbey, where a monument of white marble was erected to his memory. He was a man of singular modesty and integrity, profoundly learned in the history and antiquities of this kingdom, and a judicious and conscientious historian. He was respected and esteemed by the literati of the Continent, and will be ever remembered as an honour to the age and country in which he lived. Besides the works already mentioned, he was author of an excellent Greek grammar, and of several tracts in Hearne's collection. But his great and most useful work, the *Britannia*, is that upon which his fame is chiefly built. It was first translated into English, and published in folio in London in 1611, by Dr Philemon Holland, who is thought to have consulted the author himself; and therefore great respect has been paid to his additions and explanations, on a supposition that they may belong to Camden. But in a later edition of the same translation, published in 1636, the doctor has taken liberties which cannot be excused. A new translation, made with the utmost fidelity from the last edition, was published in 1695, by Edmund Gibson of Queen's College, Oxford, afterwards bishop of London; in which, besides the addition of notes, and of all that deserved to be taken notice of in Dr Holland's first edition, there are many other augmentations and improvements, all properly distinguished from the genuine work of the author; and the same judicious method was followed in the next edition of this performance. But afterwards there appeared a new translation and improved edition, by the learned and industrious topographer Mr Gough, under whose hands it was enlarged to nearly double the size of the last of the preceding editions.

Camden, a city and seaport, capital of the county of the same name, in the state of New Jersey, North America, stands on the east side of the Delaware river, opposite Philadelphia, and 29 miles S.S.W. of Trenton. The city consists of three parts, the central or principal part, and the northern and southern suburbs; from all of which there are ferries to Philadelphia. The largest ships can come up to the lower part of the city, and vessels of 150 tons to the central parts. The city has considerable trade and manufactures, and numerous fine public buildings. The Camden and Amboy railway, leading from New York, terminates here; and there is also a railway to Woodbury. Pop. 9618.

Camden, a village, capital of the Kershaw district in the state of South Carolina, North America, 33 miles N.E. of Columbia. It stands on the east bank of the Waterel river, by means of which flat-bottomed boats of 70 tons come up to the village. It contains a court-house, jail, academy, masonic-hall, market-house, library, arsenal, and about 1000 inhabitants. Two battles were fought here (1780–81) during the revolutionary war; and a fine marble monument has been erected to the memory of Baron de Kalb.

CAMEL. See Mammalia, and *Index*.

Camel, a machine, of Dutch invention, for raising large ships so far above the water-line as to enable them to pass over the obstruction of a bar or shallow. It consisted of two large boxes or half ships, which were applied to each side of the hull of a large vessel, and from which a number of cables were passed under the keel and attached to horizontal windlasses on the deck of either half of the camel. When the machine was to be used, water was allowed to enter so as to sink the two parts of the machine to the requisite depth; the ropes were then cast loose, and large beams were placed horizontally through the port-holes of the ship, with their ends resting on the camel on each side. When the ropes were made fast, and the ship properly secured, the water was pumped out of the camel, which then rose and bore up the ship along with it. By this contrivance, East Indiamen drawing 15 feet could be made to draw only 11 feet; and ships of war carrying 90 or 100 guns were enabled to pass the sandbanks of the Zuyder-Zee. (Beckmann's *Hist. of Inventions*, vol. iii. p. 338.)

This machine is also available for raising sunken vessels.

[1] The reign of Queen Elizabeth was so recent when the first volume of the annals was published, that many of the persons concerned, or their dependents, were still living. It is no wonder, therefore, that the honest historian should offend those whose actions would not bear inquiry. Some of his enemies were clamorous and troublesome, which determined him not to publish the second volume during his life; but, that posterity might be in no danger of disappointment, he deposited one copy in the Cotton Library, and transmitted another to his friend Dupuy at Paris It was first printed at Leyden in 1625.

CAMELEON. See REPTILIA (*Chamæleonidæ*).

CAMELFORD, a market-town in the parish of Lanteglos, and county of Cornwall, on the Camel, 12 miles N.N.E. of Bodmin. Previous to the Reform act it returned two members to parliament. Population of parish (1851) 1740.

CAMELLIA, a very ornamental genus of plants, natives of China and Japan, belonging to the natural order Ternstromiaceæ. A great many varieties of this plant are grown in England and Belgium, sometimes in the open air, but more generally in hothouses. Though usually cultivated in pots, they are found to thrive best in open soil in a glass-house artificially heated. See HORTICULTURE, and BOTANY.

CAMELOPARD, the giraffe. See MAMMALIA.

CAMENÆ, or CAMŒNÆ, also called *Carmenæ*, *Casmenæ*, certain prophetic nymphs connected with the religious worship of ancient Italy, though later traditions represent them as of Arcadian origin. The appellation is derived from *carmen* a "prophecy." Of these goddesses, the principal was Carmenta or Carmentis, who had a temple and altars at Rome. See CARMENTALIA. The muses are frequently called Camenæ by the Roman poets.

CAMEO. See CAMAIEU.

CAMERA ÆOLIA, a contrivance for blowing the fire, for the fusion of ores, by means of water falling through a funnel into a close vessel, which sends forth as much air or vapour as keeps up a constant blast. By the intervention of another vessel for the air to expand in by the way, it there deposits its humidity, which otherwise would impede the work.

CAMERA *Lucida*, a contrivance of Dr Hook for making the image of any thing appear on the wall of a room during sunshine. Opposite to the wall on which the image is to be received there is an aperture in the window shutter of at least a foot in diameter. The object being placed outside the aperture, it must be strongly illumined by a mirror which throws the sun's rays upon it. Between the object and the wall which is to receive the image place a large convex lens, whose focal distance is sufficiently great to give an image on the wall. In proportion as the lens is placed nearer the object, the image on the wall will be larger, and *vice versa*. (*Phil. Trans.* No. xxxviii. p. 741, *et seq.*) With a good lens, magnified images of objects, such as small gems in bas-relief, may be formed on a wall or screen so perfect as to appear like real bas-reliefs.

CAMERA *Lucida*, an instrument invented by Dr Wollaston for drawing in perspective.

If a piece of plain glass be fixed at an angle of 45° with the horizon, and if, at some distance beneath, there be a sheet of paper laid horizontally on a table, a person looking downwards through the glass will see an image of the objects situated before him; and as the glass which reflects the image is also transparent, the paper and pencil can be seen at the same time with the image, so that the outline of the image may be traced on the paper. The image is an *inverted* one. This is the simplest form of the instrument, and may be constructed extemporaneously by fixing on a stand a plain transparent glass, with its surfaces ground parallel, or a piece of Muscovy glass, at an angle of 45° with the horizon: a card with a small hole in it will serve as a sight for keeping the eye steady in one situation whilst the pencil is tracing the image.

If there be a plain mirror at an angle of 22½ degrees with the horizon, and a piece of plain transparent glass be placed near it, at an angle of 22½ degrees with the vertical, the rays from the object will be twice reflected before they reach the eye; and consequently, on looking down through the transparent glass, an *erect* image is seen, and the pencil may be drawn over the outlines of this image so as to leave a perspective representation on the paper. This disposition is seen at fig. 1, Plate CLV., where *bc* is the mirror, *ab* the transparent plain glass.

As the image and pencil are at different distances, they cannot be both seen in the same state of the eye. To remedy this inconvenience, a convex glass is used, of such focus as to require no more effort than is necessary for seeing the distant objects distinctly. By means of this lens, the image will appear as if it were placed on the surface of the paper. In fig. 1 *bd* is a convex glass of twelve inches focus; at *e* the eye is placed; *fghe* is the course of the rays proceeding from the object to the eye

Those whose eyes are adapted to seeing near objects alone, will not derive advantage from the use of a convex glass, but will require a concave glass to be placed at *f*, in the course of the rays from the object to the reflecting surface. In fig. 2, *ik* is a concave glass placed in the above-mentioned situation: it is so disposed as to be turned at pleasure into its place, as the sight of the observer may require. Persons whose sight is nearly perfect may use either the concave glass placed before the reflecting surface, or the convex glass placed between the paper and the eye.

In the actual construction of the instrument, a prism is used instead of a mirror and a plain glass. The rays from the object fall upon the surface *bc* of the prism, fig. 3. This surface *bc* is inclined 22½ degrees to the horizon. The refractive power of the glass allows none of the rays in this situation to pass out; they are all reflected from the surface *bc* to the surface *ab*, and from that to the eye. *ab* makes an angle of 135 degrees with *bc*, and 22½ degrees with the vertical. The eye cannot see the pencil through the prism as it does through a plain glass; therefore, in order that the pencil may be seen, the eye must be so placed that only a part of the pupil may be above the edge of the prism, as at *e*, fig. 3; and then the reflected image will be seen at the same time with the paper and pencil. There is a small piece of brass perforated with a hole *c*, and moving on a centre, fig. 2; this serves to keep the eye in one position, as it must be, that the image may be steady, and also to regulate the relative quantities of light to be received from the object and from the paper.

The instrument, being near the eye, does not require to be large. The smallest size which can be executed with accuracy is to be preferred, and is such that the lens is only three fourths of an inch in diameter. Fig 4 shows the instrument on its stand, and clamped to a board. The joint by which the prism is attached to the stand is double. The whole instrument packs in a box eight inches by two, and half an inch deep.

This instrument serves for drawing objects of all forms. and consequently also for copying lines already drawn on a plain surface. If it is required that the copy shall be of the same size as the original drawing, the distance of the drawing from the prism should be the same as the distance of the paper from the eye-hole. No lens will be necessary in this case, because the image and the paper, being both at the same distance from the eye, coincide without the aid of a glass.

In order to have a reduced copy of a drawing, the drawing is to be placed at a distance from the prism greater than the distance of the paper from the eye-hole. If the distance is twice as great, a copy will be obtained in which the lines are of one half the size of the lines in the original, and so in proportion for other distances. A lens is necessary, that the eye may be enabled to see at two different distances; and, in order that one lens may serve, the distance between the eye-hole and the paper should be variable; to that effect the stand is susceptible of being lengthened or shortened at pleasure.

The length of the stem is adjusted upon optical principles. When a distant object is to be delineated, the rays coming from it, and reflected by the instrument to the eye, are parallel, and it is required that the rays proceeding from the paper to the eye should also be parallel. This is accomplished by interposing a lens between the paper and the eye, with its principal focus on the paper. When the object to be delineated is so near that the rays which come from it to the eye are divergent, then it is required that the rays from the paper should likewise be divergent in the same degree, in order that the paper and the image may both be seen distinctly by the same eye; for this purpose the lens must be placed at a distance from the paper less than the distance of its principal focus. The stem of the instrument is marked at certain distances, to which the conjugate foci are in the several proportions of 2, 3, 4, &c. to 1, so that distinct vision may be obtained in all cases by placing the original drawing more distant.

If the convex lens be transposed to the front of the prism, and the proportional distances be reversed, a magnified image of the object will be obtained.

This instrument has deservedly come into use. Its advantages, when compared with the camera obscura, are, 1*st*, That it is small and easily carried about. 2*dly*, That no lines are distorted, not even those most remote from the centre; whereas, in the camera obscura, the lines which are not near the centre of the field are more or less distorted. 3*dly*, In the field of the camera lucida 70 or 80 degrees may be included, whilst the distinct field of the camera obscura does not extend beyond 30 or 35 degrees at most. The specification of Dr Wollaston's patent for the camera lucida is inserted in the *Repertory of Arts*, vol. x. 1807, p. 162, and his description of the instrument in Nicholson's *Journal*, vol. xvii.

The camera lucida employed by Captain Hall packs in a small box. When the instrument is to be used the box folds out and forms a small table, which is fixed on the top of a tripod. There is a folding three-legged seat, which packs within the tripod. The tripod, when closed and containing the seat, is only the size of a walking stick.

If the camera lucida be fixed at the eye-glass of a telescope, it will reflect to the eye the image of the objects in the field of the telescope, so that a drawing of the image may be made. See Dr Brewster's *Account of some Philosophical Instruments.* A plain reflecting glass, fixed at an angle of 45 degrees with the horizon, and placed so as to receive the rays from the eye-glass of a telescope, will also give an image of the objects in the field, so situated that the image may be traced with a pencil. Varley's patent graphic telescope is upon this principle. In order that the field may be large, the magnifying power of the telescope should be small.

The inherent qualities of all the instruments for drawing in perspective being closely allied, it will be proper to say something of the principles on which these instruments are formed, and to mention some that are not described in other parts of this work.

To make a perspective drawing of an object is to lay down on paper a section of the perspective cone, whose apex is at the eye, and whose base is the object. An experienced draughtsman can draw the figure of this section without the aid of instruments. Others who have not acquired the facility of drawing the image they see, must have recourse either to *measurement*, or to *instruments which bring the image under the pencil.*

Drawing by measurement is performed by actually measuring the height of the principal parts of the object, and their horizontal distance from the eye; together with the distance of the paper from the eye; and from these dimensions the drawing is constructed by the systematic rules of perspective.

Another mode of obtaining a drawing by measurement is to measure the angles at the eye. Suited to this purpose are theodolites, astronomical quadrants, or other instruments capable of measuring vertical and azimuthal angles at the eye. The angles to be measured are, the angles of altitude, and the angles of azimuth, between the point of sight and the principal points of the object; and if the tangents of the azimuthal angles be laid down with a radius equal to the distance of the paper from the eye, and the tangents of the angles of altitude with a radius equal to the distance of the paper multiplied by the secant of the azimuth, the situation of the principal points of the drawing will be determined. Or, if the instrument is capable of measuring angles in any plane, the angles between the principal points of the object and the point of sight are to be observed, and the azimuthal angles of these principal points with the point of sight; and the tangents of both are to be laid down on the paper, with a radius equal to the distance of the paper from the eye.

But these two modes by measurement are long, particularly the first. Usually, therefore, the instruments to which recourse is had for facilitating the operation of drawing, are such as give an image or section of the perspective cone on a plain surface, so that the pencil may be drawn over the outline of the image. These instruments may be considered under two heads; the first comprehending those in which the pencil is immediately drawn over the lines of the image; the second those in which the pencil has a motion parallel to that of the point which moves over the lines of the image.

Of the first kind are the following. 1. The tracing pane, a very simple and convenient instrument, consisting in a transparent plate of plain ground glass, or of Muscovy glass, placed vertically between the object and the eye; whilst the eye is kept fixed by a sight, the outline of the image is drawn on the glass with Indian ink. 2. Or the upright glass may be divided into small squares by lines crossing each other, and the paper on which the drawing is to be made being similarly divided, the particular intersections on the glass that cover the principal points of the object are observed, and these points are laid down on the corresponding intersections on the paper. 3. The image seen in a plain mirror may also be drawn on its surface with Indian ink. 4. In the camera obscura, different forms of which are described in the *Encyclopædia* under the articles Dioptrics and Optics, the image to be drawn is formed at the focus of a lens. 5. In the camera lucida the reflected image is used.

In the second division of the instruments which give a section of the perspective cone susceptible of being delineated, the pencil does not move immediately over the lines of the image, but moves parallel to these lines. 1. There is a rod which can be moved in all directions, consistent with its remaining parallel to itself. If one extremity of this rod be moved in space over the outlines of the image which the eye sees, a pencil at the other extremity will necessarily move with a similar motion, and form a drawing of the object on paper. In Sir Christopher Wren's instrument, of which he has given the description and figure in the *Philosophical Transactions*, vol. iv., the rod is suspended by strings passing over pullies, and the ends of the strings are fixed to a counterpoise. On a similar principle is Peacock's instrument, described in the *Philosophical Transactions*, vol. lxxv., p. 366, and the instruments treated of in the *Stockholm Transactions* for the years 1760, 1774, and 1790. A well-constructed instrument on this principle, and for which there is a pa-

tent,[1] is to be found now (1831) at Mr Cary's in the Strand. 2. The pencil may delineate the base of a cone similar and opposite to the perspective cone. If the rays from the extreme points of an object cross on the ray from the centre, as they do in passing through a small hole into a dark room, and if it be supposed that, in the place of one of the rays a slender inflexible rod is substituted moveable on a centre at the hole, when this rod is moved so that its outer extremity goes over the outlines of the external image, a pencil fixed to its inner extremity will form an inverted drawing of the object. Of this nature is the optigraph of Ramsden and Thomas Jones, described in the *Philosophical Magazine*, vol. xxviii., 1807, p. 67. The image of the object is seen in a telescope. There is a piece of plain glass near *c* in the focus of the eye-glass of the telescope F, fig. 5. On the centre of this piece of glass is a dot; *a* is a plain mirror, inclined so as to reflect the image of the object down into the telescope. This mirror remains fixed, whilst the telescope is moveable on a universal joint at its object-glass *b*. Near *c* is another plain mirror, which reflects the rays to the eye-glass. The eye being placed at the eye-glass at *e*, the telescope is to be moved by the handle *h*, so that the dot in the focus of the eye-glass shall pass over the outlines of the image seen by the eye, and the pencil at L performing a similar motion to that of the dot, and sliding freely in its sheath, presses with its weight on the paper: a drawing of the object is the result. If the stand and slider H be lengthened, an enlarged drawing will be obtained. The instrument packs in a box 14 inches by 6 and 3.

The instrument used for drawing profiles of the face consists of a long rod which moves on a joint. One end of the rod is moved over the face, the other end, which terminates in an iron point, describes the profile on paper. Professor Wallace of Edinburgh constructed an improved drawing instrument, which he has denominated an Eidograph. This instrument is described under the head EIDOGRAPH. It is of the nature of the pantograph, and serves for copying and reducing. (W.A.C.)

CAMERA *Obscura* (*i.e. Dark Chamber*), in *Optics*, a machine or apparatus representing an artificial eye, by which the images of external objects, received through a double convex glass, are exhibited distinctly, and in their native colours, on a white board placed within the machine, or on the focusing glass. The invention of this instrument is due to Friar Bacon, though by some it has been ascribed to Baptista Porta.

The *camera obscura* affords very diverting spectacles, by representing images perfectly like their objects, while at the same time it exhibits all their motions. By means of this instrument, a person unacquainted with designing may delineate objects with the greatest accuracy. Its use in photography will be found under that head.

CAMERALISTICS, (German *cameral*, financial), the science of finance.

CAMERARIUS, JOACHIM, whose real name was Liebhard, one of the most learned writers of his time, was born at Bamberg in 1500. He translated into Latin Herodotus, Demosthenes, Xenophon, Euclid, Homer, Theocritus, Sophocles, Lucian, Theodoret, Nicephorus, and other Greek writers. He published a Catalogue of the Bishops of the principal Sees; Greek Epistles; Accounts of his Journeys, in Latin verse; a Commentary on Plautus; the Lives of Helius Eobanus Hessus, and Philip Melanchthon, &c. He died at Leipsic in 1574.

CAMERARIUS, *Joachim*, a learned physician, son of the preceding, was born at Nuremberg in 1534. After having finished his studies in Germany, he visited Italy, where he was greatly esteemed by the learned. At his return he was invited to reside at the courts of several princes; but he was too much devoted to the study of chemistry and botany to accept their offers. He wrote a Hortus Medicus and several other works, and died in 1598.

CAMERINO, the capital of a delegation of the same name in the States of the Church, 40 miles S.S.W of Ancona. It is the seat of an archbishopric, and has a cathedral, several churches and convents, an archiepiscopal palace, and a university. Pop. 5200. The delegation has an area of 320 square miles, and a pop. of 38,415.

CAMERLINGO (German *Kämmerling*), according to Du Cange, originally signified the treasurer of the pope or the emperor. The title is now only used at Rome, where it is applied to the cardinal who governs the ecclesiastical state and administers justice. It is the most important office at the court of Rome, because he who holds it is at the head of the treasury. During a vacation of the papal chair, the cardinal camerlingo publishes edicts, coins money, and exercises every other prerogative of a sovereign prince. He has under him a treasurer-general, auditor-general, and twelve prelates called *clerks of the chamber*.

CAMERON, JOHN, a theologian of great erudition, was born at Glasgow about 1579, and received his early education in his native city. He was employed in teaching the Greek language in the university for twelve months; and then he embarked for France. Arriving at Bordeaux, he recommended himself to the favour and friendship of two Protestant clergymen by his agreeable manners, ingenuous disposition, and uncommon skill in the Greek and Latin languages. He spoke Greek with as much fluency and elegance as other persons could speak Latin—a proficiency that excited the admiration of Casaubon, with whom he soon afterwards became intimately acquainted. One of the pastors of the church of Bordeaux was his own countryman Gilbert Primrose, D.D., who was himself a man of learning. Through the recommendation of these clergymen, he was appointed a regent in the College of Bergerac, where it was his province to teach the classical languages; but thence he was speedily withdrawn by the Duc de Bouillon, who appointed him a professor of philosophy at Sedan. Here he acquired new reputation; and the duke next made him an offer of the Greek chair, which however he declined, on the plea that he could not accept it without depriving a friend of his office.

Having continued two years at Sedan, he resigned his professorship, and, after visiting Paris, returned to Bordeaux. In the beginning of 1604, he was nominated one of the students of divinity who were maintained at the expense of the church, and who for the period of four years were at liberty to prosecute their studies in any Protestant seminary. During this period he acted as tutor to the two sons of Calignon, chancellor of Navarre. They spent one year at Paris, and two at Geneva, whence they removed to Heidelberg, where they remained nearly twelve months. In this university, on the 4th of April 1608, he gave a public proof of his ability by maintaining a series of theses, "De triplici Dei cum Homine Fœdere," printed among his works. The same year he was recalled to Bordeaux, where he was appointed the colleague of Dr Primrose; and when Gomarus was removed to Leyden, Cameron in 1618 was appointed professor of divinity at Saumur, the principal seminary of the French Protestants. The principal of the college was at this time Dr Duncan, another of his learned countrymen, who were then so numerous in France. Cameron had already published several of his works, and his celebrity was in no small degree increased by his academical lectures.

In 1620, the progress of the civil troubles in France

[1] This *patent* instrument is the same in principle, and almost identical in form, with an instrument figured and described in an old work on Perspective, Joannis Francisci Niceronis *Thaumaturgus Opticus*, pars 1. Printed at Paris in 1646.

obliged Cameron to seek refuge in England for himself and family. For a short time he read private lectures on divinity in London; and in 1622 the king appointed him principal of the university of Glasgow in the room of Robert Boyd, who had been removed from his office in consequence of his adherence to the cause of presbytery. His successor appears to have been more favourably inclined to episcopacy; a circumstance that may have tended to diminish the cordiality of his reception in his native city. Here he likewise taught divinity with great reputation, but he resigned his office in less than a year. Calderwood says that "Cameron was so misliked by the people that he was forced to quit his place soon afterwards."

He returned to France, and fixed his residence at Saumur; and after an interval of a year he was appointed professor of divinity at Montauban. The country was still torn by civil and religious dissensions; and as Cameron maintained the doctrine of passive obedience, he excited the indignation of the more strenuous adherents of his own party. He withdrew to the neighbouring town of Moissac; but he soon returned to Montauban, and a few days afterwards he died at the age of about forty-six. Cameron left by his first wife several children, whose maintenance was undertaken by the Protestant churches in France.

In his person, Cameron was of the middle size, and somewhat spare; his hair was yellow, his eyes were brilliant, and the expression of his countenance was lively and pleasant.

Soon after the death of Cameron, his friends published his "Prælectiones in selectiora Loca Novi Testamenti." Salmurii, 1626–8, 3 tom. 4to. The editor was his learned pupil Louis Cappel, professor of Hebrew, and afterwards of divinity, in the university of Saumur; to whom we are likewise indebted for a sketch of the author's life and character. A collection of his theological works appeared under the title of "Joannis Cameronis, Scoto-Britanni, Theologi eximii τα σωζομένα, sive Opera partim ab auctore ipso edita, partim post ejus obitum vulgata, partim nusquam hactenus publicata, vel e Gallico idiomate nunc primum in Latinam linguam translata: in unum collecta, et variis indicibus instructa." Genevæ, 1642, fol. Cappel's *Icon Joh. Cameronis* is here reprinted. The writer of the preface to the volume was Frederic Spanheim, professor of divinity at Geneva. Cappel had published another work of his preceptor, which is not included in this collection: "Myrothecium Evangelicum, in quo aliquot Loca Novi Testamenti explicantur: una cum Spicilegio Ludovici Capelli de eodem argumento, cumque 2 Diatribis in Matth. xv. 5 de Voto Jephtæ." Genevæ, 1632, 4to. Another edition appeared under the subsequent title: "Myrothecium Evangelicum; hoc est, Novi Testamenti Loca quamplurima ab eo, post aliorum labores, apte et commode vel illustrata, vel explicata, vel vindicata. Quibus adjectæ sunt Alexandri Mori Notæ in Novum Fœdus, jam antea editæ, et Dissertatio in Mat. c. 24. v. 28. hactenus inedita: nec-non ejusdem A. Mori Axiomata Theologica, quæ nunc primum in lucem prodeunt. Editio novissima, locorum indicibus locupletata." Salmurii, 1677, 4to.

The name of this distinguished person furnished a denomination to a party of Calvinists in France, who asserted that the will of a man is only determined by the practical judgment of the mind; that the cause of men's doing good or evil proceeds from the knowledge which God infuses into them; and that God does not move the will physically, but only morally, by virtue of its dependence on the judgment of the mind. This peculiar doctrine of grace and free will was adopted by Amyraut, Cappel, Bochart, Daillé, and others of the more learned among the reformed ministers, who judged Calvin's doctrines on these points too harsh. The Cameronites are a sort of mitigated Calvinists, and approach to the opinion of the Arminians. They are also called Universalists, as holding the universality of Christ's death; and sometimes Amyraldists. The rigid adherents to the synod of Dort accused them of Pelagianism, and even of Manicheism; and the controversy between the parties was carried on with a zeal and subtilty scarcely conceivable; yet the whole question between them was only, whether the will of man is determined by the immediate action of God upon it, or by the intervention of a knowledge which God impresses on the mind. The synod of Dort had defined that God not only illuminates the understanding, but gives motion to the will by making an internal change therein; whereas Cameron only admitted the illumination by which the mind is morally moved, and explained the sentiment of the synod of Dort so as to make the two opinions consistent.

Cameron, *Richard*, the founder of the Cameronians, was born at Falkland, in the county of Fife. His father, who was a shopkeeper in that town, gave him such an education as the village school afforded; and his success was so great, that while still a youth he was appointed schoolmaster. In this situation he had opportunities of becoming acquainted with some of the more violent field-preachers, who at this time wandered through the country disseminating their doctrines as they went. Persuaded by them, he resigned his situation, and shortly after entered the family of Sir Walter Scott of Harden, as chaplain and tutor. He did not remain here long however; for refusing to acknowledge the Indulgence, he joined the ranks of the non-conforming ministers, and incited the inhabitants of the southern counties of Scotland to protest openly against the new edict. So formidable was the agitation that the government thought fit to interfere, and pronounced illegal all armed assemblages for religious purposes. Cameron was obliged to take refuge in Holland, where he resided for some time; but in the spring of 1680 he returned to Scotland, and once more made himself formidable and obnoxious to the government. Shortly after the defeat of the Covenanters at Bothwell Bridge in that year, Cameron was slain in a skirmish at Ayr's Moss, fighting bravely at the head of the few troops he had been able to collect.

CAMERONIANS. See Presbyterians, Reformed.

CAMEROONS, a river of Africa in Upper Guinea, falling into the bight of Biafra, about Lat. 4. N., Long. 9. 40. E. Cameroons peak, the highest point of the Cameroon mountains, being 13,000 feet above the sea, is in Lat. 4. 13. N., Long. 9. 10. E.

CAMILLI and Camillæ, boys and girls who ministered in the religious rites and ceremonies of the Romans, and especially those employed in the sacrifices of the Flamen Dialis, or priest of Jupiter. They were required to be free-born, perfect and unblemished in form, and the children of living parents. The origin of the word camillus (or casmillus, as it is sometimes written) has been connected with the Samothracian Kabiren-Hermes, Κάδμιλος and Κάδμος; but its etymology is in fact quite uncertain.

CAMILLUS, Marcus Furius, one of the most illustrious heroes of the Roman republic. He triumphed four times, was five times dictator, and was honoured with the appellation of Second Founder of Rome. When accused of having unfairly distributed the spoil taken at Veii, he anticipated judgment, and went voluntarily into exile at Ardea. But during his exile, instead of rejoicing at the devastation of Rome by the Gauls, he exerted all his wisdom and bravery to drive away the enemy, and yet kept with the utmost strictness the sacred law of Rome, in refusing to accept the command, which was offered him by several private persons. The Romans, when besieged in the capitol by the Gauls, created him dictator; and in this capacity he acted with so much bravery and conduct, that he entirely drove the enemy out of the territories of the commonwealth. He died of the plague in the eighty-first year of his age, B.C. 365. The famous story of Camillus and the schoolmaster belongs to the campaign against the

Faliscans, B.C. 394. It is said that when Camillus appeared before Falerii, a schoolmaster attempted to betray the town by bringing into his camp the sons of some of the principal inhabitants of the place. Camillus, indignant at such baseness, ordered that the traitor should have his hands tied behind him, and thus be whipped into the town by his own scholars. It is said that the Faliscans were so affected by the generosity of the Roman general that they immediately surrendered. (Livy; Plutarch.) See ROMAN HISTORY.

CAMIS, or KAMIS, in the *Japanese mythology*, the deified souls of ancient heroes, who are supposed still to interest themselves in the welfare of those they once commanded.

CAMISADE an attack by surprise at night or at break of day, when the enemy is supposed to be asleep. The word is said to have taken its rise from an attack of this kind, in which, as a badge by which to distinguish each other, the attacking party wore over their dress a shirt, in French called *chemise*, or *chamise*.

CAMISARDS, a name given to the Calvinists of the Cevennes, who took up arms in their own defence in 1688, after the revocation of the edict of Nantes. The origin of the name is given under CAMISADE.

CAMLET, or CAMBLET, a stuff made sometimes of wool, sometimes of silk, and sometimes of hair, especially that of goats, with wool or silk. In some, the warp is silk and wool twisted together, and the woof is hair.

The true Oriental camlet is made of the hair of a sort of goat frequent about Angora, and which constitutes the riches of that city. Camlets are now made in Europe. Writers of the middle age mention stuffs of camel's hair, under the denominations of *cameletum* and *camelinum*, whence probably the term; but these are represented as coarse and rough, and seem to have been chiefly used among the monks by way of mortification, as the hair shirt of later times.

CAMOËNS, LUIS DE, the most illustrious of the Portuguese poets, was born at Lisbon in 1517. His family was of considerable note, and originally Spanish. In 1370 Vasco Perez de Camoëns fled in disgust from the court of Castile to that of Lisbon, where King Ferdinand immediately admitted him into his council, and gave him the lordships of Sardoal, Punhete, Marano, Amendo, and other lands of considerable extent, a certain proof of the eminence of his rank and abilities. In the war of the succession, which broke out on the death of Ferdinand, Vasco sided with the king of Castile, and was killed in the battle of Aljabarota. But though John I., the victor, seized a great part of his estate, his widow, the daughter of Gonzalo Tereyro grand master of the order of Christ and general of the Portuguese army, was not reduced beneath her rank. She had three sons who took the name of Camoëns. The family of the eldest intermarried with the first nobility of Portugal, and even, according to Casterra, with the blood royal; but the family of the second brother, whose fortune was slender, had the superior honour of producing the author of the *Lusiad*.

The misfortunes of the poet commenced early in life. In his infancy Simon Vaz de Camoëns his father, commander of a vessel, was shipwrecked at Goa, where he perished, together with the greater part of his fortune. His mother, however, Anne de Macedo of Santarem, provided for the education of her son Luis at the university of Coimbra, where he acquired an extensive knowledge of the classics. When he left the university he appeared at court. He was handsome, with expressive eyes and a fine complexion; and as he was a polished scholar, this, added to the natural ardour and vivacity of his disposition, rendered him an accomplished gentleman. Having become deeply enamoured of Donna Catharina d'Alayada one of the queen's ladies, who, it appears, returned his passion, Camoëns was in consequence banished from court.

He now retired to his mother's friends at Santarem, where he renewed his studies, and began his poem on the discovery of India. At this time John III. was preparing an armament against Africa; and Camoëns, tired of an obscure and inactive life, went to Ceuta with the expedition, and greatly distinguished himself by his valour in several encounters. In a naval engagement with the Moors in the Straits of Gibraltar he was among the foremost to board, and lost his right eye in the conflict. Yet neither the hurry of actual service, nor the dissipation of a camp, could stifle his genius. He continued his *Lusiadas*, and several of his most beautiful sonnets were written in Africa, while, as he expressed it, "one hand the pen, and one the sword employed." The fame of his valour having reached the court, he obtained permission to return to Lisbon, where he found that his beloved Catharina was dead. He solicited an establishment which he had merited in the ranks of battle; but the malignity of evil tongues, as he expresses it in one of his letters, was poured out upon him. Stung by such ungrateful treatment, Camoëns resolved to bid his country a final farewell; and accordingly, in 1553, he sailed for India. As the ship left the Tagus he exclaimed, in the words of the sepulchral monument of Scipio Africanus, *Ingrata patria, non possidebis ossa mea;* "ungrateful country, thou shalt not possess my bones." But he knew not what evils in the East would awaken the remembrance of his native land.

When Camoëns arrived in India, an expedition was ready to sail to avenge the king of Cochin on the king of Pimenta. Without allowing himself any rest on shore after his long voyage, he joined this armament, and in the conquest of the Alagada islands displayed his usual bravery. In the following year he attended Manuel de Vasconcello in an expedition to the Red Sea, where, as he had no use for his sword, he employed his pen, and also visited Mount Felix and the adjacent part of Africa, which he so strongly pictures in the *Lusiad*, and in one of his sonnets, in which he bewails the loss of his Catharina. When he returned to Goa he enjoyed a tranquillity which enabled him to bestow attention on his epic; but this serenity was interrupted by his own imprudence; for he wrote some satires which gave offence, and by order of the viceroy, Francisco Barreto, he was banished to China.

But the accomplishments and manners of Camoëns soon procured him friends. He was appointed commissary in the island of Macao, a Portuguese settlement in the bay of Canton, where he continued his *Lusiad;* and, after five years' residence, he acquired a fortune, small indeed, yet equal to his wishes. A new viceroy, Dom Constantine de Braganza, having been appointed, Camoëns obtained his permission to return to Goa, and set sail in a ship freighted by himself; but he was shipwrecked in the passage on the coast of Cambodia, and all he had acquired perished in the waves. His poems, which he held in one hand while he swam with the other, were all he found himself possessed of when he stood friendless on an unknown shore.

On the banks of the Mecon he wrote his beautiful paraphrase of the psalm *Super flumina Babylonis*, where the Jews, in the finest strain of poetry, are represented as hanging their harps on the willows by the rivers of Babylon, and lamenting their exile from their native land. Here Camoëns continued some time, till an opportunity offered of a passage to Goa. When he arrived at that city, Dom Constantine de Braganza, the viceroy, admitted him to his friendship, and Camoëns continued happy till Count Redondo assumed the government. While Constantine continued in power, those who had formerly procured the banishment of the satirist were silent; but now they exerted all their arts against him. Redondo, when he entered upon office, however, pretended to be the friend of Camoëns; yet with unfeeling indifference he suffered the innocent man to be thrown into the common prison. After much delay, Camoëns in a public trial fully refuted every accusation

directed against his conduct while commissary at Macao, and his enemies were loaded with ignominy. Camoëns, however, had contracted certain necessary debts, and his creditors detained him in prison till some spirited townsmen of Goa, ashamed that a man of his singular merit should experience such treatment among them, procured his release. Once more he assumed the profession of arms, and received the allowance of a gentleman volunteer, a character at this time common in Portuguese India. Soon afterwards Pedro Barreto, appointed governor of the fort at Sofala, allured the poet by high promises to attend him thither. The governor of a distant fort in a barbarous country shares in some measure the fate of an exile; yet, though the only motive of Barreto was to enjoy the conversation of Camoëns at his table, he took no care to render the life of his guest agreeable. Chagrined at his treatment and weary of a state of dependence, Camoëns resolved to return to his native country. A ship on the homeward voyage at this time touched at Sofala, and several of the passengers were desirous that Camoëns should accompany them; but this the governor ungenerously endeavoured to prevent, and charged him with a debt for board. Anthony de Cabra, however, and Hector de Sylveira, paid the demand; and Camoëns and the honour of Barreto were discharged together.

After an absence of sixteen years, Camoëns in 1569 returned to Lisbon, unhappy even in his restoration to his native country, for the pestilence then raged in the capital. At last, in 1572, he printed his *Lusiad*, which, in the opening of the first book, he addressed to the youthful king Sebastian, who was so pleased with its merit that he gave the author a pension of four thousand reals, on condition that he should reside at court; but on the death of his patron, who fell in the battle of Alcazar in 1578, this pension was withdrawn by Cardinal Henry, who succeeded to the throne. Under his inglorious reign Camoëns died in all the misery of poverty. He was even indebted for the means of sustenance to an old Javanese servant, named Antonio, who begged in the streets of Lisbon for the only man in Portugal on whom God had bestowed those talents which had a tendency to elevate the spirit of a declining age. To the eye of a faithful observer, the fate of Camoëns throws great light on that of his country. The same ignorance and the same degenerate spirit which suffered Camoëns to depend on his share of the alms begged in the streets by his aged servant, sunk the kingdom of Portugal into the most abject vassalage ever experienced by a conquered nation. But while the grandees of Portugal were blind to the ruin which impended over them, Camoëns beheld it with a poignancy of grief which hastened his end. In one of his letters he has these remarkable words: "I am ending the course of my life; the world will witness how I have loved my country. I have returned not only to die in her bosom, but to die with her." In an alms-house at Lisbon, in 1579, died, at the age of sixty-two, Luis de Camoëns, the greatest genius Portugal ever produced; in martial courage and spirit nothing inferior to her most honoured heroes.

Fifteen years after his death, a monument was erected to his memory. Death had allayed all jealousies; and the homage due to him, as the national poet of Portugal, was now enthusiastically paid. The genius of Camoëns was inspired by the history of his country and the manners of his age; his lyric poems in particular, like the works of Dante, Petrarch, Ariosto, and Tasso, belong to romantic and chivalrous rather than to purely classical literature; and hence the partizans of the latter, who were very numerous in his time, were far from greeting with applause the first steps of his career. Of the *Lusiad* it would be superfluous to offer any criticism in this place. Suffice it to say, that with many faults, both of design and execution, it possesses perfect unity of interest, arising from the patriotic sentiment with which it is animated throughout, and charms alike by the stateliness and the grace of its versification, which foreigners as well as native Portuguese can relish and appreciate. The most esteemed edition of the works of Camoëns appeared at Lisbon in 1779–1780, under the title of *Obras de Luis de Camoëns principe dos poetas de Hespanha*, 4 tom. 12mo. A second edition also appeared in 1782–1783, the first volume of which contains the life of the author and the *Lusiad*, and the last his dramatic and other pieces. A splendid and correct, but very scarce edition of the *Lusiad* was published, with fine engravings, by Firmin Didot, Paris, 1817, 4to. It has been translated into several languages, and twice into English, by Fanshawe and Mickle.

CAMOMILE, or more properly CHAMOMILE, the flowers of the *Anthemis nobilis*. The flowers have a white ray with a central yellow disk, and have an aromatic bitter taste and a powerful odour. The infusion of the flowers is when cold a useful stimulant, bitter or tonic; the infusion taken warm, however, acts as an emetic. The virtues reside in a volatile oil, and in a bitter principle, which may be separated from one another.

CAMP, the ground on which an army pitch their tents. See WAR.

The Hebrew camp during the Exodus was of a quadrangular form, surrounded with an inclosure of the height of ten handbreadths. It formed a square of twelve miles in compass about the tabernacle; and within this was another called the *Levites' camp*.

The Greek camps were fortified with gates and ditches. The Lacedæmonians formed their camps in a circular shape. Of other Grecian camps it may be observed, that the most valiant soldiers were placed at the extremities. Thus in the Iliad, Achilles and Ajax were stationed at the extremities of the camp before Troy.

The figure of the Roman camp (*castra*) was a square divided into two principal parts. In the upper part were the general's pavilion, or *prætorium*, and the tents of the chief officers; in the lower were those of inferior degree. On one side of the *prætorium* stood the *quæstorium*, or quarters of the treasurer of the army; and near this the *forum*, called also *quintana*, where things were sold and meetings held. On the other side of the *prætorium* were lodged the *legati;* and below it the tribunes had their quarters, opposite to their respective legions. In this part of the camp also were the tents of the *præfecti* of the foreign troops, as well as those of the *evocati*, and of the *extraordinarii* and *ablecti*, both horse and foot. The precise order in which they were arranged is unknown. Between the two divisions was a broad open space called *principia*, where the tribunal of the general was erected when he either administered justice or harangued the army, where punishments were inflicted, and the principal standards, with the altars and images of the gods, were placed. The middle of the lower division was assigned to the Roman horse; next to them were quartered the *triarii;* then the *principes;* and close by them the *hastati*. The companies of foreign horse and foot were posted on the flanks, and carefully kept apart, to obviate the danger of a treacherous coalition. The Roman camp had four gates, and was surrounded by a rampart termed *vallum*, and a ditch, *fossa*. The *agger* or mound of earth was secured by *sudes* or sharp wooden stakes. The camps were sometimes surrounded by walls built of hewn stone; and the soldiers' quarters were occasionally formed of the same materials.

CAMPAGNA, a town of Naples, in the province of Principato Citra, 19 miles east of Salerno. It stands in the centre of a mountainous district, of which it is the capital. It is the see of a bishop, and contains a cathedral and college, besides several churches and convents. Pop. 6700.

CAMPAGNA DI ROMA, the name of an extensive undulating plain which surrounds Rome, coinciding very nearly with the ancient province of Latium. It is bounded N.W.

and N. by the Tiber and Teverone; E. by a branch of the Apennines; S. and S.W. by the Mediterranean; and contains an area of about 2400 square miles, with a population which varies according to the season of the year from about 15,000 to about 275,000. Its greatest length is about 65 miles, its greatest breadth about 45. The most elevated and salubrious districts are in the north and east, embracing the slopes of the Apennines, which are watered by the Teverone and Saccho. Towards the coast the soil is flat, and covered with vegetation only in winter and the early part of spring. In summer it is parched and bare; and would be entirely deserted but for the few farm-servants who at night retire for shelter to the towns, and the hardy peasants from the neighbouring hills who for a trifling remuneration expose themselves to the malaria and vapours which prevail at harvest-time. Many of these soon fall victims to the malaria fever, and in the end of autumn the hospitals at Rome are filled with others. The proprietors of the farms for the most part reside in the capital; and on the approach of summer the herdsmen, turning loose their horses, drive the sheep and oxen to the pastures of the Apennines. The most pestilential district is that in the south, which lies between the Lepini hills and the sea, including the swamps commonly known as the Pomptine marshes. Part of this tract is under cultivation, and a considerable portion was drained by Pius VI., but without much effect so far as the salubrity of the district is concerned. The Campagna is studded with the ruins of ancient Roman villas, and the remains of the aqueducts which supplied the city with water form a very striking feature in the landscape.

The Campagna is divided for judicial purposes between the Comarca di Roma and the delegation of Frosinone.

CAMPAIGN, the space of time during which an army keeps the field. See War.

CAMPAN, a small town of France, department of Hautes Pyrénées, arrondissement of Bagnères-en-Bigorres. It is pleasantly situated in a fine valley on the left bank of the Adour, 16 miles S.S.E. of Tarbes. The town is well laid out, and the houses, which are neat and clean, are mostly built of marble from the neighbouring quarries. Pop. 3500.

Campan, *Madame* (*née* Genet), was married to M. Campan in 1770, soon after which she was appointed first lady of the bed-chamber to the dauphiness Marie Antoinette. She remained at court until the revolution, but was not permitted to accompany her unfortunate mistress to prison. She then supported herself by setting up a boarding school at Germain-en-laye. When Napoleon, in 1806, founded the establishment for the daughters and families of members of the Legion of Honour, the elegant manners and character of Madame Campan pointed her out as a fit superintendent of that institution, an office which she filled with credit to herself, till the overthrow of the emperor and the restoration of the Bourbons caused the suppression of the establishment at Ecouen. Madame Campan then retired to Mantes, where she wrote a very agreeable book, "Memoires sur la Vie Privée de Marie Antoinette Reine de France." It was published some time before the death of the author, which happened in 1822.

CAMPANA, a town of Spain, in the province of Seville, on a small tributary of the Guadalquivir. It contains about 1000 houses, a parish church, several monasteries, and five schools. It has a considerable commerce in the agricultural produce and cattle of the surrounding districts. The flour-mills, oil-mills, wine-presses, and coarse-linen factories, employ the greater part of the inhabitants. Pop. 5380.

CAMPANELLA, Thomas, was born at Stilo, a village of Calabria, in 1568. His progress in languages at school was so rapid, that his father was induced to send him to Naples to study law; but of his own accord he joined the order of Dominicans, and applied to the study of theology. He first signalized himself in the disputes which then raged between the Dominicans and Franciscans; but soon following in the wake of Cardan and Telesius, whose book he publicly defended at Naples, he began to question, and then discarded the authority of Aristotle, although not till after he had mastered the entire circle of Greek, Latin, and Arabian commentators. After a careful study of all the previous systems of philosophy, he published his *Philosophia sensibus demonstrata*; and from the novelty of his opinions he made so many enemies, that he had to take refuge successively in Rome, Florence, Venice, Padua, and Bologna. On account of his supposed connection with a conspiracy then organized in Calabria against the Spanish government, he was seized at Venice, carried to Spain, and imprisoned. He remained in confinement till the death of Philip III., when, at the intercession of Pope Urban VIII., he was transferred to the prison of the Inquisition at Rome, and finally liberated in 1629. It was during his incarceration in Spain that he wrote his *Atheismus triumphatus*, and his *Apologia pro Galilæo*. To escape the machinations of the Spaniards against him, he retired to France; and by the efforts of Cardinal Richelieu he obtained a pension of 2000 livres from Louis XIII. After visiting Descartes in Holland, he attached himself to a Dominican convent at Paris, where he died in 1639. Campanella was the contemporary of Bacon, and like him attempted to deduce all knowledge from nature and experience. He held the only two sources of knowledge to be revelation and nature, and from these endeavoured to construct a new system of theology, metaphysics, ethics, and political economy, in opposition to the prevailing schools of Aristotle and Machiavelli. With Bacon he also attempted a new classification of the sciences.

Besides those already mentioned, his principal works are:—*Philosophiæ rationalis et realis partes V.*, 4to, Paris, 1638; *Civitas Solis*, 12mo, Utrecht, 1643; *Ad doctorem gentium de gentilismo non retinendo, et de prædestinatione et gratiâ*, 4to, Paris, 1656; *De sensu rerum et magia*, 4to, Paris, 1637; *De prædestinatione, electione, reprobatione, et auxiliis divinæ gratiæ, contra Thomisticos*, 4to, Paris, 1636; *Universalis philosophiæ seu metaphysicarum rerum juxta propria dogmata, partes tres, libri XVIII.*, fol., Paris, 1637; *De monarchia Hispanica discursus*, 24mo, Amsterdam, 1640; *Scelta d'alcune poesie filosofice*, Franf. 1622, under the pseudonyme of *Settimontano Squilla*, &c., &c.

CAMPANIA, that part of ancient Italy of which Capua was the chief city. It was bounded by Latium on the north, Samnium on the east, Lucania on the south, and the Mare Inferum on the west. It was anciently celebrated for its fertility and delicious climate; and it constitutes the *Campania Felice* or *Terra di Lavoro* of the modern kingdom of Naples, on both sides of the capital. The ancient Campania, besides Capua and Neapolis, could boast of the flourishing cities of Nuceria, Nola, Pompeii, Herculaneum, Stabiæ, Baiæ, and Salernum.

CAMPANI-ALIMENIS, Matteo, an Italian mechanician and natural philosopher of the seventeenth century. He was born at Spoletto, and held a curacy at Rome in 1661, but devoted himself principally to scientific pursuits. As an optician, he is chiefly celebrated for the manufacture of the large object glasses with which Cassini discovered two of Saturn's satellites, and for an attempt to rectify chromatic aberration; and in clock-making, for his invention of the illuminated dial-plate, as well as for an attempt to correct the irregularities of the pendulum, arising from variations of temperature. Campani published in 1678 a work on horology, and on the manufacture of lenses for telescopes. His younger brother Giuseppe was also an ingenious optician.

CAMPANIFORM, or Campanulated, *bell-shaped*; a term applied to flowers.

CAMPANILE (Ital. *campána*, a bell), a tower for a bell or bells, either attached to some building, or an independent

structure, as seen in many of the cities of Italy. The campanile of Cremona, the loftiest of these towers, is 396 feet in height.

CAMPANINI, an Italian marble dug at Carrara; so named from its sonorousness when struck.

CAMPBELL, ARCHIBALD, Earl and Marquis of Argyll, was the son of Archibald Earl of Argyll and Lady Anne Douglas daughter of William Earl of Morton. He was born in the year 1598, and educated in the principles of the Reformed religion, of which his ancestors had been zealous promoters. When his father, however, renounced Protestantism and declared himself a Papist, the young earl was put in possesson of his patrimonial estates by order of government, and quickly promoted to places of trust and power. From the commencement of his political career he espoused the cause of the Presbyterian party, and defended the Covenanters when summoned to London to give his opinion of their proceedings before the king. In 1638 he remained with the General Assembly after it had been dissolved by the king's commissioner, and with the other nobility and gentry signed the Solemn League and Covenant in defence of the national liberties. Having thus openly committed himself to the Presbyterian cause, he took a prominent part in the various civil and military transactions of the following years. (See BRITAIN, p. 395, *et seq.*) Having gone to London in the year 1660, he was arrested and thrown into prison. In the following year he was tried for high treason, and, principally on ground of treasonable correspondence with Monk expressing concurrence with his government, he was condemned to death and executed on the 25th of May. He took a cheerful leave of his friends before ascending the scaffold, saying, "I could die like a Roman, but choose rather to die as a Christian;" and kneeling down, he received the fatal blow with the greatest calmness.

CAMPBELL, *Archibald*, Earl of Argyll, son of the preceding, from his youth distinguished himself by his loyalty and attachment to the royal family. Though his father headed the Covenanters, he openly declared his aversion to their cause, and attached himself to the interests of the king. Under Middleton he continued to harass the victorious English, till he received express orders from that general to accept of a capitulation. On the establishment of the commonwealth he was committed to prison, and jealously watched till the restoration, when the king remitted to him his father's forfeiture, and created him Earl of Argyll.

He continued in high esteem with the king and court till the passing of the Test Act in 1681, when, by opposing the exemption from the oath granted in favour of princes of the blood, he had the misfortune to draw down on himself the indignation of the Duke of York.

When called to take the test, Argyll refused, except with the explanation, which he believed to have been approved by the duke, to the effect that he took it only so far as it was consistent with itself and the Protestant religion. The duke accepted the qualification, and Argyll was admitted to sit in council; but a few days afterwards was committed to prison, and indicted for high treason. On being tried, three judges did not scruple to convict him of treason and leasing-making; a jury of fifteen noblemen gave a verdict against him; and the king ordered sentence to be pronounced, but the execution of it suspended till further orders. Argyll, however, seeing no reason to trust to the justice or mercy of his enemies, made his escape from prison, and concealed himself for some time in London. All the rest of his sentence was rigorously executed; his estate was confiscated, and his arms were reversed and torn down. Having escaped to Holland, he remained there during the remaining part of the reign of Charles II. Thinking that the interval before the coronation of James II. presented a favourable opportunity for recovering the constitution by force of arms, he concerted measures with the Duke of Monmouth, and returned to Scotland to command the forces already raised for the purpose; but after a few unsuccessful skirmishes he was taken prisoner and carried to Edinburgh, where he was beheaded on his former sentence, June 30, 1685. At the place of execution he made a short speech; and, after solemnly declaring that he forgave all his enemies, submitted to death with heroic firmness. See BRITAIN.

CAMPBELL, *Archibald*, first Duke of Argyll, son of the preceding, was an active promoter of the revolution. He came over with the Prince of Orange, and was admitted into the convention as Earl of Argyll, though his father's attainder had not been reversed. Having been deputed, along with Sir James Montgomery and Sir John Dalrymple, to present the crown in name of the Scottish Convention to the Prince of Orange, and to tender to him the coronation oath, he was admitted a member of the privy-council, and in 1690 made one of the lords of the treasury. In 1701 he was created Duke of Argyll. He married Elizabeth, daughter of Sir Lionel Talmash of Helmingham in the county of Suffolk, by whom he left issue two sons and a daughter.

CAMPBELL, *John*, second Duke of Argyll, and also Duke of Greenwich and Baron of Chatham, son of the preceding, was born on the 10th of October 1680. On perceiving his military talents, his father in 1701 introduced him to King William, and procured his appointment to the command of a regiment. In this situation he remained till the death of his father in 1703, when, becoming Duke of Argyll, he was appointed a member of Queen Anne's privy-council, and at the same time captain of the Scotch horse guards, and one of the extraordinary lords of session. In 1704 he was installed one of the knights of the recently revived order of the Thistle, and soon afterwards appointed high commissioner to the Scotch parliament. In return for his services in promoting the Union, he was created a peer of England, by the titles of Baron of Chatham and Earl of Greenwich; and in 1710 was made a knight of the Garter. His grace first distinguished himself in a military capacity at the battle of Oudenarde, where he commanded as brigadier-general; and was afterwards present under the Duke of Marlborough at the sieges of Lisle, Ghent, Bruges, and Tournay. He had also a considerable share in the victory obtained over the French at the battle of Malplaquet, by dislodging them from the wood of Sart, and gaining a post of great consequence. In this sharp engagement several musket-balls passed through the duke's clothes, hat, and peruke. Soon after the action he was sent to take the command in Spain; but being seized with a violent fever at Barcelona, and disappointed of supplies from home, he returned to England. Having a seat in the House of Lords, he censured the measures of the ministry with such freedom that all his places were disposed of to other noblemen; but at the accession of George I. he recovered his influence. On the breaking out of the rebellion in 1715 he was appointed commander-in-chief of the forces in North Britain, and was principally instrumental in effecting the total extinction of the rebellion in Scotland, without much bloodshed. He arrived in London early in March 1716, and at first stood high in the favour of the king; but in a few months was stripped of his offices. This disgrace, however, did not deter him from the discharge of his parliamentary duties; he supported the bill for the impeachment of Bishop Atterbury, and lent his aid to his countrymen by opposing the bill for punishing the city of Edinburgh for the Porteous riot. In the beginning of the year 1719 he was again admitted into favour, appointed lord-steward of the household, and in April following created Duke of Greenwich. He continued in the administration during the remaining part of that reign, and, after the accession of George II., till April 1740, when, on occasion of

a violent speech against the government, he was again dismissed from office. On a change of the ministry, however, he was soon restored; but disapproving of the measures of the new administration, he finally resigned all his posts, and spent the rest of his life in privacy and retirement. He died of a paralytic disorder on the 4th of October 1743. A monument, executed by Roubillac, has been erected to his memory in Westminster Abbey. See Britain.

Campbell, *Archibald*, third Duke of Argyll, brother of the preceding, was born at Hamhouse in England, in June 1682, and was educated at the university of Glasgow. He afterwards studied civil law at Utrecht; but, upon his father being created a duke, he betook himself to a military life, and served for a short time under the Duke of Marlborough. In 1705 he was appointed treasurer of Scotland, and in the following year was one of the commissioners for treating of the Union; on the consummation of which, he was chosen one of the sixteen peers for Scotland in the first parliament of Great Britain. In 1711 he was called to the privy-council; and when the rebellion broke out in 1715, he took up arms in defence of the house of Hanover, and received a wound at the battle of Sheriffmuir. He was appointed keeper of the privy seal in 1725, and afterwards intrusted with the principal management of Scottish affairs. It was by his advice that, after the rebellion in 1745, the Highlanders were employed in the royal army. In 1734 he was made keeper of the great seal, an office which he held till his death. The duke was eminent not only for his political abilities, but for his literary accomplishments, and had collected one of the most valuable private libraries in Great Britain. He died suddenly on the 15th of April 1761, in the seventy-ninth year of his age.

Campbell, *George*, D.D., a distinguished theologian and philosopher, was born at Aberdeen, December 25, 1719. He was educated at the grammar-school of his native place; but being designed by his friends for the legal profession, he was immediately after removed to Edinburgh, and apprenticed to a writer to the signet. Long before the term of his apprenticeship had expired, he had been in the habit of attending the divinity lectures at the university; and when he had fulfilled his engagement, he enrolled himself as a regular student in the divinity hall at Aberdeen, attending the lectures at both colleges. Having received license from the presbytery of that city in 1746, he was two years later presented to the living of Banchory-Ternan, where he continued to labour till 1757. From Banchory-Ternan he was translated to Aberdeen, and soon afterwards appointed Principal of Marischal college. In 1763 he published his well-known *Dissertation* in answer to Hume's *Treatise on Miracles*, a work which procured for him the respect of his antagonist, and still ranks as a valuable contribution to the literature of apologetic theology. On being elected professor of divinity in Marischal college he resigned his ministerial charge in the city, and devoted himself entirely to his professorial duties. In 1771 he published a *Sermon on the Spirit of the Gospel;* and five years later, the *Philosophy of Rhetoric*, part of which was written at Banchory-Ternan. In the discussion of the leading political questions of the day, Principal Campbell took a prominent part. In his sermon on the Duty of Allegiance he severely condemned the American revolutionary war; and still later he rendered himself peculiarly unpopular by his zealous advocacy of the Catholic Emancipation bill, in an *Address to the People of Scotland* on that subject. The last of his works which he lived to complete was a *Translation of the Four Gospels, with Dissertations and Notes*, which is valuable as one of the few native contributions to exegetical science. He was compelled by the state of his health to resign his professorship in 1795, on which occasion he received a pension of L.300 a-year from the government. In the following year he died of a paroxysm of palsy in the 77th year of his age. His *Lectures on Ecclesiastical History* were published after his death. These consist entirely of the prelections which he had delivered to the students on that subject.

Campbell, *John*, LL.D., a voluminous historical, biographical, and political writer, was born at Edinburgh, March 8, 1708. His father was Robert Campbell, Esq. of Glenlyon, and his mother, Elizabeth, daughter of Mr Smith of Windsor, was a descendant of the poet Waller. Having been designed by his father for the legal profession, he was sent to Windsor, and apprenticed to an attorney; but his tastes soon after led him to abandon the study of law, and to devote himself entirely to literature. In 1736 he published the *Military History of Prince Eugene and the Duke of Marlborough*, and soon after contributed several important articles to the *Ancient Universal History*. This was succeeded, in 1742 and 1744, by the *Lives of the British Admirals*, &c., in 4 vols., a work that was highly popular when it appeared, and which has received continuations from the pens of Dr Berkenhout, Redhead York, and Stephens. Besides contributing to the *Biographia Britannica*, and Dodsley's *Preceptor*, he published a work on *The Present State of Europe*, consisting of a series of papers which had appeared in the *Museum*. He also wrote the histories of the Portuguese, Dutch, Spanish, French, Swedish, Danish, and Ostend settlements in the East Indies, and the histories of Spain, Portugal, Algarve, Navarre, and France, from the time of Clovis till 1656, for the *Modern Universal History*. At the request of Lord Bute, he published a vindication of the Peace of Paris concluded in 1763, embodying in it a descriptive and historical account of the New Sugar Islands in the West Indies. By the king he was appointed agent for the provinces of Georgia in 1755. His last and most elaborate work, *Political Survey of Britain*, 2 vols., 4to, was published in 1744, and greatly increased the author's reputation, though now it is almost entirely superseded by later authorities. Dr Campbell died December 28, 1775. During his lifetime he enjoyed a European reputation for the extent and accuracy of his scholarship, the simplicity of his life, and the amiability of his disposition. He received the honorary degree of LL.D. from the university of Glasgow in 1745.

Campbell, *Thomas* (1777–1844). This distinguished poet was a cadet of the respectable family of Campbell of Kirnan, in Argyllshire. Owing to the straitened circumstances of his father, who had settled in Glasgow and been unfortunate in business, young Campbell was obliged, while attending college, to have recourse to private teaching as a tutor. Notwithstanding the amount of additional labour thus entailed, he made rapid progress in his studies, and attained considerable distinction at the university over which it was his fortune, in after years, to preside. He very early gave proofs of his aptitude for literary composition, especially in the department of poetry; and so strong was his addiction to these pursuits, that he could not bring himself seriously to adopt the choice of a profession. From private tuition, which is at best an irksome drudgery, he recoiled after a short trial. Neither law, physic, nor divinity, had any attractions for him; nor is it probable that he ever would have risen to eminence in a regular profession, owing to a constitutional sensitiveness almost morbid, and a want of resolute energy. We are told by his friend and biographer Dr Beattie, that "the imaginative faculty had been so unremittingly cultivated, that circumstances, trifling in themselves, had acquired undue influence over his mind, and been rendered formidable by an exaggeration of which he was at the moment unconscious. Hence various difficulties, which industry might have overcome, assumed to his eye the appearance of insurmountable obstacles. Without resolution to persevere, or philosophy to submit to the force

of necessity, he drew from everything around him, with morbid ingenuity, some melancholy presage of the future. He was dissatisfied with himself, chilled by the world's neglect, and greatly hurt by the apathy of friends who had extolled his merits, but left him to pine in obscurity." Campbell was not a man who could have successfully struggled with the world. Fortunately for him, his genius was such as to ensure an early recognition.

We find him at the age of twenty in Edinburgh, attending lectures at the university, soliciting employment from the booksellers, and not unknown to a circle of young men then resident in the Scottish metropolis, whose names have become historical. Among these were Walter Scott, Henry Brougham, Francis Jeffrey, Dr Thomas Brown, John Leyden, and James Grahame, the author of the *Sabbath*. He also became acquainted with the late Dr Robert Anderson, editor of a collection of the British poets, a man of extreme enthusiasm and kindliness of disposition, who early appreciated the remarkable powers of Campbell, and encouraged him to proceed in his literary career. In 1799 his poem *The Pleasures of Hope* was published.

Probably there is no parallel instance of literary success so instantaneously achieved by a first effort; nor was that owing to novelty of design on the part of the author, or the caprice of the public. For more than half a century the poem has maintained, nay, increased its popularity. During that time the public has adopted and abandoned many favourites—names once famous and in every mouth, have gradually become forgotten and unregarded—poetical works of greater pretension, which were once considered as master-pieces of genius and inspiration, have fallen into neglect; but this poem by the boy Campbell remains a universal favourite. It is not too much to say that it is, without any exception, the finest didactic poem in the English language. Even those who are not admirers of didactic poetry are forced to admit its charm; and the uttermost objection that criticism can make appears to be a certain vagueness, which, after all, is inseparable from the nature of the subject, and the necessary plan of the composition. The delicacy of the thoughts, the beauty of the imagery, the occasional power of pathos, the extraordinary felicity of the language, and the wonderful harmony of the versification, distinguish the *Pleasures of Hope* from any poem which has been written before or since, and entitle it to a very high place as an original work of genius. It is as original, and characteristic of its author, as is the *Deserted Village* of Goldsmith, with which it has been frequently, but surely improperly compared. Goldsmith's poem affects us by its simplicity and truth. Campbell's, it must be owned, is much more florid and ornamented; but how exquisite is the taste of the ornament!

The literary and the private histories of an author are inseparable. In order to comprehend the one we must have recourse to the other. The first success of Campbell brought him fame, but not fortune. He had disposed of the copyright of the *Pleasures of Hope*, by his original bargain with the publishers, for a sum certainly moderate, which, however, probably exceeded his expectations at the time. He was, moreover, very kindly treated, for he received a considerable unstipulated allowance for each new edition, which circumstance ought to have deterred him from uttering certain diatribes against "the trade," in which he was afterwards rather prone to indulge. The fact is that he did not know how to make use of his success. Instead of availing himself of the reputation which he had so worthily and decisively won, and applying himself to a new effort, he went abroad without any determinate aim; was perfectly wretched on the Continent, where he had no friends, and was sorely embarrassed for want of means; and began to write fugitive poetry for the London journals. On his return to Britain he had ample opportunity of bettering his condition. With a name such as his, a moderate amount of exertion would have secured him not only a competency but comparative affluence; but indolence, perhaps the result of timidity, had grown upon him. Campbell never could adapt himself even to the profession of literature, which, precarious though it be, is not without its prizes. In that profession, as in all others, the requisites for success are steadiness, punctuality, and perseverance; but Campbell possessed none of them. The publishers were ready, and offered to give him lucrative employment, nor was he at all backward in accepting their offers; but when the period for performance arrived he had literally done nothing. In extraordinary contrast to him stands Scott, who seemed simply to will in order to conceive and execute. Campbell had many bright conceptions, but he could not apply himself to the work. Of course he lost repute with the men who alone can intervene between an author and the public, and "the fathers of the Row" became chary of offering him engagements. Some idea of the extent of his habitual indolence may be formed from the fact, that the publication of his *Specimens of the British Poets* did not take place until thirteen years after the work was undertaken!

In the meantime Campbell married; and his prospects were of the darkest, when, in 1805, he received a government pension of L.200. He was then in great distress, and even that aid, material as it was, failed to extricate him. It was probably fortunate for his fame that such was the case, for in 1809 he published his poem of *Gertrude of Wyoming*, to which were attached the most celebrated of his grand and powerful lyrics.

Among Campbell's lengthier poems, *Gertrude of Wyoming* must hold the second place. He designed it for a poem of action, but he has failed to give it that interest and vivacity which a poem of action requires. There is in it too decided a predominance of the sentimental vein, and an extreme degree of elaboration, which, in poetry as in painting, is hurtful to the general effect. There is great truth in the following criticism, which occurs in a letter from Jeffrey to the author: "Your timidity or fastidiousness, or some other knavish quality, will not let you give your conceptions glowing, and bold, and powerful, as they present themselves; but you must chasten, and refine, and soften them, forsooth, till half their nature and grandeur is chiselled away from them. Believe me, the world will never know how truly you are a great and original poet till you venture to cast before it some of the rough pearls of your fancy." In spite of these defects, *Gertrude* was considered at the time as a work in every way worthy of the poet's previous reputation; and it will ever be admired by that numerous class of readers who are more fascinated by the beauties of expression than by high inventive power and vigorous execution.

The soundness of the above criticism, proceeding from an eminent literary authority whose own leanings were rather towards than against fastidiousness in composition, is demonstrated by the universal admiration accorded to Campbell's lyrical pieces. One or two of these, in particular *Lochiel's Warning* and *Hohenlinden*, are to be referred to an earlier period than the composition of *Gertrude;* but there are others of a later date which show how much power remained in the man when he chose to exert it freely. There are few lyrics in the English language to be placed in comparison with the *Mariners of England* or *The Battle of the Baltic;* and his exquisite poem of *O'Connor's Child*, which has not unaptly been termed the diamond of his casket of gems, is greatly superior in pathos and passion to his more elaborate compositions. All these, and others scarcely inferior to them, seem to have been struck off at a heat, and to have escaped that chiselling process to which Jeffrey so pointedly referred.

Campbell was now settled at Sydenham in England, and

his circumstances were materially improved. His home was a happy one; the society in which he moved was of the most refined and intellectual character; and he enjoyed the personal friendship of many of his distinguished contemporaries. Ample leisure was afforded him to carry into effect any of the cherished schemes of his literary ambition; but his indolence and inherent want of resolution again interfered. His most note-worthy exertion for years appears to have been the preparation of a short course of lectures on poetry, which he delivered with great *eclat* at the Royal Institution in London, and elsewhere. It appears that at one time it was proposed by his friends, and especially by Sir Walter Scott, that he should become a candidate for the occupancy of a literary chair in the University of Edinburgh; but he shrunk from the idea of undertaking so serious a labour as is involved in the preparation of a thorough academical course. In 1820 he accepted the editorship of the *New Monthly Magazine*, and acted in that capacity for a considerable period, until he resigned it to take charge of the *Metropolitan*. His connection with periodical literature may have been advantageous in a pecuniary point of view, but did not tend materially to enhance his reputation. His was not the pen of the ready writer; and it must ever be regretted that he was induced to bestow so much attention upon merely ephemeral literature, to the sacrifice of the nobler aims which were expected from his acknowledged genius. In 1824 he published his *Theodric*, a poem which, in spite of some fine passages, was generally considered as a failure. With *Theodric* his poetical career may be said to have closed. At times he put forth short poems of various degrees of merit, but none of them were equal to the grand lyrics already treasured in the memory of his countrymen. It seemed as if a large portion of the old virtue had departed from him; and his last published poem, the *Pilgrim of Glencoe*, showed hardly any marks of his former accomplishment and power.

In fact it appeared that the rich mine of poetry had been worked out. Without actually adopting that conclusion, we may observe that Campbell had latterly occupied himself most zealously with matters which were apart from his earlier pursuits. In the first place he took an active share in the institution of the London University, and it was mainly through his exertions that it was saved from becoming a mere sectarian college. Shortly afterwards, in 1826, he was elected Lord Rector of the University of Glasgow, an event which he considered as the crowning honour of his life, and which certainly was a mark of distinction of which any man might have been proud. He did not accept the office as a mere sinecure, but applied himself to discharge the actual duties (which, through the negligence of former rectors, had been allowed to fall into abeyance) with a zeal and energy which made entire conquest of the hearts of his youthful constituents. In 1831, the year in which the gallant struggle of the Poles for their independence was terminated by entire defeat, Campbell, who in his earliest poem had referred in such beautiful language to the shameful partition of Poland, more than revived his youthful enthusiasm for her cause. He had watched with an anxiety almost bordering on fanaticism the progress of the patriotic movement; and the news of the capture of Warsaw by the Russians affected him as if it had been the deepest of personal calamities. "His heart," says his biographer, "was in the subject of Poland; he could neither write nor speak upon any other with common patience; and if a word was dropt in company that did not harmonize with his feelings, he was very apt to consider it as a personal offence." In one of his own letters he says—"I know that my zeal for Poland has put me half mad." And again—"It is still all that I can do to support a tolerable cheerfulness before these kind hospitable people, for Poland preys on my heart night and day. It is sometimes a relief to me to weep in secret, and I do weep long and bitterly." Nor did he show his sympathy by words alone, but by resolute and continued action. He was the founder of the association in London of the Friends of Poland, which not only served to maintain the strong interest felt by the British people for the Polish cause, but was the means of providing assistance and giving employment to large numbers of the unfortunate exiles who were driven to seek refuge in this country. Never, till his dying day, did he relax his exertions in their behalf; and many an unhappy wanderer, who, but for unexpected aid, might have perished in the streets of a foreign city, had reason to bless the name of Thomas Campbell.

The remainder of his life presents few features of interest. Domestic calamity had overtaken him. His wife, whom he loved affectionately, had been taken from him—of his two sons, one died in infancy, and the other was afflicted by an incurable malady. His own health became impaired. He gradually withdrew from public life, and died at Boulogne on 15th July 1844, at the age of sixty-seven. His last hours were soothed by the affectionate care of his relatives and friends; nor did his countrymen forget the poet in his death, for his remains were solemnly interred in Westminster Abbey, with the honours of a public funeral.

Few poets of reputation, whose span has been extended nearly to the threescore and ten allotted years, have written so little as Campbell: at the same time it must be confessed that there are fewer still whose works are likely to be prized by posterity in the like proportion with his. If we throw out of consideration altogether *Theodric*—though some might demur to such an excision—if we overlook the *Pilgrim of Glencoe*, and weed from his lyrical garden such plants as have little charm either from their colour or their fragrance, there will still remain a mass of poetry familiar to the ear and the heart, such as hardly any other writer of this century has been able to produce. We may regret that Campbell was not more diligent in the cultivation of his poetical genius—that he did not apply himself more sedulously in his earlier years to some serious effort—and that he allowed other pursuits and designs to interfere with his peculiar calling. But who can venture to say what success might have attended his efforts had he acted otherwise than he did? We blame the poet for apparent indolence, not reflecting that inspiration is not to be commanded at will. It is not only possible but easy for the man who is practised in versification to write a certain given number of lines within a certain specified time; but genuine poetry never was and never will be the product of Egyptian taskwork. It cannot be produced to order—it must be spontaneous; and its quality must depend entirely upon the mood of mind under which it is composed. The greater part of the poetry or rather the verse of Southey, a considerable portion of that of Scott, and a vast deal of that of Wordsworth, was not conceived or written under the poetic impulse. On such occasions these celebrated men were writing verse, as they might have written prose, without enthusiasm or anything like the feeling of passion: and although their ordinary thoughts were far higher, bolder, and more subtle than those of the million, they still were not attempting to rise beyond their ordinary intellectual level. One can see at a glance when they were inspired, and when they were merely versifying. Of the poets who adorned the first half of the present century, Coleridge and Campbell were conspicuous for their abstinence in writing except under the influence of real emotion. Of the former it may be said that he has hardly penned a line of mere mechanical verse—the latter did not do so until his inspiration seemed to have abandoned him. Undoubtedly, however—to have recourse to a hackneyed, though by no means an unmeaning phrase—it is the duty of the poet to woo the muse, not to wait for her courtship. He must seek for the

waters of Castaly, not tarry till they are conveyed to him; and it is in this respect probably that Campbell principally erred. He did not sufficiently endeavour to awake his genius; he was too much a dreamer; and may at times have lost his opportunity from the sheer weight of indolence. And yet, considering the value of the legacy he has left, we have no reason to complain. Critics may dispute regarding the comparative merits of his longer works; and, as they incline towards didactic or narrative poetry, may prefer the one composition to the other. Both are entitled to high praise and honour, but it is on his lyrics that the future reputation of Campbell must principally rest. They have taken their place, never to be disturbed, in the popular heart; and, until the language in which they are written perishes, they are certain to endure. (W. E. A.)

CAMPBELTOWN, a royal burgh and seaport of Scotland, Argyllshire, situated on an indentation of the coast near the southern extremity of the peninsula of Cantyre. The inlet of the sea, which forms an excellent harbour, is about 2 miles in length by 1 in breadth, and has from 6 to 15 fathoms water. The registered vessels belonging to the ports at 31st December 1852, were 21 sailing vessels of 1252 tons, and 2 steam vessels of 259 tons. During that year 752 sailing vessels of 21,512 tons, and 342 steam vessels of 44,619 tons entered; and 341 sailing vessels of 8645 tons, and 339 steam vessels of 43,954 tons left. It is supposed to be a place of considerable antiquity, though no memorial of this exists except a flat stone cross on which are a variety of figures in relief and an inscription, but no date. Popular tradition, however, has assigned it to the twelfth century. It was brought from Icolmkill, and is now elevated on a pedestal in the market-place. Prior to 1700 Campbeltown was a mere fishing village, but was then erected into a royal burgh through the interest of the Argyll family, from whom it derived its name. The parliamentary boundaries are very extensive, including the entire parish, which had in 1851 a pop. of 6880. It unites with Ayr, Irvine, Inverary, and Oban, in returning a member to parliament. The town is governed by a provost and 17 councillors. There are distilleries in the town and neighbourhood, and its whisky is much esteemed. Many of the inhabitants are engaged in the fisheries and coasting trade.

CAMPDEN-CHIPPING, a market-town of England, county of Gloucester, 24 miles N.E. of the town of Gloucester, and 90 miles from London. It is situated in a well-wooded valley, and consists of one long street, with some fine old buildings, among which are the market-house, court-house, grammar-school, which has an exhibition at Pembroke College, Oxford, and a beautiful Gothic church. Pop. of parish (1851) 2351.

CAMPEACHY, or CAMPECHE, a fortified town of Mexico, in the province of Yucatan, is situated on a bay to which it gives name, on the west coast of the peninsula. When first taken by the Spaniards it contained about 3000 houses, and had considerable monuments of Indian art and industry. It has often been stormed and taken by English and French bucaneers, and has also suffered severely from other marauders. The town is generally well-built, the houses being of stone, with some substantial public edifices, including several churches and convents, a theatre, museum, college, &c. The port is large, but shallow. It is the centre of a large trade in log-wood, and exports considerable quantities of wax and cotton. The population of the town amounts to about 9000. W. Long. 90. 31., N. Lat. 19. 51.

CAMPER, PETER, a celebrated naturalist and anatomist, born at Leyden, May 11, 1722. His family had long held distinguished situations in the magistracy of that city. His father, Florent Camper, a Protestant clergyman, was an enthusiastic admirer of painting, and a great patron of artists; and was intimate with several of the learned men who adorned the university of Leyden at that time, especially Boerhaave.

Under circumstances that afforded him so many advantages, young Camper applied himself at an early age to drawing and painting, in which he soon became remarkably proficient.

He was indebted to Laborde for his first lessons in geometry, and was instructed in natural philosophy by Muschenbroeck and Gravesande. At Leyden university he became the pupil of Gaubius, Van Rooyen, and the elder Albinus; and in 1746 he took the degree of doctor in philosophy and medicine, on which occasion he published two dissertations, the one *De Visu*, the other *De Oculi quibusdam Partibus*. In the first he illustrates and defends Smith's *Theory of Vision*, and in the latter describes, with plates, Petit's *Canal in the Eyes of different Animals*.

After the death of his parents, which happened in 1748, Camper visited London, where he made the acquaintance of Mead, Pringle, and Pitcairn. He pursued his medical studies under Hunter, Sharp, Smellie, and Winchester; and diligently examined the cabinets of Hans Sloane and Collinson, and the collections of Hill and Catesby. He studied botany under Elliot, astronomy under Short, and the use of the microscope under Baker. He also directed his attention to the mechanical arts; visiting the principal manufactories, and collecting instructions from artists of eminence in every department, including even naval architecture. He was in the habit of making minutes of everything he saw and learned; and his facility with the pencil enabled him to take sketches of every object of which a delineation could be useful. He still cultivated his taste for painting, and acquired much practical skill in the art of engraving. After remaining about a year in London, and visiting the universities of Oxford and Cambridge, he proceeded to Paris, where he inspected the principal public establishments in that capital. He then proceeded to Lyons and Geneva, when having received intelligence of his being appointed professor in philosophy, medicine, and surgery, at Franeker, he returned to Holland by Switzerland and the banks of the Rhine, visiting as he passed through Basle the great Bernouilli, and examining in the library of that city the writings of Erasmus and the paintings of Holbein. The itinerary which he kept of his journey contains a great number of valuable remarks on agriculture and geology, and shows how well he was gifted with the talent for observation.

In consequence of a severe illness he was obliged to defer entering upon the duties of his professorship till the autumn of 1750. On this occasion he pronounced a public inaugural discourse, *De Mundo Optimo*. About the same period he was elected a fellow of the Royal Society of London.

He again visited England in 1752, and resumed his favourite pursuits with unabated ardour. Among other objects, his attention was much directed to the method of inoculating for the smallpox, the practice of which was as yet confined to England. On his return to Franeker he resumed his lectures, and gained such increasing celebrity that he was soon ranked as one of the ablest men of science in Holland. In 1755 he was appointed professor of anatomy and surgery at the Athenæum of Amsterdam, and settled in that city. According to custom, he pronounced two inaugural discourses, the first, *De Anatomes in omnibus Scientiis usu;* and the second, *De Certo in Medicina*. In 1756 he married the widow of the burgomaster of Harlingen.

After continuing six years in Amsterdam, he resigned his chair, and retired to his country house at Franeker. His principal work during the time he had held that chair was the first volume of his *Demonstrationes Anatomico-Pathologicæ*, the second volume of which appeared in 1762.

Having, two years afterwards, been elected professor of medicine, surgery, and anatomy, at Groningen, he took up his abode in that city, and at his inauguration as professor

Camper. delivered a discourse *De admirabili analogia inter Stirpes et Animalia*. Under his auspices was established a society for the purpose of conducting experiments in agriculture. To this society Camper was nominated secretary. He bestowed much pains in investigating the nature of an epidemic disorder which prevailed extensively among the cattle of Holland. He made this the subject of several lectures which he read in 1796 to the academy of Groningen; and his proposed method of disarming the disease of its virulence by inoculation appears to have effectually succeeded where adopted. At this period he also made a variety of important discoveries in comparative anatomy.

After ten years spent at Groningen, he was induced to remove to Franeker, that he might superintend the education of his sons, who were to be placed at the academy in that place. In 1776, the death of his wife, in whom his affections had been centred during a union of twenty years, determined him to seek in travel some alleviation of his sorrow. After visiting all the cities that offered objects of attraction in the sciences or the fine arts, he proceeded to Paris, where he enjoyed the society of Franklin, Marmontel, Diderot, Daubenton, Portal, and other distinguished men. Returning to his own country with recruited spirits, he applied himself with fresh ardour to his favourite pursuits; and aiming at more comprehensive views of the animal kingdom, occupied himself in pursuing the analogies which connect its several departments, and in tracing the successive links of that extended chain by which the different orders of beings are united in one continued series of gradation. A tour through Germany, at a later period, made him acquainted with many treasures in natural history, with which that country abounds. The anatomical preparations of Kerkringius, and the observatory of Tycho Brahe at Hamburg, the collections of natural history of Taube and Desrogues at Zell, and the superb cabinet of antiquities of the Count Walmoden at Hanover, particularly attracted his attention; and he explored with the eye of a geologist the volcanic district of Cassel. He formed also the acquaintance of Zimmerman, Soemmerring, and other eminent physicians. The following year he visited Prussia, and was presented to the great Frederick, who received him at Potsdam with much affability and respect; and on his return he had the honour of spending two days with the brother of the king, Prince Henry of Prussia, at Rheinsberg.

In 1785 Camper was chosen member of the Royal Academy of Sciences at Paris; and in the same year he paid a fourth visit to England.

His literary and philosophical occupations did not preclude him from taking an active part in the political concerns of his country. In 1762 he was returned as deputy in the assembly of the province of Friesland; and in 1776 he appeared there as deputy for Idaarderadeel. In 1783, on the recommendation of the stadtholder, he was nominated one of the council of state of the United Provinces, and was of course obliged to reside at the Hague. During the revolution he remained faithfully attached to the party of the stadtholder. Camper died of a violent pleurisy, on the 7th of April 1789; and his remains were deposited in the church of St Peter at Leyden.

To a mind enriched with vast stores of knowledge, and adorned with a taste at once elegant and refined, Camper united the most benevolent affections, and possessed all the virtues of domestic and social life. Nature had bestowed upon him a dignified and graceful form, and a remarkably animated and expressive countenance. He spoke fluently Latin, English, French, and German, and had a competent knowledge of Greek and Italian.

Besides the honorary distinctions already mentioned, Camper was member of the academies of Petersburg, Berlin, Edinburgh, Manchester, Toulouse, Göttingen, Haarlem, Rotterdam, and Flushing; and was foreign associate of the Royal Society of Medicine at Paris. He obtained the prize of the academy of Haarlem for his *Memoir on the Physical Education of Children*. His *Researches on Specific Remedies* gained him the prize of the Academy of Sciences of Dijon; his *Observations on Inoculation* that of the Academy of Toulouse; and his *Memoir on Chronic Diseases of the Chest* that of the Academy of Lyons. The Royal Academy of Surgery voted him three prizes for his *Memoirs on the Influence of Different Circumstances in Regimen on the Treatment of Surgical Diseases*. Of Camper's numerous works, the most important only can be noticed here. His principal labours were bestowed on comparative anatomy and physiology, and his discoveries in this wide field of research are numerous and important. A posthumous collection of his works on these subjects appeared at Paris in 1803, in 3 vols. 8vo, with a folio atlas of plates, under the title of *Œuvres de Pierre Camper, qui ont pour objet l'Histoire Naturelle, la Physiologie, et l'Anatomie Comparée;* to which is prefixed an Essay on his Life and Writings by his son, and two eulogiums, one by Vicq d'Azyr, and the other by Condorcet. They contain his *Dissection and Natural History of the Orang-outang, and other Species of Apes*. He examines especially the peculiarities in the structure of the organ of voice of those animals, which deprive them of the power of uttering articulate sounds, and which alone would place an immense interval between them and the human species. His anatomical description of the two-horned rhinoceros, of the rein-deer, and of the elephant, are the subjects of separate dissertations; as also his researches on the structure of the great bones of birds, and the manner in which atmospherical air is introduced into them (a fact which was discovered by Camper prior to the time at which Hunter published his observations on it); on the structure of the porpoise and the whale; on the classification of fishes according to the system of Linnæus; on the anatomical structure of the organs of hearing in fishes, and of the blowing-holes of the *cetacea;* on the *dugon* of Buffon, and the *sirena lacertina* of Linnæus, both of which he pronounces to belong to the class of fishes; on the generation of the *pipa* or American toad; on the croaking of the male frog; on the petrifactions found in the mountain of St Peter near Maestricht, and the fossil bones of fish and other animals; on the analogies that may be traced between the several parts of the animal kingdom, especially in the structure of the human species compared with those of quadrupeds, birds, and fishes; on the alteration of form in the human species produced by age; on the diversity of features which characterize different nations, and the mode of expressing these differences in delineating the human figure; on the mode in which the passions are indicated by the countenance; on the *beau physique*, or the beauty of forms; and on the analogy between plants and animals. In the practical branches of medicine he has written observations on the inoculation of the smallpox, founded on experiment; on the theory and treatment of chronic diseases of the lungs, and a historical inquiry into the principal methods of cure employed by the ancients and moderns in these disorders; on the nature, employment, and mode of operation of remedies termed specifics; on the nature, causes, and treatment of dropsy, and the different indications of cure derived from the symptoms; on the nature of cancer, and on the signs denoting those of the breast that do not admit of cure; on the herniæ incident to new-born children, &c.; on ulcers in the urethra and prolapsus ani; on the fracture of the patella; on the callus of fractured bones; on lithotomy, and especially on the method of performing that operation at two different times, according to the plan of the celebrated Franco; on the construction of bandages for herniæ; on bandages in general; on the abuse of ointments and plasters in the treatment of ulcers, and on improved methods of managing them; on the noxious effects attending the admission of air into the body, and the influence of this principle on the treatment of surgical diseases. In the department of midwifery he has written a letter to Dr Van Gescher on the utility of the section of the *symphysis pubis* in severe labours, and observations on the use of the lever of Roonhuysen in difficult parturition. Several memoirs on the subject of infanticide, and the juridical questions connected with that subject, were published by him at Leeuwarden. (P. M. R.)

Camperdown ‖ Camphor.

CAMPERDOWN, a village of Holland, province of North Holland, 27 miles N.W. of Amsterdam. Off this place Admiral Duncan gained a great naval victory over the Dutch under Admiral de Winter, Oct. 11, 1797.

CAMPHOR, a concrete essential oil, or *stearoptine*, obtained from vegetables. Two kinds are known in commerce. The well-known common camphor is obtained in the East by the distillation of the roots and branches of the *Laurus camphora*. Small quantities of it are found in the wood of the tree in a solid state. The second kind was

till lately little known in Europe. It is found in cavities in the stem of a large Bornean forest tree, *Dryobalanops camphora*. This sort has a slightly alliaceous odour mixed with that of camphor, occurs in small grains, and is highly valued by the Chinese, who give for it 100 times the price which they give for ordinary camphor. A tree of full size will yield, it is said, from 11 to 22 pounds avoirdupois of that camphor; but it causes the total destruction of the tree, which does not produce this substance until it has attained a large size. See CHEMISTRY, and *Index*.

CAMPIAN, EDMUND, a celebrated English Jesuit, born of indigent parents at London in 1540. From Christ's Hospital he removed to Oxford University, where he took a degree. He was admitted to holy orders in the English Church, and held the respondency of the philosophical act at St Mary's Church. When at school he had been selected to make an oration before Queen Mary on her accession, and now when at college he did the same before Queen Elizabeth. On leaving college he went to Ireland, where he wrote the history of that country, and joined the Church of Rome. Betraying too great zeal in proselytizing to his new faith, he drew down on himself the suspicions of the government, and was committed to prison; but soon after escaped to the Low Countries, when he settled at Douay, and passed his novitiate as member of the Society of Jesus. After residing for a short time at Brune, Vienna, and Prague, where he taught philosophy and rhetoric, he was sent by Gregory XIII., along with Father Parsons, on a propagandist mission to England. Scarcely had he arrived in England in 1581, and entered on his duties by challenging the universities and clergy to dispute with him, when at the instance of Secretary Walshingham he was apprehended along with Parsons and two other agents at Lyford in Berks, and thrown into the Tower, on a charge of having excited the people to rebellion, and holding treasonable correspondence with the foreign powers. Having been found guilty, he was condemned to death, and executed at Tyburn, Dec. 1, 1581, with several others of his order. He is admitted to have been a man of great abilities, an eloquent orator, a subtle philosopher, and able diplomatist; and he is praised by all writers, whether Protestant or Popish, not only for his talents and acquirements, but likewise for the amiableness of his disposition. Besides the History of Ireland already mentioned, he wrote a *Chronologia Universalis; Conferences at the Tower*, 4to, 1583; *Narratio de Divortio; Orationes; Epistolæ Variæ;* and *De Imitatione Rhetorica.*

CAMPIDOCTORES, officers who drilled the Roman soldiery.

CAMPILLO DE ARENAS, a village in the district of Jaen, Seville, Spain. It was the scene of a battle gained by the French over the Spaniards in 1823. Pop. 1121.

CAMPITÆ, an appellation of the Donatists, from their assembling in the fields. For a similar reason they were sometimes called *Montenses* and *Rupitani.*

CAMPLI, a town of Italy, in the Neapolitan province of Abruzzo-Ulteriore, five miles north of Teramo. It has a cathedral, an abbey, several churches and convents, and 6200 inhabitants.

CAMPOBASSO, a city of Italy, the capital of the province Molise, 53 miles N.N.E. of Naples. It is situated on the ascent of a high mountain, around which it forms a kind of amphitheatre. It is fortified, and contains two churches, with 7660 inhabitants, who are employed chiefly in making cutlery ware. It is in a fertile district, and has a considerable export trade in corn.

CAMPO DE CRIPTANA, a small town in the province of Ciudad Real, New Castile, Spain. Its principal trade is in the agricultural produce of the district, and the coarse woollen stuffs manufactured in the town. Pop. 5230.

CAMPO FORMIO, a town of Italy, in the delegation of Udine, in Austrian Lombardy, containing 1500 inhabitants. Here, on 17th October 1797, peace was concluded between France and Austria.

CAMPOMANES, PEDRO RODRIQUEZ, CONDE DE, a celebrated Spanish statesman and writer, born in the Asturias about 1710. His grand objects seem to have been to stimulate the industry and education of the people of Spain; and while president of the council of Castile, and director of the Royal Academy of History, he was distinguished by forwarding to the utmost those two important objects, which had been sadly neglected for ages by Spanish statesmen. His transcendent abilities, his learning, and patriotic efforts are highly praised by Townsend and other intelligent travellers who visited Spain from 1780 to 1788. From 1788 to 1793 he was president of the council of Castile; but on the accession of Charles IV. he was removed from his office, and retired from public life, regretted by the true friends of his country. His first work was literary, *Antiquidad Maritima de la Republica de Cartago*, with an appendix containing a translation of the *Voyage of Hanno* the Carthaginian, with curious notes. This appeared in a quarto volume in 1756. His principal works are two admirable essays, *Discurso sobre el Fomento de la Industria Popular*, 1774, and *Discurso sobre la Educacion Popular de los Artesanos y su Fomento*, 1775. As a supplement to the last, he published four appendices, each considerably larger than the original essay. The first contains reflections on the origin of the decay of arts and manufactures in Spain during the last century: the second points out the steps necessary for improving the old manufactures, or of reestablishing them, with a curious collection of royal ordinances and rescripts regarding the encouragement of arts and manufactures, and the introduction of foreign raw materials; the third treats of the guild laws of artizans, contrasted with the results of Spanish legislation and municipal ordinances of towns; the fourth contains eight essays of Francisco Martinez de Mata, on national commerce, with some observations adapted to present circumstances. These were all printed at Madrid in 1774 and 1777 in 5 volumes in 8vo, which then corresponded with the size of our 12mo, as appears from a copy which had been presented by the illustrious author, now in the possession of the writer of this article. Count Campomanes died in 1802. (T. S. T.)

CAMPSIE, a village and parish of Scotland, in the county of Stirling, situated on the banks of the Kelvin, 9 miles from Glasgow. Bleaching, printing, and the manufacture of cotton are extensively carried on here. North of the village are the Campsie Falls, a range of hills rising to the height of 1500 feet. Pop. of parish, including Lennoxtown, &c. (1851) 6918. The population of the village and parish amounted in 1821 to 4927; in 1831 to 5109.

CAMPUS, in antiquity, a field or vacant space in a city for shows, combats, exercises, and other uses.

CAMPUS *Mail*, an anniversary assemblage of our ancestors, held on May-day, when they confederated for the defence of the kingdom against its enemies.

CAMPUS *Martius*, a large plain in the suburbs of ancient Rome, lying between the Quirinal and Capitoline Mounts and the Tiber, and so called because it was consecrated to Mars, and set apart for military sports and exercises. Here also the comitia of the centuries were held, and races were run either with chariots or single horses; and here also stood the villa publica, or palace for the reception of ambassadors, who were not permitted to enter the city. The place was also nobly decorated with statues, arches, columns, porticoes, &c. It was included within the city walls by Aurelian.

CAMPUS Sceleratus, a place beyond the walls of ancient Rome, where unchaste vestals were buried alive. (Liv. viii. 15.)

CAMROOP. See ASSAM.

CAMUS, Charles Stephen Louis, a mathematician and mechanician, born at Cressy en Brie, near Meaux, the 25th August 1699, son of Stephen Camus, a surgeon of that town, and Margaret Maillard.

His taste for practical mechanics was very early demonstrated by a singular ingenuity in the construction of a variety of little machines with which he amused himself; and he soon felt so strongly the value of mathematical studies, that he urged his parents to find the means of sending him to a school where he might apply to them. In compliance with his wishes, he was placed, when he was little more than ten years old, at the College de Navarre in Paris; and in two years he acquired knowledge enough to become an instructor of others, and to relieve his friends from all further expense in his education. He was assisted in the pursuit of the higher departments of the mathematics by the celebrated M. Varignon; and he particularly applied himself to civil and military architecture, and to astronomy.

The first result of his studies that was destined for the public eye, was an essay *On the Masts of Ships*, a subject which had been proposed in 1727 as a prize question by the Academy of Sciences. This essay was received with considerable approbation, and was inserted in the second volume of the *Collection of Prize Memoirs*. Shortly after, the author was made an adjunct or sub-associate of the academy, in the department of mechanics.

In 1728 he brought forward a memoir on the *Living Force* of bodies in motion, in which he concludes, from considering the action of springs and other similar powers, that its true measure is the product of the mass into the square of the velocity, as Leibnitz maintained; this product being also proportional to that of the force into the space through which it acts, while the momentum is proportional to the force and the time conjointly. In December 1730 M. Camus was appointed professor of geometry to the Academy of Architecture, and a few years afterwards he became secretary to the same body.

The *Memoirs of the Academy* for 1732 contain a short paper on a *Problem proposed by M. Cramer*, respecting the determination of two curves bearing a particular relation to each other. It was the custom of the age to consider exercises of this sort as trials of strength, to which it was incumbent on all geometricians to submit, for the honour of the countries in which they lived, and of the societies to which they belonged. The author was elevated in 1733 to the rank of an associate of the academy, together with Clairaut, over whom he even obtained some advantage in the ballot.

He communicated to the academy, in the same year, a valuable paper on the *Teeth of Wheels*. La Hire had already laid the foundation of the investigation on its true basis, and had pointed out the use of different epicycloidal curves for the forms of the teeth of wheels in different circumstances; and M. Camus in this essay enters into some further inquiries, particularly with regard to the best proportions for the length of the teeth, and the comparative diameters of the wheels; a discussion for which his intimate acquaintance with the art of the clockmaker made him particularly well qualified. In 1736 he accompanied Maupertuis and Clairaut in the expedition to Lapland, for the measurement of a degree of the meridian; and he was enabled to render them very essential service, not only as a geometrician and an astronomer, but also by his skill in various departments of the mechanical arts, which became particularly valuable in so remote a situation.

M. Camus directed his attention in 1738 to the well known but interesting mechanical phenomenon of a *pistol ball piercing an open door* without causing any very sensible motion in the door, and published a paper on the subject in the *Memoirs of the Academy*. He justly observes, that the effect of any force depends, not only on its magnitude, but also on the time for which it operates; and that though the impulse of the ball must tend to carry the door before it with a force paramount to the resistance which it opposes to the ball, yet the time of the action of this force is too short to produce a sensible effect on the whole mass of the door. In 1739 he presented to the academy two hydraulic memoirs, the one on *Water Buckets*, the other on *Pumps*. In the latter he investigates the diameter of a valve capable of transmitting the greatest quantity of water within a given barrel; a valve which is too large not being at liberty to rise to a sufficient height.

He inserted in the *Memoirs* for 1740 a confutation of a *Mechanical Fallacy*, which has misled many of the enthusiasts who have bewildered themselves in the search of a perpetual motion; demonstrating that when a number of weights are caused to descend, in any imaginable paths, at a greater distance from the centre of a wheel than they ascend, the number of the weights descending at any one time must always be smaller than those of the weights ascending, and in such a proportion as perfectly to compensate for the mechanical advantage apparently gained by the greater distance. In the following year he was received into the number of the academicians in the department of geometry, on occasion of the resignation of M. Fontenelle. He published also, in the *Memoirs* for 1741, an account of a *Gauging Rule* for measuring barrels of different forms, by simple inspection of the logarithmic scales engraved on it, observing only some easy rules for their adjustment, according to the general nature of the solid. In 1746 he presented a report, in conjunction with M. Hellot, on the *Length of the Standard Ell*, which was thought worthy of being inserted in the collection of the academy.

We find among the *Memoirs* for 1747 an essay of M. Camus on the *Tangents of Curves* having several branches crossing each other, which frequently require for their determination the use of fluxions of the higher orders, the first fluxions of the absciss and ordinate vanishing together. M. Saurin had before given a similar solution of the problem, but had not attempted to explain the metaphysical ground upon which the apparent paradox is reconciled to the general principles of the differential method.

M. Camus also assisted in several determinations and reports which were referred at various times to committees of the academy; and particularly in the remeasurement of M. Picard's base from Villejuif to Juvisy, which was performed by eight members, and recorded in the *Memoirs* for 1754.

The latter years of his life were much occupied in various engagements connected with the offices of examiner in the schools of the Royal Engineers and in that of the Artillery, to which he was nominated by the king. He undertook, for the advantage of the students in these schools, the laborious task of reducing into a uniform system a complete course of mathematical study, in which the geometrical method was as much as possible observed, and which is considered as highly creditable to his talents and exertions; it was entitled *Cours des Mathématiques*, 4 vols. 8vo. 14. He also published an *Elementary work on Arithmetic*.

In person M. Camus was tall; his countenance was agreeable; his manners were firm, and occasionally somewhat warm; but he was far from being either morose or vindictive. He was elected a foreign member of the Royal Society of London in January 1764. He married, in 1733, Mademoiselle M. A. M. Fourrier, and had four daughters, the eldest of whom was married to M. Pagin; the others died young. His last illness was supposed to have originated from a cold taken in a professional journey during the hard winter of 1766, and to have been aggravated by affliction for the loss of his surviving daughter. He died a few months after her, on the 4th of May 1768. He left a variety of manuscripts, demonstrative of his habitual dili-

gence and of the extent of his researches; but not deemed of sufficient importance to meet the hazards of posthumous publication. (*Hist. Acad. Par.* 1768, p. 144.) (T. Y.)

CAMUS, *Jean Pierre*, bishop of Bellay, was born at Paris in 1582. He wrote a great number of pious romances adapted to the taste of his time, and other theological works. His definition of politics is remarkakle—*Ars non tam regendi quam fallendi homines*, the art not so much of governing as of deceiving mankind. He was an exemplary prelate, and distinguished for the zeal with which he attacked the abuses of his time. He died in 1652. Moreri has given a large catalogue of his works.

CAMWOOD, a red dyewood imported from Western Africa. See DYEING.

CANA, a town of Galilee, not far from Capernaum, where Christ performed his first miracle by turning water into wine. Cana is not mentioned in the Old Testament. It has been identified with the modern Kefr Kenna, a small village about four miles N.E. from Nazareth, where there are the remains of an ancient Greek church.

CANAAN, son of Ham and grandson of Noah. The transgressions of his father Ham (Gen. ix. 22–27), to which some suppose Canaan to have been in some way a party, gave occasion to Noah to pronounce that doom on the descendants of Canaan which was, perhaps, at that moment made known to him by one of those extemporaneous inspirations with which the patriarchal fathers appear in other instances to have been favoured. That there is no just ground for the conclusion that the descendants of Canaan were cursed as an immediate consequence of the transgression of Ham, is shown by Professor Bush, who in his *Notes on Genesis* has fairly met the difficulties on the subject.

CANAAN, *Land of*, was the ancient name of that portion of Palestine which lay to the west of the Jordan; the part beyond the Jordan eastward being distinguished by the general name of Gilead. Canaan included both those districts known amongst the Greeks and Romans as Philistia and Phœnicia; and was inhabited by the descendants of Canaan, from whom it took its name. From being promised to Abraham and his seed, it was known beforehand to the patriarchs as the Land of Promise; and when it came to be possessed by the Jews, it went successively under the names the Land of Israel, the Land of Judah, and the Holy Land. For their idolatry seven distinct Canaanitish tribes were given over to the Israelites to be annihilated; but some of them seem to have escaped and incorporated themselves with the invaders, while according to tradition others fled and emigrated to the coast of Africa. In St Athanasius's time the Africans still pretended they were descended from the Canaanites; and it is said that the Punic tongue was almost entirely the same with the Canaanitish and Hebrew languages. The colonies which Cadmus carried into Thebes in Bœotia, and his brother Cilix into Cilicia, appear to have sprung from the stock of Canaan; and the isles of Sicily, Sardinia, Malta, Cyprus, Corfu, Majorca and Minorca, Gades, and Ebusus, are also supposed to have been peopled by the Canaanites. Besides those seven nations which were put to the sword, there were other tribes of Canaanitish origin scattered along the coast of Tyre and Sidon, who were not driven out by the children of Israel; and hence this tract seems to have retained the name of Canaan long after those other parts of the country, which were inhabited by the Israelites, had lost that appellation. The Greeks called the tract along the Mediterranean, inhabited by the old Canaanites, Phœnicia; and the more inland parts, inhabited partly by Canaanites and partly by Syrians, Syrophœnicia; and hence the woman said by St Matthew to be a woman of Canaan is said by St Mark to be a Syrophœnician by nation, as she was a Greek by religion and language. See PALESTINE.

CANADA.

THIS extensive tract of country, and most important colony of England, may be described as a great belt of territory stretching from the centre of North America to the shores of Labrador, and from the waters which flow into the Northern Ocean to the parallel of Pennsylvania, in the United States. Its extent from east to west is computed at about 1400 miles, and from north to south at from 200 to 400 miles. Its precise geographical limits are between the parallels of 41. 71. and 50. N. Lat., and between the meridian of 57. 50. and 117. W. Long.[1]

General Description.

Canada, lying diagonally along the frontier of the United States, from N.E. to S.W., and possessing an inland navigation along its entire border, in a series of lakes and rivers unrivalled for extent and grandeur, has, especially of late years, been making such rapid progress, that it promises soon to become, in conjunction with its sister British provinces, a power of first-class importance, commercially and politically. The entire surface of the present territory of Canada, exclusive of its great waters, has been estimated at 196,000,000 acres, or between two and three times the size of Great Britain and Ireland.

This country, formerly divided into two provinces known as Upper and Lower Canada, was in 1841 by an act of the imperial parliament constituted one province with one legislature. Although now united, however, for legislative and other purposes, the country will most probably continue to be viewed and spoken of under its formerly recognised divisions of Upper and Lower Canada.

Canada may be said to comprise one vast valley through which the great river St Lawrence takes its course, issuing from Lake Superior and flowing successively through Lakes Huron, Erie, and Ontario, until it falls into the ocean after a course of 2000 miles. This immense valley is on each side encompassed by different mountain ranges, sometimes nearly approaching the water, and at other times receding into the interior, and thus forming extensive plains, for the most part alluvial, and suitable for nearly every description of produce. The high table-land along the northern boundary of this valley separates the streams which take their rise within it and flow into its basin from those that take their rise in the almost unknown territory beyond, and which fall into Hudson's Bay. The high land along the southern boundary of the valley separates the streams which flow northwards into its basin, from those that have their course southwards towards the Atlantic and Mississippi.

Northern shore of the St Lawrence.

Commencing at the northern shore of the St Lawrence, towards the mouth of that river, where the width is 90 miles, we find one of the walls of this vast valley which constitutes Canada rising boldly in mountainous form, close to the river, and continuing thus to form its rugged bank for upwards

[1] Bouchette's *British Dominions in North America*, Lond. 1832; *Report to the Senate of the United States*, by Israel D. Andrews, United States Consul for Canada, &c. Washington, 1853.

Canada.

of 100 miles. One of the most remarkable of the heights of this northern bank is Cape Tourment, overhanging the very brink of the river, and somewhat preparing the voyager for the still bolder and more magnificent grandeur of Cape Diamond, the Gibraltar of America, which rises to a height of 400 feet, and is crowned by the citadel of Quebec.

City of Quebec.

The city of Quebec, here clinging around the rocky steeps of Cape Diamond, and overlooking one of the most magnificent harbours in the world, is situate on the northern bank of the St Lawrence, and about 400 miles from the mouth of that river. The view from the citadel presents on every side a country with features of peculiar and striking grandeur. Immediately opposite Quebec, the St Lawrence contracts to about half a mile in width, with bold rocky banks on either side. The northern or Cape Diamond side, being much the bolder of the two, commands a view of the wide stretch of table-land extending beyond the southern bank, the vast plains presenting for leagues upon leagues their dark masses of forest, with houses and cultivated fields interspersed, until the distant mountains of the states of Maine and Vermont bound the view. The northern shore presents a wilder and more rugged aspect. From the heights of Cape Diamond, the spectator surveys bold ranges of hills fringing the northern horizon, and forming the boundaries of almost unexplored territories beyond.

About 30 miles below Quebec is Cape Tourment, to which in our upward progress we had traced the rocky northern bank of the river. Here the ridge, taking a direction W.S.W., terminates on the river Ottawa, about 120 miles above its confluence with the St Lawrence, thus extending westward from Cape Tourment along the course of the St Lawrence about 300 miles. The tract of country lying between this ridge and the St Lawrence, which may be estimated at from 15 to 30 miles in breadth, is beautifully picturesque, well watered, level, and fertile. This portion of Canada, stretching along the northern shore of the river, from below Quebec upwards to Montreal, a distance of about 200 miles, and thence along the banks of the beautiful Ottawa may be considered, especially towards its upper and western extremity, one of the choicest parts of the country.

The territory lying beyond this ridge is intersected by another and higher range of mountains, which runs into the interior in a N.W. direction, at the distance of about 200 miles from the other, and forms the watershed beween the tributary streams of the St Lawrence and those that fall into Hudson's Bay. This territory may be said to be only one great wilderness of forest, whose solitudes are as yet unexplored, and only occasionally tracked by wandering hunters.

South shore of the St Lawrence.

Glancing at the south shore of the St Lawrence, a ridge commences nearly 100 miles below Quebec, which, passing upwards in a S.W. direction, opposite that city, at a distance of 30 miles from the river, crosses the boundary line between Canada and the United States, and finally slopes down to the river Hudson. Beyond this ridge, at about the distance of 50 miles, is another and a higher one, which commences at Cape Rozière, the bold headland at the mouth of the St Lawrence, and, running for about 400 miles in a direction nearly parallel with the river and with the other chain, terminates upon the eastern branch of the river Connecticut. This forms the dividing ridge between the tributary streams of the St Lawrence, and those which flow towards the Atlantic Ocean, and separates a portion of Canada from the territory of the United States.

The general character of the country along this south side of the river, from Cape Rozière upwards, to within about 100 miles of Quebec, where the lesser ridge commences, is somewhat rugged and mountainous; but there are many fertile parts near the river which are populous and well cultivated. On the south side of this main ridge, down to the shores of Gaspé and Chaleur Bay, the country is mountainous, but interspersed with level and fertile spots, some of which are under cultivation, especially along the coast, where the inhabitants are principally dependent on the fisheries. The country for 100 miles below Quebec, and extending to the river Chaudière, a few miles above that city, has much of the broken and hilly character which it has further down the river, but with extensive tracts of excellent land.

This portion, as well as for a distance of above 100 miles further down along the banks of the river, is a succession of settlements. Between Quebec and the lower ridge of mountain-land already mentioned, the country presents a fertile plain, broken by a few insulated hills covered with trees to their summits. It is well settled, and a considerable portion of the land cultivated.

Country above Quebec.

The country above Quebec, along the south side of the St Lawrence, to the line 45. of N. Lat. (which is the southern boundary of Lower Canada), may be characterized as one extensive and fertile plain, in parts agreeably broken and undulating. Much of it is covered with populous and prosperous settlements. As it lies contiguous to the United States, and embraces some of the principal points of communication between the two territories, it is at present, and bids fair to continue to be, the most flourishing portion of this lower division of Canada.

City and Island of Montreal.

The city and island of Montreal, situated in Lower Canada, and immediately below the confluence of the river Ottawa with the St Lawrence, may be said to form the chief connecting link between the lower and upper provinces. Being about 180 miles above Quebec, and Quebec being itself about 400 miles up the river, Montreal is thus situated nearly 600 miles in the interior of Canada.

"The banks of the St Lawrence are here presented stretched out into smiling plains of most luxuriant appearance, in midst of which, and forming a main feature, is the garden-island of Montreal—producing grain and fruit, especially some description of the latter, in perhaps greater perfection than in any other part of the country. The size of this island is 32 miles in length and about ten in breadth, upon which is situated the city, covering above one thousand acres—with its quaint mixture of English, American, and old French architecture, in its streets, shops, English, American, and Scotch churches, French cathedrals and spires, and ancient convents. Rising from, and forming a sheltering background to the city on the north, is 'The Mountain,' as it is called, thickly wooded to the summit—an elevation of between 500 and 600 feet, commanding a magnificent view of the picturesque and luxuriant country around, the expanse of the St Lawrence, and the bold mountain scenery in the distance. Along the substantially-built stone wharfs skirting the south of the town, and towards the broadest channel of the river, lie throngs of ships, barges, and steam-vessels, loading and unloading the natural products of the interior, and the manufactures and other merchandise of Britain. Montreal, situated about 600 miles up the St Lawrence, forms the head of navigation for the large class of ocean vessels, and is the main point at which the produce of the interior arrives, in steam-boats, screw-propellers, and barges, for reshipment on board of the Atlantic vessels." [1]

Ocean vessels may now, however, by recent improvements of the internal navigation upwards through the great lakes, proceed with their cargoes many hundreds of miles further into the interior; thus opening up to Canada not only the

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[1] *Views of Canada and the Colonists*, by J. B. Brown; 2d Ed., Edinburgh, 1851; chap. ii. p. 18.

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fertile regions of her own most westerly districts, but the famous Far West of the United States, stretching even to the territories of the Mississippi; and it may be at no remote period to the yet distant shores of the Pacific.

Upper Canada.

We have now briefly to describe the leading features of Upper Canada. This division of the country, commencing about 80 miles up the St Lawrence from Montreal, upon the north side of the river, extends for about 100 miles further along this shore of the river to the city of Kingston, at the foot of Lake Ontario, and thence along the north shores of the great lakes Ontario, Erie, St Clair, Huron, and Superior, with their connecting rivers or straits, and stretching to the head waters of the streams which flow into Lake Superior. This great stretch of territory, with its almost unsurpassed extent of inland coast navigation, extends from 74. 30. to 117. W. Long.

The grand course of navigable waters directly inland through Canada, by the St Lawrence and great lakes, may be safely stated to exceed 2000 miles. The coast of the lakes alone has been estimated at upwards of 5000 miles.[1] The shores of this great valley, through which these waters take their course, embrace a country which has been styled "the garden of North America." It has already in our own day presented an increase in population, and in agricultural and commercial wealth, so wonderfully rapid as to be unprecedented in history.

Upper Canada, thus so favourably situated—comprehending one side of the entire upper portion of the great valley of the St Lawrence—is bounded on the south by the territories of the United States, on the north by the Hudson's Bay territory, and on the east by Lower Canada, while to the west extends that vast tract of country within British dominion, but as yet in a comparatively primeval state, and most generally known hitherto as the north-west Indian territory.

That portion of Upper Canada which has been set apart and divided for settlement, extends from its extreme eastern point, where it leaves Lower Canada, 80 miles above Montreal, and reaches along the northern shore of the St Lawrence, and upwards along the lakes to the shores of Lake Huron,—a direct course of about 700 miles. This breadth of settled country towards the north may be said to vary from 50 to 80 miles. Throughout the whole of this tract the soil is excellent, and is not surpassed by any other part of the American continent. It consists, generally speaking, of a fine dark loam, mixed with a vegetable mould, but it is in a great measure so varied as to present soils adapted to almost every species of produce.

From the commencement of Upper Canada to the head of the Bay of Quinte, on Lake Ontario, the land is spread out into an almost uniform level of great beauty, which rises only a few feet from the banks of the St Lawrence. It is in every direction well watered by numerous streams, which are generally navigable for boats and canoes, and at the same time present the most desirable situations for the erection of machinery.

Farther into the interior, along the course of the great stream of the Ottawa, which flows into the St Lawrence a short distance above Montreal, and between the Ottawa and Lake Ontario, the face of the country—which we have noticed as being spread out into a plain so attractive—is, in parts, here diversified by ridges and bold heights, and also by numerous streams and inland lakes. The Rideau canal, a work constructed by the imperial government for military purposes, passing through this part of the interior, from the town of Bytown, on the Ottawa, 120 miles above Montreal, through the country to Kingston—a distance of 135 miles—is almost one continued chain of natural lakes and streams. The chief link of these waters is Rideau lake, 24 miles in length, forming the summit level of the canal, and being 280 feet above the level of the Ottawa river, and 150 feet above Lake Ontario.

Lake Ontario.

Lake Ontario, which receives the waters of the upper lakes from the Niagara river, and discharges them into the St Lawrence, nearly 800 miles from the mouth of that river, may be said to be the first link in our upward progress of the chain of great lakes which so distinguish Canada, and confer upon the country unsurpassed means of internal communication. The height of this lake above the sea is 232 feet. It is 180 miles in length, 50 miles in breadth, and 470 miles in circumference. While the shores of this lake present the most populous and prosperous parts of Canada, the lake itself is believed to be the safest of the three lower lakes for the purposes of navigation. It possesses several excellent harbours; and from its great depth of 500 feet, compared with the two lakes above it, it is not so easily moved by storms as Lake Erie, while it is quite exempt from the shallows, or *flats*, as they are called, of Lake St Clair.

There are several pretty large islands scattered over the lower extremity of Lake Ontario, one of which, Amherst island, is about 10 miles in length and 6 in breadth. One of the most fertile and beautiful portions of this lake is the magnificent inlet of the Bay of Quinte, commencing near the city of Kingston, at the foot of the lake, and forming a spacious indentation of about 70 miles to the mouths of the rivers Trent and Moira. The shores of this bay are more diversified and pleasing in their features than those of the great lake itself, whose Indian name, "Ontario," signifies the Beautiful. Lake Ontario is never frozen over, and throughout winter steam-boats frequently run across the upper part of the lake from Toronto to Niagara when the weather is fine.[2]

All along the north shore of Lake Ontario, a distance of 180 miles, one extensive fertile plain presents itself, now and then agreeably sloping to the very edge of the lake, and bearing evidences of successful cultivation and progress. Several thriving towns are growing up rapidly along the shores of Ontario, the chief of which are Kingston at the foot of the lake, Toronto 35 miles from the head, and Hamilton at the extreme head. Toronto, which is very finely situated, spreading over a wide and gently rising plateau, and in a protected part of the lake shore, is the largest city of Upper Canada. The generally level stretch of well-cultivated plain which forms this northern shore of Lake Ontario is only partially broken by an inconsiderable ridge which runs through it, and which, coursing around the head of the lake, and crossing into the United States at the Falls of Niagara, forms the commencement of the extensive and fertile table-land which stretches westward from Lake Ontario, and, situated between Lakes Erie and Huron, forms the great western peninsula of Upper Canada.

Peninsula of Upper Canada.

The eastern boundary of this peninsula, thus situated between these three great lakes, is the neck of land of 36 miles between the shores of Lake Ontario, at Toronto, and Lake Simcoe, which communicates by means of the River Severn with the Georgian Bay on Lake Huron.

The settled parts of this great peninsula embrace about one-half of the settled parts of Upper Canada; and it is estimated to have at present a cultivated surface equal to about a fourth part of the cultivated surface of Scotland. This settled and partially occupied portion of the peninsula contains upwards of 9,000,000 acres. The entire district has been styled "the Garden of Upper Canada."

"I am delighted to have seen this part of the country," said the late Lord Sydenham, in recording his impressions to a

[1] *Prize Essay on the Canals of Canada*, by Thomas C. Keefer, C.E. Toronto, 1850.

[2] *Canadian Gazetteer*. By William H. Smith. Toronto, 1849, p. 95.

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friend, after having visited this district in the course of a tour which he performed in the capacity of governor-general of Canada, in the autumn of 1840—"I am delighted to have seen this part of the country; I mean the great district, nearly as large as Ireland, placed between the three lakes—Erie, Ontario, and Huron. You can conceive nothing finer! The most magnificent soil in the world—four feet of vegetable mould—a climate certainly the best in North America—the greater part of it admirably watered. In a word, there is land enough and capabilities enough for some millions of people, and in one of the finest provinces in the world."[1]

City of Hamilton.

Hamilton, situated at the extreme head of Lake Ontario, between 500 and 600 miles above Quebec, and nearly 1000 miles into the interior of Canada from the mouth of the St Lawrence, is the chief port of this valuable country westward. Its situation is commodious and picturesque, being at the head of a fine bay, locked in by a strip of land from the main lake, with the exception of a navigable passage for steam and sailing vessels. Immediately behind the town rise the agreeably wooded heights which form the commencement of the great and fertile table-land stretching westward.

The view from this elevation, called Burlington Heights, is one of the finest in Western Canada. The expanse of the waters of Ontario, surrounded by its wooded shores, speckled with towns and farm-settlements, spread themselves in panoramic view under the eye of the spectator; while stretching into the interior, northward, is the mass of primeval forest, almost in every direction broken by cultivated openings, with farms and rising villages. Clustering around the level shores of the bay beneath, and along the slopes, and in the wooded nooks of the picturesque eminence, are the many elegant residences and rows of wide streets of the young and prosperous city of Hamilton.

Following the chain of waters westward, the traveller approaches the Niagara river, 33 miles long, connecting Lakes Ontario and Erie. The town of Niagara is situated near the mouth of the river; and the small village of Queenston at the foot of the table-land which stretches westward, is about four miles further up. Queenston is about nine miles from the celebrated falls, and about 20 miles from Lake Erie. The scenery along both the United States and Canada sides of this beautiful river or strait, not to speak of its one stupendous feature, presents much both of grandeur and picturesque beauty.

Falls of Niagara.

Yet all is subsidiary to that one mass of falling waters, suggesting the idea of the great bed of the broad river having given way beneath their weight, and seeming to batter in vain upon the more solid rocks beneath to which they descend. The troubled and broken sheet of river assuming in its descent one mass of raging foam, and pouring down with incessant roar, whitening the entire stretch of precipice from bank to bank—presents a scene of unequalled grandeur and sublimity. Yet amid its features of stupendous magnificence, the interest of Niagara is heightened by noting others of calm and softest beauty. In all its turmoil may be noted the soft bow of the varied coloured iris resting in the sun beams, amid the light ascending spray, and that spray falling again, sprinkling the green fresh foliage which clings around the overhanging rocky cliffs. And not less striking to the observer of the great scene are the ever-playful eddies of the waters far beneath, laving the edges of the pebbled shore. There all is roar and turmoil—here, close by, soft and playful repose.

This great fall, which has been celebrated by all travellers as one of the greatest wonders of nature, is occasioned by the configuration of the country, which is one vast plain, extending from the Ohio and Lake Erie westward beyond the Mississippi, and eastward to the Allegany mountains. This plain, after passing Lake Erie to the north, rapidly descends 340 feet to another plain, in the level of which lies Lake Ontario; and it is from the higher level of Lake Erie that the river Niagara is precipitated with such tremendous violence into the plain below. The rock over which the Niagara falls is in the form of an irregular semicircle about three-quarters of a mile in extent. The river is here divided into two by Goat Island, the lower extremity of which is perpendicular, and in a line with the rock over which the water is precipitated. The cataract on the Canada side is called the Horse-Shoe, from its peculiar form, or the Great Fall; and the other, towards the south shore of the river, the American Fall.

Sir Charles Lyell, in his journal of a tour in North America in 1841–2, presents a very interesting and detailed account of these celebrated falls; and his very valuable geological observations are enhanced by excellent coloured illustrations.

Sir Charles Lyell on the Recession of the Falls.

"It has long been a favourite subject of discussion," observes Sir Charles Lyell, "whether the falls were once situated seven miles north, further down the river, at the village of Queenston. Here the descent from the platform, in a depression of which Lake Erie is situated, to the lower level of 330 feet of Lake Ontario, is sudden and abrupt.

"The strata throughout this whole region," continues Sir Charles, "are nearly horizontal, but they have a gentle dip to the south of 25 feet in a mile. This inclination is sufficient to cause the different groups of rock to crop out one from beneath the other, or to come up to the surface in parallel zones, which may be traced for a great distance east and west through the state of New York and Canada. They all consist of different members of the Silurian series, the uppermost or newest being those nearest to Lake Erie. The Niagara is bounded by low banks, where it issues from Lake Erie, and varies in width from one to three miles. It here resembles a prolongation of the tranquil lake, being interspersed with low wooded islands. This lake-like scenery continues for about 15 miles, during which the fall of the river scarce exceeds as many feet, but on reaching the rapids it descends over a bed of limestone about 80 feet in less than a mile, and is then thrown down about 165 perpendicularly at the falls. The largest of these, called the Horse-Shoe Fall, is 1800 feet, or more than a third of a mile broad, the island in the middle somewhat less in width, and the American Fall about 600 feet wide. The deep narrow chasm below the great cataract is from 200 to 400 yards wide, and 300 feet deep; and here in seven miles the river descends 100 feet, at the end of which it emerges from the gorge into the open and flat country, so nearly on a level with Lake Ontario, that there is only a fall of about four feet in the seven additional miles which intervene between Queenston and the lake. The great ravine is winding, and makes a turn nearly at right angles to itself at the whirlpool where the Niagara sweeps round a large circular basin. At some points the boundary cliffs are undermined on one side by the impetuous stream, but there is usually a talus at the base of the precipice supporting a very ornamental fringe of trees.

It has long been a popular belief, from a mere cursory inspection of the district, that the Niagara once flowed in a shallow valley across the whole platform from the present site of the falls to the Queenston heights, where it was supposed the cataract was first situated, and that the river has been slowly eating its way backwards through the rocks for a distance of seven miles. According to this hypothesis the falls must have had originally nearly twice their present height, and must have been always diminishing in grandeur from age to age, as they will continue to do in future, so long as the retrograde movement is prolonged. It becomes, therefore, a matter of no small interest and curiosity to inquire at what rate the work of excavation is now going on, and thus to obtain a measure for calculating how many thousands of years or centuries have been required to hollow out the chasm already excavated.

It is an ascertained fact, that the falls do not remain absolutely stationary at the same point of space, and that they have

[1] *Memoir of the Life of Lord Sydenham.* Lond., 1843.

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shifted their position slightly during the last half century. Every observer will also be convinced that the small portion of the great ravine which has been eroded within the memory of man is so precisely identical in character with the whole gorge for seven miles below, that the river supplies an adequate cause for executing the task assigned to it, provided we grant sufficient time for its completion.

The waters, after cutting through strata of limestone, about 50 feet thick in the rapids, descend perpendicularly at the falls over another mass of limestone about 90 feet thick, beneath which lie soft shales of equal thickness, continually undermined by the action of the spray driven violently by gusts of wind against the base of the precipice. In consequence of this disintegration, portions of the incumbent rock are left unsupported and tumble down from time to time, so that the cataract is made to proceed southwards. The sudden descent of huge rocky fragments of the undermined limestone at the Horse-Shoe Fall in 1828, and another at the American Fall in 1818, are said to have shaken the adjacent country like an earthquake. According to the statement of our guide in 1841, Samuel Hooker, an indentation of about 40 feet has been produced in the middle of the ledge of limestone at the lesser fall since the year 1815, so that it has begun to assume the shape of a crescent, while within the same period, the Horse-Shoe Fall has been altered so as less to deserve its name. Goat Island has lost several acres in area in the last four years, and I have no doubt that this waste neither is, nor has been, a mere temporary accident, since I found that the same recession was in progress in various other waterfalls, which I visited with Mr Hall, in the State of New York. Some of these intersect the same rocks as the Niagara—for example the Genesee at Rochester; others are cutting their way through newer formations, as Allan's Creek, below Le Roy, or the Genesee at its upper falls at Portage. Mr Bakewell calculated that in the forty years preceding 1830, the Niagara had been going back at the rate of about a yard annually, but I conceive that one foot per year would be a much more probable conjecture, in which case 35,000 years would have been required for the retreat of the falls from the escarpment of Queenston to their present site, if we could assume that the retrograde movement had been uniform throughout. This, however, could not have been the case, as at every step in the process of excavation the height of the precipices, the hardness of the materials at its base, and the quantity of fallen matter to be removed, must have varied. At some points it may have receded much faster than at present, at others much slower, and it would be scarcely possible to decide whether its average progress has been more or less rapid than now.

Unfortunately our historical evidence of the former condition of the cataract is meagre and scanty in the extreme. Sixty years ago the whole district between Lakes Erie and Ontario was a wilderness in which the Indian hunter chased the bear and the buffalo.[1]

Future Retrocession of the Falls.

In regard to the future retrocession of the falls, Sir Charles Lyell observes, that when they have travelled back two miles, the massive limestone now at the top of the falls will then be at their base; and its great hardness may then perhaps effectually stop the excavating process, if it should not have been previously arrested by the descent of large masses of the same rock from the cliff above. It will also appear that the falls will continually diminish in height, and should they ever reach Lake Erie, they will intersect entirely different strata from those over which they are now thrown.

Impressions of the Falls.

The first impressions of Sir Charles Lyell, like those of many others, were not what he expected, but closer intercourse, as most usually is the case, in time rewarded him by the great scene revealing itself in its true grandeur. "We first came in sight of the Falls of Niagara when they were about three miles distant. The sun was shining full upon them—no building in view—nothing but the green wood, the falling waters, and the white foam. At that moment they appeared to me more beautiful than I had expected, and less grand; but after several days, when I had enjoyed a nearer view of the two cataracts, had listened to their thundering sound, and gazed on them for hours from above and below, and had watched the river foaming over the rapids, then plunging headlong into the dark pool, and when I had explored the delightful island which divides the falls, where the solitude of the ancient forest is still unbroken, I at last learned by degrees to comprehend the wonders of the scene, and to feel its full magnificence."[2]

The falls are most frequently viewed from a jutting shelf of the rock, called Table Rock, on the British side, which is on a level with the edge of the cataract; but the grandeur of the spectacle is still more striking on the same side, below the falls, at the bottom, the descent to which is partly down the less steep part of the bank, and partly by a spiral ladder, from the bottom of which a kind of path leads, among rocks and under the precipitous banks, to the crescent or great Horse-Shoe Fall. "Here," says Mr Macgregor, in his work on British America, "we have the grand outlet of these great lakes, which contain nearly half of all the fresh waters on our globe, thundering over a terrific precipice, having for a short distance a smooth green surface, but quickly raging in impetuous, broken, foaming, grandeur, as it hurls into the vast unfathomable abyss below." The precipice over which the cataract rolls projects about fifty feet beyond its base, and hence the waters descend in the form of a crescent, within which it is customary for travellers to enter thirty or forty yards. Mr Weld, who visited Niagara in 1796, was among the first travellers who ventured under the cataract, and to within six yards of the sheet of water which rushes into the gulf below. Captain Hall also took his station under the cataract; and both travellers experienced the greatest inconvenience, and even some risk, from the violent tempest and whirlwind which always rages at the bottom of the cataract, arising from the air carried down by the cascade, and forced under the water, rising up again in tremendous gusts, and driving upward incessant deluges of the spray.[3]

The appearance of Niagara, and the surrounding country, has been very greatly changed by the progress of cultivation. There are several excellent hotels near the falls, the windows of which command a view of the cataract. At the village of Manchester, on the United States side, mills, forges, trip-hammers, &c., are erected close to the rapids, which turn the wheels of the mills and forges; and thus some portion of the scenery has exchanged its original character of wildness and grandeur for the softer aspect of civilized life.

Lake Erie.

Having now parted from Niagara, we pass to the shores of Lake Erie. The obstruction to navigation caused by the Falls of Niagara is obviated by the Welland canal, which cuts through the neck of land situated along the course of the Niagara river, and thus unites Lakes Ontario and Erie for the purposes of navigation. Lake Erie, which is situated 565 feet above the sea, and 333 feet above the level of Lake Ontario, is about 265 miles in length, from 30 to 60 miles in breadth, and between 600 and 700 miles in circumference. Its mean depth is 120 feet, being the shallowest of all the great lakes, and most easily frozen. Its waters are also, on account of its shallowness, more readily agitated by storms, causing its navigation to be therefore more dan-

[1] *Travels in North America*, by Charles Lyell, Esq., F.R.S. Lond., 1845, vol. i. chap. ii. p. 30–35.

[2] *Travels in North America*, vol. i. chap. ii. p. 27.

[3] For a more particular description of this fall, the reader is referred to Chateaubriand's *Recollections of America*, p. 184; Volney's *View of the Climate and Soil of America*, &c., chap. vi.; Weld's *Travels*, vol. ii. p. 123–9; Heriot's *Travels*; Howison's *Sketches of Upper Canada*, Letter vii. p. 91; Captain Hall's *Travels in North America*, vol. i. chap. vi.; Sir Charles Lyell's *Travels*, vol. i. chap. xi.; *Views of Canada and the Colonists*, 2d Edit. chap. iii.

Canada. gerous during stormy weather. Disasters, involving large loss of life and property, are not of unfrequent occurrence on this lake, toward the close of navigation, before the rigours of winter have put a final stop to all active lake traffic.

The shores of this lake present features very similar to those of Lake Ontario; the banks of Lake Erie being generally bolder and more elevated, and composed chiefly of clay and sand. The more fertile parts are at some distance from the banks, throughout the extensive plain of table-land beyond. There are several good natural harbours along the shore, formed chiefly by the mouths of deep creeks or streams, and protected from the action of storms and current of the lake by strong projecting piers. Among the harbours of Lake Erie may be mentioned Port Colborne, situated at the entrance to the Welland canal, at the foot of Lake Erie, and a little above the commencement of the Niagara river. A little further up is the harbour of Port Maitland, at the mouth of the Grand river. This is a very fine and capacious stream, navigable for small vessels a considerable distance, and possessing much fertile land and pleasing scenery along its banks. The shore of the lake for some way above the mouth of the Grand river presents many delightful and fertile settlements. Among the harbours further up the lake are Ports Dover, Burwell, and Stanley. Port Stanley is perhaps the most flourishing of these harbours, being the port of one of the most populous and enterprising districts of this part of Canada, and situated near the centre of the great fertile peninsula.

The banks of Lake Erie are here high, and of a sandy character; but off the immediate bank, and extending all the way through the extensive tract of country, to the town of Goderich, on Lake Huron, a distance of 85 miles, the soil is of the best quality, being for the most part timbered with beech, maple, black and white walnut, oak, ash, cherry, and other trees, indicating the first qualities of soil. The whole tract is greatly undulating in its appearance, and is everywhere well watered.

The upper part of Lake Erie is distinguished by many beautiful islands, the largest of which is Pele, on which there is a lighthouse, and several farms. The shores along the upper part of the lake, especially towards the mouth of the Detroit river, have a smiling and luxuriant aspect. Trees of the finest growth rise from the shore, and the wild vine may be seen twining and clustering among the branches of the lesser trees and tall shrubs along the sloping banks. The shore is here covered with fine white sand.

In our further progress up this country, we pass the Detroit river, thence into Lake St Clair, then the River St Clair, which last opens into the broad expanse of Lake Huron. From the head of Lake Erie to the foot of Lake Huron, is a distance of between 80 and 90 miles, through a country of unsurpassed fertility and luxuriance, and possessing many delightful features. The Detroit river, about 27 miles in length, is interspersed with many islands, several of which, near its entrance into Lake Erie, are beautifully wooded. The towns of Amherstburgh and Sandwich, and the small village of Windsor, are situated along the Canada side of this river. Opposite Windsor, towards the upper part of the river, and where the banks narrow to about three-quarters of a mile, is the American city of Detroit, in the state of Michigan.

Lake St Clair. Lake St Clair, which forms the connecting link, by means of the St Clair and Detroit rivers, between Lakes Huron, Michigan, and Erie, is the smallest of all the lakes, and exceedingly shallow for the larger class of vessels passing through it. It is from 20 to 30 miles in length, and about the same in breadth. Its average depth is about 20 feet, but the principal channel used by vessels passing through it is much shallower, especially in dry seasons, when the mud of its *flats* is stirred to the surface not unfrequently by large vessels. The chief stream which it receives from the Canadian shore is the River Thames, which is navigable for lake vessels 22 miles from its mouth, and the banks of which are exceedingly fertile, and mostly well settled. Much of the land bordering on the lake is low and marshy. In the upper part of the lake are several islands, the principal of which is Walpole island, about 10 miles long, and from 3 to 4 miles wide. This island is inhabited by a stray portion of the remnant of Indians still existing in small and decreasing numbers in Canada.

We are now at the entrance to the River St Clair, in length about 30 miles. There are several thriving settlements along the fertile and beautiful banks of this river. Towards the lower part, amid a cluster of wooded islands, the banks, with somewhat of a flat appearance, are covered with luxuriant timber. Farther up the land rises, with finely sloping banks and cultivated farms. Near the head of the river, and pleasantly situated, is the flourishing town of Sarnia.

The River St Clair now opens to the wide expanse of Lake Huron, of about 1000 miles in circumference. Lake Huron.

This vast sheet of inland sea is the second in point of size of the great lakes, yielding only in this respect to Lake Superior. The surface of Lake Huron is about 30 feet above the level of Lake Erie, and 595 feet above the level of the Atlantic. The length may be estimated at 250 miles, and its breadth 160 miles, inclusive of the Georgian bay, a large wing of the lake, extending along the north-eastern shore for a distance of about 100 miles. The mean depth of Lake Huron is 900 feet, and its greatest depth 1000 feet near the west shore.

This lake is said to contain the almost incredible number of 32,000 islands, principally along the northern shore and at the north-western end, varying in size from mere rocky reefs and pinnacles to large and cultivable islands. The Great Manitoulin, the longest of the islands, is upwards of 75 miles in length, and varies in width from 3 to 23 miles. The waters of the lake are remarkably pure, clear, and cold; in these respects resembling the great upper Lake Superior. The surface of Lake Huron is about 32 feet lower than that of Lake Superior, and it is very nearly as deep as that lake. The nature of the banks of Lake Huron vary very much. In parts they are low and sandy, in others formed of clay; they rise to a height of about 120 feet, while again the shore of this inland sea presents a bold, rocky, iron-bound coast, having great depth of water to the base. Numerous streams descend on all sides into the lake; and among its rivers may be mentioned the Maitland, Severn, and River Francais. The lake, which is rather subject to storms, is deficient in good natural harbours, the principal of which, along the eastern coast, are Goderich, at the mouth of the Maitland, Saugeen, and Penetanguishene; and on the western shore the best places of shelter in heavy weather are Thunder bay and Saginaw bay.

Lake Huron possesses the advantage of being remarkably centrically situated with respect to the other great lakes. With Lake Erie, as we have seen, it is connected by the straits or rivers St Clair and Detroit, and the small lake St Clair. Lake Ontario, the lower of the lakes, is even open to it by the river Severn, Lake Simcoe, then by a short portage, a chain of lakes, and Trent river. Lake Simcoe, thus situated between Lake Huron and Ontario, is a very beautiful lake about 30 miles in length and 20 in breadth. The neck of land south of Lake Simcoe from Holland river leading to Toronto is, it will be remembered, about 36 miles; and again, north of Lake Simcoe, from the narrows of this lake to Lake Huron, the postage is only about 14 miles. The new railway now cutting through this neck of the peninsula westward, situated between the lakes Erie, Ontario, and Huron, will greatly facilitate the growing intercourse between the shores of Ontario, as well as all the country lower down along the banks of the St Lawrence, and also great part of the United States,

Canada.

with the regions of the great upper lakes, Huron and Superior. This direct course will no doubt be much preferred to the circuitous route through Lakes Erie and St Clair, and the connecting rivers.

Lake Huron, besides, communicates with the Ottawa, and thence with the St Lawrence above Montreal, by means of French river, Lake Nipissing and the river Mattawa into the Ottawa. This is the route adopted generally by the north-west traders in proceeding to the remote parts of the country, and it is also the one by which Europeans first penetrated the West. The distance from Montreal by this route to Lake Huron is fully more than one-half shorter than that by the St Lawrence. From Montreal to the Georgian bay, the distance is estimated at 400 miles, while by the St Lawrence the distance is upwards of 1000 miles.[1] Again, Lake Huron communicates with the great upper Lake Superior by means of the river St Mary about 40 miles in length. Lastly, we have this centrically situated lake communicating by the straits of Mackinac with Lake Michigan, and thence by the Illinois river and canal with the Mississippi and Gulf of Mexico.

The shores of Lake Huron have of late revealed important mineral treasures. The Bruce copper mines promise to be of great value. These mines are situated upon the northern shore of the lake under the Cloche mountains, a bold range of hills extending about 40 miles along the coast.

Along the south-eastern shores of the lake, extending beyond the town and harbour of Goderich, on the River Maitland, are many highly prosperous settlements. The lands in this direction, and through the large and fine district inland, are believed to be the most fertile in Canada. The country is everywhere well watered, and enjoys much delightful scenery, both along the elevated banks of the lake, and the beautiful rivers which diversify it. The town of Goderich, on the River Maitland, is very agreeably situated, and possesses an excellent harbour. The high banks of the Maitland are exceedingly picturesque.

Lake Superior.

We now approach the uppermost of these vast collections of waters, not inappropriately named inland seas. The river or strait of St Mary, connecting Lake Huron with Lake Superior, is between 30 and 40 miles in length. The character of the scenery, on entering St Mary's Channel, is the most delightful that can be imagined. The channel throughout, with the exception of several small lakes, seems to be almost packed with islands; and while perplexing the navigator by its intricacy, it is every now and then revealing new and striking beauties of wooded heights and steep banks clothed with verdure, and spots of flat, fertile meadows, and, at times, bare, rocky, fantastic crags. The sides of the ridges of table-lands that skirt the country, around the borders of Lake Superior, appear in the distance clothed with one mass of lively green.

The foot of the Falls, or more properly speaking Rapids of St Mary, approach within about 18 miles of Lake Superior. The region in this direction seems much less fertile; the trees along the shores of the broad strait appearing to be chiefly of the pine species, and the soil in many parts light and sandy, while the lands close upon the banks lie for the most part low and flat. We now approach the chief seat of the great copper district of America, where the barrenness of a large portion of the country is richly compensated by the value of the metals with which it abounds. The copper mines of Canada, along the shores of Lakes Huron and Superior, are perhaps entitled to rank among the most valuable resources of this great country.

As we approach the great queen lake or inland sea, upwards of 400 miles in length and 130 in breadth, dark blue masses of hills uprise, somewhat reminding the voyager of the approaches to the St Lawrence in the forms of the headlands of Cape Rozière and others, yet being neither so high nor so bold as these. The main entrance to the lake is marked by two such rocky headlands, one upon either shore several miles apart. From the heights of the one on the other shore, named Gros Cap, composed of the rock of the old red sandstone, the sides of which are partially covered with junipers, blue bells, wild briars, and other vegetation, reminding one of the Scottish hills, we overlook a scene of the most imposing and still grandeur possible to be imagined. The dim distance into the lake is bounded by vast islands, and along both shores bold uneven banks uprise, apparently covered with dark dense foliage, and stretch themselves in irregular course, as far as the eye can reach, along the wide expanse of water that scarcely as yet presents any speck of navigation. The shores of Lake Superior, which are even now imperfectly explored, already prove to be abundant in mineral resources. Many of the enterprising inhabitants of Canada, having formed themselves into associations, are now engaged in mining the seemingly inexhaustible treasures of virgin copper which are found along the shores of this lake as well as Lake Huron. This source of wealth to the colony is likely to prove of considerable importance.

Lake Superior, which is the largest sheet of fresh water on the face of the globe, is the most remarkable of the great American lakes, not only from its magnitude, but also from the picturesque scenery of its borders, and the interest and value attaching to its geological features. "As a mining region," continues Dr Jackson, who, as United States geologist, was intrusted by his government to survey the territory, "it is one of the most important to this country, and is rich in veins of metallic copper and silver, as well as in the ores of those metals. At the present moment it may be regarded as the most valuable mining district in North America, with the exception only of the gold deposits of California.[2]

Coast of Lake Superior.

The whole coast of Lake Superior, we are informed by Dr Jackson, is rock-bound. Mountain masses of considerable elevation in some places rear themselves from the immediate shore, while steep precipices and frightful crags oppose themselves to the surges of the mighty lake, and threaten the unfortunate mariner who may be caught in a storm upon a lee shore with almost inevitable destruction. The northern or Canadian shore of the lake is the most precipitous, and consequently most dangerous to the navigator. Good harbours for vessels of moderate capacity are comparatively few, but there are abundance of coves or boat-harbours formed by the countless indentations of the rocky coast. In remarkable contrast to Lake Huron, which is thickly studded with islands, there are very few islands in Lake Superior.

Agriculture may be truly said to have not yet commenced to tame the great and comparatively unexplored wilderness around the shores of Lake Superior. The forests of stunted spruce and fir-trees along the immediate coast of the lake are said to afford a very inadequate idea of the agricultural resources of the shores of the great queen lake. The cold air from the lake, says Dr Jackson, affects only the vegetation near its shores, while further inland the temperature more resembles that of the settled parts of Canada. The native forest trees, and also the flowering plants, as well as the agricultural produce where clearings have been made, are believed to afford very satisfactory evidence on this

[1] Despatch from the Earl of Elgin, Governor-General, &c. Quebec, August 16, 1853.

[2] *Geology, Mineralogy, and Topography of the lands around Lake Superior*, by Charles T. Jackson, M.D., late United States Geologist, &c. Appended to I. D. Andrews' *Report on Colonial and Lake Trade to the Senate of the United States.*

Canada. point. The forests are filled with excellent timber for building purposes; the white and yellow pines, particularly, being of large dimensions. "The tributary rivers of Lake Superior are numerous," says Mr I. D. Andrews, in his very interesting report to the United States senate, "and, bringing down a large volume of water, afford superabundant water-power for manufactories, the most extensive in the world, though from their precipitous descents and numerous falls and chutes, they can never be rendered navigable for more than a few miles above their mouths except for canoes."[1]

The importance to Canada of the varied resources of the shores of the great lake, as well as its very valuable fisheries, cannot yet be fully appreciated. The mines, with their inexhaustible riches of silver and copper, were only discovered so lately as 1844; and although geological surveys have been made both by the United States and Canadian governments, yet much remains to be ascertained respecting this region. A ship and steamboat canal, on the United States side, now unites the upper and lower sections of the St Mary's River, by which vessels in transit between Lakes Huron and Superior may avoid the rapids between the latter and the lower waters. The uninterrupted navigation between the great queen lake and the rest of the vast chain of inland waters thus acquired, will not only materially facilitate the traffic of the mining associations, but will also rapidly develop this part of Canada, so rich in promise to the commercial interests of the country. The commerce of the vast region bordering on Lake Superior will thus be opened up, and to the already unrivalled inland navigation of about 1500 miles from tide-water at Quebec, will be added a further direct length of at least 500 miles, and a coast navigation around the shores of Superior of not less than 2000 miles.[2]

Climate and Seasons of Canada.

The severity of winter in Canada is very commonly much exaggerated in England. The thermometer in the dry, clear, bracing atmosphere of this colony is, to a certain extent, a rather imperfect guide to the inquirer accustomed to its ranges in the raw damp atmosphere of our own islands. Throughout the greater part of the winter season in Canada, the cold in the open air is by no means unpleasant.

During a comparatively few days only the degree of cold is uncomfortable. Persons who have resided in Canada not unfrequently observe that they have experienced more disagreeable sensations from the raw easterly winds of spring or autumn, while travelling in this country, than they have in the depth of winter in Canada, though travelling in an open sleigh. This fact of open sleighs being used throughout the whole winter, is one of the best proofs of the enjoyable nature of the climate. With good horses, and a well-beaten snow-path on the principal roads of the country, the exercise of sleigh-driving is most exhilarating. The horses with their tinkling bells on their necks, seem to participate as they bound along, in the enjoyment of the pure bracing atmosphere. Warm clothing and good heavy furs are all that are requisite to ensure complete comfort in an open sleigh, in the depth of winter in Canada.

The four coldest months of the year are November, December, January, and February. By observations made at Toronto and at Greenwich from 1840 to 1847 inclusive, the average quantity of snow at Toronto in November was very little over 2 inches. The average quantity of rain was a little over $3\frac{1}{4}$ inches. The average quantity of rain at Greenwich was not quite $3\frac{1}{4}$ inches. The mean temperature at Toronto in November was 35·50°; at Montreal, 32·36°; and at Greenwich, 44·57°. The mean highest temperature at Toronto was 56·26°; at Montreal, 59·25°; and at Greenwich, 59·59°. The mean lowest at Toronto was 12·21°; at Montreal, 7·75°; and at Greenwich, 26·50°. The colder nights and mornings in Canada, compared with England, have now set in, while the mean highest temperatures in both countries, so far as Upper Canada is concerned, differ only by about three degrees of the thermometer; and with regard to Lower Canada, the mean temperature at Montreal in November was almost precisely the same as in England in that month to a fraction of a degree. Another series of observations extending to eight years in Canada and four in England gave the mean highest temperature in November, in Upper Canada and England, at precisely the same. And with regard to Lower Canada, the mean highest temperature at Montreal in November was the same as in England during that month to a fraction of a degree.

Winter. In December, when winter has fairly commenced, the average quantity of snow at Toronto was 6 inches. The average quantity of rain was not quite $1\frac{3}{4}$ inches, and at Greenwich it was not quite 1 inch. The mean temperature at Toronto was 27·62°; at Montreal, 18·50°; and at Greenwich, 39·97°. The mean highest at Toronto was 45·71°; at Montreal, 42°, and at Greenwich, 54·43°. The mean lowest at Toronto was 0·18°; at Montreal, 10·75°, and at Greenwich, 24·94°.

The coldest month of the year in both countries, so far as the result of these observations go, which we have taken for our guidance—is the month of January. The mean temperature of this month at Toronto was 24·64°, and at Greenwich it was 37·79°. The mean highest temperature at Toronto was 45·79°, and at Greenwich, 52·83°. The mean lowest at Toronto was 5·12° and at Greenwich it was 20·97°. We have now for the first time the thermometer below zero at Toronto, to the the extent of a little over five degrees. At Montreal the mean lowest temperature for January was 15·50°, the mean temperature 18·58°, and the mean highest 42°. The average quantity of snow at Toronto in January was slightly over 13 inches. The average quantity of rain was not quite $2\frac{1}{2}$ inches; at Greenwich it was a little over $1\frac{1}{2}$ inch.

We now arrive at February, when the cold, according to our present data, has commenced to be less severe. Observations from another series of years might show the cold in February to be quite as great as in January, and perhaps more so, as it sometimes is in particular seasons. The winters in Canada, as in England, vary a good deal. Certain seasons are much more open and less severe than others. The months also differ at times in their general character. By the observations which we have now for our guidance, however, the difference in the mean lowest temperature between the two months of January and February is very slight. At Toronto, in February, the mean lowest temperature was 4·59°. At Montreal it was 13·50°. At Greenwich the mean lowest temperature was 17·70°. The mean temperature at Montreal was 13·32°, at Toronto, 24·21°, and at Greenwich, 37·06°. The mean highest temperature at Montreal was 40·25°, at Toronto 45·32°, and at Greenwich 53·70°. The average quantity of snow at Toronto in February was slightly over 21 inches. This month gives the greatest quantity of snow. The average quantity of rain in February was not quite 1 inch. At Greenwich it was slightly over $1\frac{1}{4}$ inch.

March now brings milder weather. The mean lowest temperature in this month at Montreal was 4·20°, and at Toronto it was 4·74°. At Greenwich it was 23·79°. The mean temperature at Montreal was 28·96°, and at Toronto 30·49°. At Greenwich the mean temperature was 42·20°. The mean highest temperature at Montreal was 57·40°, at Toronto 54·14°, and at Greenwich 61·84°. The average

[1] I. D. Andrews' *Report*, p. 231.

[2] *Report of the Commissioner of Public Works.* Quebec, August 1852.

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quantity of snow at Toronto was very little over 9 inches. The average quantity of rain was a little over $1\frac{1}{4}$ inch. At Greenwich the average quantity of rain in March was not quite 1 inch.[1]

Depth of Snow.

The depth of snow usually is from eighteen inches to two feet; the depth of frost in the ground from twelve to eighteen inches. The appearance of the snow is hailed with much pleasure, both as the means of enjoyment, and as affording facilities to the farmers for bringing their produce to market. The absence of good sleighing at any time during the winter season is universally considered a loss in limiting the means both of business and pleasure. The first snow, of any amount, very usually falls in Lower Canada about the beginning of December, and in Upper Canada about two or three weeks later. The months of January and February are the best for good steady sleighing. The season for this pastime lasts fully a month longer in Lower Canada than in the upper or western parts of the province. The more south-westerly parts of Upper Canada, such as along the shores of Lake Erie and the Detroit river, have the shortest winter of all, and least sleighing. The continuance of this amusement at any period of the season in Upper Canada is not much to be depended upon, on account of the rapid thaws which take place occasionally, causing the snow almost wholly to disappear in a day or two, under the influence of the warm south wind and the rays of the sun. The heaviest of these thaws in Upper Canada takes place, with periodical regularity, in the month of January, and is known as the January thaw. Sleighing continues with much greater steadiness in Lower Canada, where complete thaws less frequently occur. Snow finally disappears in Lower Canada about the middle of April; and in Upper Canada, especially the more western parts, about a month earlier. Then, under the influence of the genial south wind, all traces of winter rapidly disappear.

Spring.

Ploughing usually commences in Upper Canada about the middle of April. In the south-westerly parts of the country the period is a little earlier, and in the more easterly and northern districts, about a week or two later. Cattle are put out to graze from about the middle of April to the beginning of May. They are frequently at first turned into the woods, where they crop the tender growth, as the fields afford very little good pasture until after the 1st of May. The usual time for taking them into shelter, before winter commences, is about the middle of November. Harvest begins about the 1st of August.

Summer.

The luxuriance of early summer in Canada is gorgeous. With the pure atmosphere, and fertile soil, the forests rapidly assume all the freshness and beauty of their summer green.

During the month of June and the latter part of May nature is seen under the most delightful aspect. The days are seldom disagreeably warm. The really hot days are in the month of July. The weather then towards noon, and not unfrequently during the night, is oppressively hot, and very enervating; but this oppressive weather only continues a few days. The summers are somewhat hotter in Lower Canada than in Upper, just as the winters are longer and more severe in the lower or more northerly part of the province. The heats of summer, however, in Canada, have probably been as much exaggerated in England as the frosts and snows of winter.

The mean highest temperature at Montreal in May was 65·40°, at Toronto 77·16°, and at Greenwich 77·59°. We here observe how very closely the mean highest temperatures of England and Upper Canada in the month of May approach each other—a mere fraction of a degree of the thermometer of difference. The mean lowest at Montreal was 33·20°, at Toronto 39·08°, and at Greenwich 36·79°. The mean temperature at Montreal in May was 56·12°, at Toronto 52·59°, and at Greenwich 53·64°. The average quantity of rain at Toronto in May was not quite 2 inches. At Greenwich the quantity was a little over $1\frac{1}{2}$ inch.

In June the highest temperature at Montreal was 92·50°, at Toronto 83·80°, and at Greenwich 84·04°. We have here the highest temperature for the month of June in Upper Canada very much the same as in England. The mean temperature approaches still more closely in the two countries. In Upper Canada, at Toronto, it was 60·87°, and in England, at Greenwich, it was 60·03°. Lower Canada has warmer weather. The highest temperature in Lower Canada, at Montreal, in June, was 66·79°. The average quantity of rain in June at Toronto was nery nearly $3\frac{1}{2}$ inches. At Greenwich the quantity was a little over $2\frac{1}{4}$ inches.

The mean temperature of the month of July at Montreal was 71·36°; and at Toronto the mean temperature of the month of July was 66·12°. The mean temperature of July at Greenwich was 61·43°. The mean highest temperature at Montreal in July, was 97·90°; at Toronto, 88·28°; and at Greenwich, 85·37°. The mean lowest temperature at Montreal for July, was 53·25°; at Toronto, 42·86°; and at Greenwich, 45·80°. The average quantity of rain for July at Toronto, was 3·803 inches. At Greenwich for July the average was 2·049. The quantity of rain which falls at Greenwich, it may be observed, is understood to be less than the average for all England.[2]

Prevailing Winds.

The prevailing winds of Canada are the S.W., the N.E., and N.W. The S.W., which sweeps down the valley of the St Lawrence, over the rivers and great lakes, for about two-thirds of the summer season, carries with it a portion of the warmth of the region of the Gulf of Mexico and valley of the Mississippi. The N.E. wind is damp and chilly. The N.W. wind, which is most frequent in winter, is dry, cold, and elastic. The most sudden changes of wind are to the N.W., followed by weather clear and cold for the season. Heavy thunder showers clear off most frequently with this wind. These showers frequently precede the hard frosts which introduce winter. The longest storms of rain, and deepest falls of snow are usually accompanied by easterly winds. The wind blows less frequently from the west and south, and still seldomer from due north.

The great lakes of Canada are not frozen over during winter. Lake Erie alone, which is very shallow, is said to have been frozen over only two or three times within the last forty years. Only the bays and shores of the lakes, for a considerable distance from land, are frozen; and the ice in such situations, and on the rivers, is so thick and strong, that heavy loaded sleighs pass over it with perfect safety. The steamboats on Lake Ontario, between Toronto and Niagara, not unfrequently continue running through the whole winter. The steamboats plying across and along the lower part of the lake, generally continue running till about Christmas. The navigation of the St Lawrence almost invariably opens from about the middle of April to the beginning of May; when the first steamboats arrive at Quebec from Montreal, a river voyage of 180 miles.

The short but very delightful period of Indian summer, which occurs usually about the end of October or beginning of November, is a chief peculiarity of the Canadian climate. The period of its duration is variable, being from a few days to two or three weeks. The atmosphere is most

[1] *Views of Canada and the Colonists*, 2d Ed. chap. xxii. p. 328–333.

[2] The data respecting the temperature of Lower Canada are the results of observations at Montreal, derived from the registers published monthly in the *British-American Journal of Medical and Physical Science*, from 1845 to 1848 inclusive. The data for Upper Canada are deduced from the records of observations of the Royal Observatory at Toronto for nine years, from 1840 to 1848 inclusive. The data for Greenwich are from the records of the Royal Observatory there for seven years, from 1841 to 1847 inclusive.

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agreeably soft, accompanied with a peculiar and not unpleasant haziness, mellowing the rays of the sun; which has led to a popular belief that the Indians, far to the south, are then setting fire to their great prairies, and that Canada is getting a share of the distant smoke.[1]

Soil and Productions.

The soil of Canada is generally loam in its varieties, with a substratum of gravel; and when in a state of nature the surface is usually covered with a vegetable mould of some depth, formed from the decayed timber and leaves of the forest.

The Reports of the Geological Survey of Canada, under Mr W. E. Logan, provincial geologist, present very strikingly the vast resources of the lands of Canada. Entire districts of many square miles in extent are found to be composed of alluvial deposits from 30 to 40 feet deep of soil, in places so rich as to bear good crops of wheat for successive years without manure. Others of nearly equal value are found resting on red sandstone, trap, serpentine, limestone, and other strata, most favourable for agriculture. There are also, as along some of the rivers, for miles in succession, soils too rich for wheat, others of a good sandy loam, suitable to and requiring the usual English rotations. In many parts of Canada, on the other hand, there exist considerable quantities of poor, thin, and stony soils. The Reports of the Geological Survey, in presenting an account of the geological distribution of the various strata, and their agricultural capabilities, will prove of great value to the emigrant landholder, and others less or more interested in the lands of Canada.[2]

The soil and climate of Canada are such that the country produces a much greater variety of grains and fruits than is usually grown in Great Britain or Ireland. Besides wheat, barley, oats, rye, pease, turnips, potatoes, hemp, flax, hops, and the other ordinary agricultural products of England, which are all raised in abundance, Canada grows tobacco, rice, maize or Indian corn, and fruits of warmer climes than the British Islands. The full and steady heat of the summer matures with surprising rapidity the most valuable productions. "The severity of the winter," observes a very well-informed writer on the resources of the country, "are indeed unfavourable to grazing, and increase the consumption of fuel; yet without the ice and the snow the now invaluable timber of our extensive forests would be comparatively worthless. And inasmuch as we do not find the fertility of the soil impaired by the frost, we are justified in assuming that our winters have the same invigorating effect upon the earth, for our peculiar productions, as that conferred by rest upon the human frame: and that when the mantle of snow is removed, the soil, 'like a giant refreshed by sleep,' is enabled to send forth that rapid and luxuriant vegetation which renders a longer summer unnecessary."[3]

Fruits.—The fruits of Canada embrace every description usually grown in England, besides others which are produced in that country only with great care and by artificial means. The finest melons are grown in abundance in the open ground in Canada; and in some seasons peaches are so plentiful in the south-western parts of the country, along the shores of Lake Erie and the Detroit river, that they have been sold for one shilling sterling per bushel. The vine is also cultivated in open gardens around parts of those favoured shores, and grapes of perfect size and excellent flavour are produced. Apples, pears, plums, cherries, raspberries, currants, and strawberries are all grown in every part of Canada in great perfection and abundance.

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The shores of the Niagara and Detroit rivers are particularly famed for the excellence and abundance of their fruits. The island of Montreal, too, in Lower Canada, produces apples so highly esteemed for their choice and rich flavour as to be perhaps unsurpassed in any country.

Wild fruits abound in great variety in the woods and elsewhere all over Canada. The wild vine (*Vitis vulpina*) is very frequently seen luxuriantly clustering and twining its tendrils around the trunks and over the branches of the forest trees, forming all sorts of fanciful bowers. Among the other wild fruits may be mentioned cherries, raspberries, strawberries, whortleberries and blueberries, black and red currants, gooseberries, juniper berries, plums and hazle-nuts. Cranberries of large size grow in marshes in certain parts of the country very plentifully; and are much used as a favourite preserve.

Almost all kinds of vegetables necessary or desirable for the table, and in greater variety than in England, grow luxuriantly in Canada, and are cultivated with very little trouble. Cabbages, cauliflower, broccoli, pease, French beans, spinach, onions, turnips, carrots, parsnips, radishes, lettuces, beet, asparagus, celery, rhubarb, tomatoes, cucumbers, are all grown very successfully in Canada, and in great abundance. Indeed, the fruits and vegetables of Canada, in their abundance and excellence, are not only among its choicest luxuries, which nature in most liberal profusion places alike within the reach of poor and rich; but they are besides, no doubt, a very principal means of promoting the health, as well as adding to the comfort of the inhabitants during the hot summer months of the country.

Flowers.—Flowers grow in great variety, and in rich profusion, favoured by the soft genial atmosphere of a Canadian summer, and one of the most kindly soils. The woods in many places are literally carpeted with them. "Many of the cherished pets of our gardens and greenhouses are here flung carelessly from Nature's lavish hand among our woods and wilds," writes the accomplished authoress of the *Backwoods of Canada*.[4] Amongst the variety of Canadian wild flowers, may be mentioned a few, such as the scarlet lobelia, blue lupin, purple gentian, columbine, violets in great variety, honeysuckles, campanula, hare bell, Michaelmas daisy, pitcher plant, two-flowered balsam, rasp-leaved aster, calceolaria, lily of the valley, besides wild roses in profusion, with their sweet perfumes; and among the grass of the meadow land, and by the stream side, are to be found the well-known spearmint and peppermint. Besides these, there is the magnificent white water-lily, the queen of aquatic plants. The shallows of the lakes, and quiet nooks of rivers, present at times so gorgeous and beautiful a sight, as to be not inaptly compared to floating gardens.

Forests.—The forests of Canada abound in the finest and largest trees, adapted to almost every variety of purposes, useful or ornamental. Amongst the monarchs of these forests are the white and red pine, of which so large quantities are annually imported into Britain from the St Lawrence. Individual trees of the white pine are frequently found measuring 100 feet to the first branch, and occasionally trees reach 200 feet in height.

The pine timber cut for the Quebec market is usually in logs of about 20 inches square by 60 feet in length. Besides these, the growth of the Canadian forests, may be mentioned oak, elm, beech, ash, maple, birch, lime, sycamore, tamasack, cedar, walnut, and a variety of other

[1] *Views of Canada*, 2d Ed. chap. xxii. p. 338–341.

[2] *Reports of the Geological Survey of Canada*, published by order of the Legislative Assembly. *Notes on Public Subjects made during a Tour in the United States and Canada*, by Hugh Seymour Tremenheere. London, 1852. P. 194.

[3] *Prize Essay; the Canals of Canada; their Prospects and Influence.* Written for a Premium offered by his Excellency the Earl of Elgin, Governor General of British North America, by Thomas C. Keefer, C.E. Toronto, 1850.

[4] *Backwoods of Canada; being Letters from the Wife of an Emigrant Officer.* New edition, London, 1846. Letter xiv.

woods less generally known in England. The white oak of Canada, besides being cut into logs not greatly inferior in dimensions to those of white pine, serves also largely to supply staves for both the English and West Indian market. The tree called the sugar-maple is famous for the sap which it yields during early spring, from which excellent sugar is made in large quantities all over the country. Nearly 10,000,000 lb., or upwards of 500 tons, of this maple-sugar were produced in Canada in 1852. Maple groves, as collections of these trees are called, are therefore considered very valuable upon a Canadian farm. Of the ornamental woods of Canada, the bird's-eye and curled maple, and also the black walnut, deserve prominent notice. The black walnut furnishes a very beautiful wood for cabinet work.

The importance of these immense forests both to Canada and England, and even to the northern parts of the United States, may be said to be only now beginning to be fully appreciated. In 1852, according to the official returns, the products of the Canadian forests exported from the country were valued at L.1,350,000.[1] In 1851 it was computed that no less than 200,000 tons of sawn timber had been exported from Canada for the supply of the United States market on the Hudson river.[2] Of the various districts of Canada where the clearing or cutting down of the forests is being now carried on most extensively, the valley of the river Ottawa may be classed second to none. This particular branch of trade, known by the name of "lumbering," is in a great measure, as stated by the Earl of Elgin in his despatch of August 1853, carried on by persons of capital who employ large bodies of men at points far removed from markets, and who are therefore called upon to make considerable advances in providing food and necessaries, as well as in constructing slides and otherwise facilitating the passage of timber along the streams and rivers. "Many thousands of men," the Earl of Elgin goes on to observe, "are employed during the winter in these remote forests, preparing the timber which is transported during the summer in rafts, or, if sawn, in boats to Quebec when destined for England, and up the Richelieu river when intended for the United States." "It is a most interesting fact," continues his Lordship, "both in a moral and hygienic view, that for some years past intoxicating liquors have been rigorously excluded from almost all the shanties (as the dwellings of the lumbermen in these distant regions are styled); and that, notwithstanding the exposure of the men to cold during the winter, and wet in the spring, the result of the experiment has been entirely satisfactory." The prosecution of the lumbering trade has by many been considered hurtful to the interests of Canada. With regard to this interesting and important matter, Lord Elgin observes: "The bearing of the lumbering business on the settlement of the country is a point well worthy of notice. The farmer who undertakes to cultivate unreclaimed land in new countries generally finds that not only does every step of advance which he makes in the wilderness, by removing him from the centres of trade and civilization, enhance the cost of all he has to purchase, but that, moreover, it dimishes the value of what he has to sell. It is not so, however, with the farmer who follows in the wake of the lumbermen. He finds, on the contrary, in the wants of the latter a steady demand for all that he produces, at a price not only equal to that procurable in the ordinary marts, but increased by the cost of transport from them to the scene of the lumbering operations. This circumstance, no doubt, powerfully contributes to promote the settlement of those districts, and attracts population to the sections of the country which, in the absence of any such inducement, would probably remain for long periods uninhabited."

"This important region of the Ottawa," Lord Elgin states in the same despatch quoted above, "is probably doing more at the present time than any other single section of the province to enable Canada to enter the markets of the world as a purchaser." The river Ottawa, though it be but a tributary of the St Lawrence, "is one of the longest of the rivers that run uninterruptedly from its source to the embouchure within the dominions of the Queen. It drains an area of about 80,000 square miles, and receives, at various points in its course, the waters of streams, some of which equal in magnitude the chief rivers of Great Britain." The country of the Ottawa, Lord Elgin further observes, besides its wealth in timber and water power, and tracts of fertile soil, is believed to be also rich in minerals.

Animals.

The two most noted and mischievous animals of the Canadian forest are the bear and the wolf. Both of these, however, now are almost exclusively confined to the more remote and unsettled parts of the country, where their depredations in the farm-yards bordering on the woods give them occasional notoriety. It is very seldom that either animal is seen, and the hunters in search of farm-yard depredators may have sometimes to pursue their search in vain for days together. In order to exterminate wolves, a premium is paid by government for the head of each animal presented to a local magistrate. The beaver is now seldom found within reach of white settlements. Foxes, silver-gray, red, and black raccoons, otters, fitchets, martins, minks, and musk-rats still remain in diminished numbers. All of these are eagerly sought, chiefly by professional hunters, for the value of their furs, considerable quantities of which are yet exported from Canada. The official returns for 1851 show that furs and skins to the amount of L.28,000 colonial currency were exported during that year. Of this amount the greater proportion, namely, to the value of about L.20,000, went to the United States market.

Amongst the smaller animals of the woods, squirrels must not be omitted. The large black squirrels are shot in great numbers while scampering among the branches of the forest trees. The gray, the red, the ground or chipmonk, and flying squirrel, are the other varieties.

The most valuable game in Canada are the elk and the stag. The fine specimens of these noble animals, which are still found in many parts of the country in considerable numbers, occasionally afford excellent sport. Wild turkeys of large size were, several years ago, comparatively plentiful in the western parts of Canada; and are still found there, but in diminished numbers. Among other animals known in Canada, besides several species of grouse, may be mentioned the wood-cock, snipe, plover, and a species of hare. Pigeons are killed by thousands during the spring and autumn.

Of ducks there are many varieties, and several of them very beautiful. These are found in large numbers in the marshy parts of lakes and rivers. Wild swans are occasionally seen, and wild geese pretty frequently in certain parts of the country. Domestic fowls are abundant.

For the purpose of preventing the utter destruction of game in Canada, where all are allowed to indulge alike in the sport of the gun, an act was lately passed by the provincial legislature, preventing the shooting or killing any wild swan, wild goose, wild duck, teal widgeon, or snipe, between the 10th of May and the 15th of August.

The smaller kinds of birds are in many instances remarkable for beauty of plumage. In the list of these native and migratory, may be mentioned the jay, several species of woodpecker, the scarlet tanager, blue bird, the indigo bird, three species of blackbird, the American goldfinch

[1] Despatch from the Earl of Elgin. Quebec, August 16, 1853
[2] Report of Commissioners of Public Works, Quebec, August, 1852.

Canada. or flax bird, a robin, the meadow lark, several thrushes, a kingfisher, the swallow, and two or three very beautiful species of humming-birds. Several of these, although bearing the names of English birds, are specifically different from their namesakes in this country. The Canadian jay is about the size of the English bird, but the whole of the plumage is blue, and beautifully marked. The woodpeckers display gay plumage of scarlet, crimson, and green, and the largest of the species, known as the "cock of the woods," carries a tuft of scarlet feathers on his head. The Canadian robin is more than double the size of our little English favourite. As for the little humming-birds, nothing can exceed their rare beauty of plumage, tiny elegance of form, and rapid, graceful movements.

We now leave the land for the waters, to note some of the more remarkable of the finny tribe of the rivers and lakes. The sturgeon is caught in the Canadian waters, frequently weighing from 80 to 100 lb.; and the lake or salmon trout varies usually in size from 10 to 40 lb. Large quantities of the finest species of the lake trout family, known by the name of the siskawit, prized chiefly on account of its fatness, are annually caught by the fishermen of Lake Superior. This fish weighs from 5 to 20 lb. Very fine salmon are also abundant in the waters of the St Lawrence and the lakes. The smaller rivers and streams team with the speckled trout. Perhaps the chief favourites of the Canadian waters are the white fish and maskelonge. The white fish is much esteemed for delicacy and richness of flavour. Among other varieties of fish we may mention pike, pickerel, bass, perch, and herrings. The fisheries of Canada are constantly growing in importance from year to year. Many thousands of barrels of salmon, white fish, and herrings are annually exported at present, chiefly to the United States. Mackerel are also largely caught in the Gulf of St Lawrence. The parliamentary returns show that Canada produced in 1851 not less than 95,900 barrels of fish of various sorts. This quantity is exclusive of the Gaspé and Bonaventure fisheries in the Gulf of St Lawrence and Bay of Chaleurs, the southern shores of which bay are situated in the province of New Brunswick, and the northern in Canada. The Acadian French settled around the Bay of Chaleurs, employ themselves chiefly in fishing. There is a species of whale caught in the Gulf of St Lawrence by Gaspé fishermen, known by the name of "humpback," and which usually yield on an average three tons of oil each; some have been taken 70 feet long, which produced eight tons. In 1851 there were about 8500 gallons of oil exported from Canada, chiefly to England.[1]

Population.

1535 to 1759 The first settlement made by Europeans in Canada, as is well known, was by the French navigator Jacques Cartier in 1535; and, up to the memorable year 1759, the country continued to be a province of France. During the whole of that period the European population in Canada was comparatively insignificant. In 1759, when the country was under the last of the French governors, and Quebec surrendered to the forces of General Wolfe, the population of the colony amounted to 65,000. Canada was then known simply as the Province of Quebec, and the population was chiefly confined to the part of the country now known as Lower Canada.

The change of allegiance from one sovereign to another was rendered as easy as possible to the inhabitants by the lenient measures of England. Their French laws were allowed to remain unaltered. They were secured in the undisturbed possession of their lands under their ancient tenures, and in the free exercise of their religion. All ecclesiastical property was respected, and every concession was made by the British government in favour of the peculiar customs and manners of its new subjects. The French power on the continent of North America having been thus transferred and consolidated in the hands of the English, the country soon began to give token of advancement. As a reward to the army which had taken part in the conquest of the country, the provincial government was empowered to grant portions of land, varying from 50 acres up to 5000 acres, to each officer and soldier. Many old soldiers from the United States too, after this, settled along the banks of the St Lawrence. To these, considerable additions were made about the period of the United States' Declaration of Independence, as many of the defeated royalists settled in the British province of Canada at the close of the revolutionary struggle. A stimulus having now been given to English enterprise in the newly-acquired colony, the population in 1784 had risen to 113,000—being an increase since 1759, when the province was transferred to England, of 48,000.

Canada. 1759 to 1784

For a period of many years after Canada had come into the possession of England, and Lower Canada had begun to experience the stimulus of new enterprise and an increased population, the large portion of country westward, lying along the great lakes, now known as Upper Canada, and in its extent nearly double the size of England, was one vast forest. Only a few French immigrants had placed themselves near the foot of Lake Ontario, and on the shores of the Detroit river, previous to 1770. The only other inhabitants were the native Indians, to whom this forest with its occasional patch of plain by lake or river side, was one great hunting ground. Several years later, numbers of families who had resided in the now United States, and who, at the disruption with England, refused to transfer their allegiance to the independent government, came over into Canada, and settled on the borders of the lakes. These individuals, the pioneer settlers of Upper Canada, were, and have since been, termed United Empire Loyalists.

In 1791, when, by an act of the imperial parliament, the colony received a constitution, and was divided into the two provinces of Upper and Lower Canada, with separate legislatures, the amount of the white population in Upper Canada was estimated at less than 50,000. In 1811, twenty years later, it had only increased to about 77,000. Very shortly afterwards, and especially upon the conclusion of peace between Britain and the United States, in 1814, population rapidly increased in Upper Canada. In 1825, when the advantages of the colony to the home population began to attract attention, the colonists of Upper Canada had increased to 158,000. With an increasing emigration, the country now rapidly swelled the number of its inhabitants. In 1830 they amounted to 210,000; and, in 1834, the numbers exceeded 320,000: the increase within the nine years previous to 1834, namely, from 1825, having been not less than 162,000. The country during that period had indeed doubled its population. During the first five years of this period, from 1825 to 1830, the emigration to British America was proceeding very steadily at about 12,000 a-year. In 1830 this flow of emigration increased to 30,000, in 1831 it rose to 58,000, and in 1832 it reached over 66,000. From this period, during the political disturbances in Canada, the number of emigrants from Britain gradually declined. Since then, however, an increasing flow of prosperity visited the country. The official returns show that in one year, that of 1847, the emigration to British America had exceeded 109,000. In 1842, the population of Upper Canada was 486,000; showing an increase since 1830 of 276,000—a period of twelve years, and including the season of political disturbances. The population, in short, within that period, had considerably more than doubled. The census of 1848 shows the amount of population of Upper Canada to have reached 723,000—an increase within the six years of over 237,000. The last census of 1852 shows the population of this rapidly growing portion of Canada to have reached very nearly 1,000,000—the precise official return being 952,004. Comparing this with the return of 1842, we arrive at the gratifying result that the population of Upper Canada has nearly doubled itself within these last ten years.

1791 to 1834

To convey as clearly as possible an idea of the remarkable progress of Upper Canada in respect of population, we here present the results from official documents in tabular form. We shall begin with the period when Upper Canada was erected into a separate province, namely—

[1] *Views of Canada; Smith's Canadian Gazetteer; Parliamentary Returns*, &c.

Canada.

Year.	Population.	Increase.
In 1791	50,000	
1811	77,000	In 20 years, 27,000
1825	158,027	14 .. 81,027
1830	210,437	6 ... 52,410
1834	320,693	4 ... 110,256
1842	486,055	8 ... 165,362
1848	723,392	6 ... 237,337
1852	952,004	4 ... 228,632

The increase of wealth too in Upper Canada, especially of late years, has not been less remarkable than this rapid increase of population. Previous to 1850, the cultivated land of Upper Canada was valued, for the purpose of local assessment, at 20s. currency, or about 16s. sterling per acre; and uncultivated land at 4s. currency, or about 3s. 3d. sterling per acre. The total amount of assessable property in Upper Canada, according to this estimated value, was—

Year.	Property. £ currency.	Increase. £ currency.
In 1830	1,854,965	
1835	3,407,618	In 5 years, 1,552,653
1840	4,608,843	5 ... 1,201,225
1845	6,393,630	5 ... 2,784,787

These estimates of the value of cultivated and uncultivated land were, however, very considerably under the true value. The board of registration and statistics in Canada report, in 1849, the estimated value of cultivated land in Upper Canada to be 70s. 10d. currency per acre, and uncultivated land 29s. 2d. currency per acre. An act was therefore passed in 1850 requiring property to be assessed at real value. The Earl of Elgin, in his exceedingly interesting despatch dated Quebec, December, 1852, presents statements of the more just valuations of 1851 and 1852—which his lordship observes, though not strictly official, he believes to be tolerably correct.

The statements of the governor-general, published in the above mentioned despatch, have been proved to be very considerably within the actual official return. An official statement received from the government of Canada,[1] dated within a month from the time of writing this article, gives the total value of assessable property in Upper Canada—

Year.	Property. £ currency.	Increase. £ currency. In one year.
1851	44,106,817	
1852	45,863,383	1,756,566
1853	49,627,392	3,763,909

The Earl of Elgin's moderate estimates of assessable property in Upper Canada for 1851 and 1852 were fully more than L.8,000,000 less each year than the above actual official returns. The farmers, in order to avoid local taxation, are understood to keep down their returns at the lowest possible point. The real value of assessable property in Upper Canada at present is believed to be not less than L.150,000,000.

Lower Canada, as is known, is inhabited chiefly by French Canadians, speaking their native language, retaining almost entirely their ancient laws, manners, and religion, following rude modes of agriculture, and generally averse to improvement. For these and other reasons, the country has not made the same degree of progress as Upper Canada. Although a much older settlement, the old French portion of the province was, by the census of 1852, somewhat behind Upper Canada in amount of population. Upper Canada in 1852, as we have noticed, possessed a population of 952,004, while the population of Lower Canada in the same year did not exceed 890,201. Of this amount of population in Lower Canada 669,528 were of French origin, and the remaining 220,733 were composed of emigrants from Great Britain and other countries, and of Canadians not of French origin. In Upper Canada only 26,417 of the entire population were of French origin, the remaining 925,587 being composed of emigrants from Great Britain and other countries, and of Canadians not of French origin.

Lower Canada, however, has enjoyed important advantages which have enabled it, in spite of its drawbacks in respect of population, and perhaps of climate, to keep pace with the upper division of the country. Being much nearer to the sea-board of the Gulf of St Lawrence, it has been enabled to land at less cost upon the large fertile tracts it possesses numbers of enterprising emigrants. Besides, it has hitherto monopolized the navigation of our ocean vessels, as their ascent of the St Lawrence practically terminates at Montreal, and thus two large commercial cities have risen into importance, and the enterprise and wealth of extensive mercantile houses have sent abroad their influences more or less all over the country.

Canada.

The largest increase of prosperity in Lower Canada has shown itself in the Eastern Township, where the lands have been held exempt by the English government from the feudal tenure, and in the cities of Quebec and Montreal, indebted for their support to the trade of the upper and surrounding country and to the commerce of England and the United States. In 1827 these cities had each a population of about 27,000; and by the census of 1852 Quebec shows a population of 42,052, and Montreal of 57,785. Besides these cities of Quebec and Montreal, there are a number of small towns and villages scattered over Lower Canada. The largest of these are, Three Rivers, Sorel, St Hyacinthe, St John's, and Sherbrooke. The population of Three Rivers in 1852 was nearly 5000, that of Sherbrooke 3000, and those of Sorel, St Hyacinthe, and St John's, somewhat over 3000.

Towns.

The growth of the towns of Upper Canada has been very remarkable. Toronto, now a flourishing city upon the shores of Lake Ontario, contains by the census of 1852 a population of 30,775. Its population just now may be estimated at fully 40,000, and the value of its assessed property may be stated to be not far short of L.5,000,000.[2] In 1817 Little York, as Toronto was then called, contained only 1200 inhabitants, and so lately as 1826 the number had only increased to 1677. In 1830 the population had increased to 2860, and in 1836 it had risen to 10,000. In 1842 the population of the town was 15,336, in 1845 19,706, in 1848 23,500, in 1852 the number had reached 30,775, and now, in 1854, we estimate its population at fully 40,000. It has thus, we perceive, quite doubled its population within twenty years.

Amongst the other principal towns of Upper Canada are Hamilton, Kingston, London, and Bytown. The first named of these, Hamilton, which is situated at the extreme head of Lake Ontario, on a very spacious and beautiful bay, had in 1852 a population of 14,112. Its present population (1854) may be estimated at nearly 20,000, and the amount of its assessable property at nearly L.3,000,000. Hamilton, which had recently been raised to the dignity of a city, enjoys many advantages, and, like Toronto, has grown rapidly. In 1844 it had only about 5000 inhabitants, so that since then it has nearly tripled its population. Kingston, the third city of Upper Canada as respects population, is situated at the extreme foot of Lake Ontario, and contained in 1852 11,585 inhabitants. London and Bytown had each in 1852 populations of over 7000, and both towns are growing rapidly. London is situated in the heart of one of the finest agricultural districts in Upper Canada, in the centre of the great peninsula situated between the lakes Ontario, Erie, and Huron, and on the main trunk line of railway passing through Canada from some distance below Quebec, and from the Atlantic sea-board at Portland, Maine, to the foot of Lake Huron. This town of London, with its population in 1852 of 7000, and now at least 10,000, had not a single house until 1827. Bytown, on the river Ottawa, is at present chiefly indebted for its importance perhaps to the extensive lumbering trade carried on along the shores of that great river. It is very agreeably situated upon a high bank of the river, about 180 miles above Montreal.

Besides those larger towns of Upper Canada, there are other prosperous and growing towns, such as Belleville, St Catherines, Brantford, Cobourg, Dundas, Niagara, Brockville, Port Hope, Prescott, Galt, Peterbro', Woodstock, and Chatham. The two first-named of these, Belleville and St Catherines, possessed each a population of over 4000. The one is situated on the bay of Quinté, an inlet of Lake Ontario; the other on the Welland canal, which connects the navigation of Lake Ontario and Erie, and thus obviates the interruption caused by the Falls of Niagara. The rest of the places named have each a population from 2000 and upwards to nearly 4000, and the whole of

[1] Statement showing the assessable value of property within the several counties and cities in Canada West, in 1851, 1852, and 1853. Inspector-General's Office, Quebec, March 23, 1854.

[2] The assessed value of property in Toronto in 1853 was L.4,216,666.—Statement, Inspector-General's Office, Quebec, March 23, 1854.

Canada.

them are steadily growing with the rising interests of the country. They are all very favourably situated, commanding the resources of fertile and prosperous districts, and many of them are ports possessing either navigable rivers, or the more direct communication of the shores of the great lakes.

The area of Great Britain in statute acres is 57,624,377, while that of Canada is 155,188,425, Canada being thus not far from three times the size of Great Britain; and it is believed we are safe in estimating the proportion of cultivable land to be much larger in Canada than Britain. The proportion of land to each person in Canada at present is nearly 69 acres, while in Great Britain the proportion to each person is a fraction over two acres. During the last 50 years, in which time 10,000,000 of people have been added to the British population, the proportion of land to each person had decreased from five to two acres. The number of persons to a square mile in Canada is only eight, while in Great Britain the census of 1851 gave 233 persons to a square mile.

When we consider that the emigration from Great Britain and Ireland amounted in 1852 to 368,764, which is at the rate of 1000 persons a-day sailing from the United Kingdom, we can readily account for the wonderfully rapid growth of Canada, especially of late years. While our home population thus increases notwithstanding this large emigration, and the proportion of land to each person is thus continually diminishing, Canada will no doubt continue much more rapidly to increase, both in numbers and prosperity. America and Australia divide between them the great outflow of our population. The cheap and fertile lands of Canada will continue more strongly to invite the enterprising and industrious of all classes; and while its towns grow as they are now doing, adding to their material prosperity a larger increase of all the comforts and luxuries of home cities, continual inducements will be held out to gentlemen of moderate fortunes and large families, and also to young men of education who are now crowding the professions in England.[1]

Situated so near to Europe, and offering so inexhaustible supplies of fertile and cheap land, with light taxes and a liberal government, we are prepared to find in Canada people from various countries. The subjoined analysis is from the tables of the census of Upper Canada of 1852.

Population of Upper Canada, 1852,		952,004
Natives of—		
England and Wales,	82,699	
Scotland,	75,811	
Ireland,	176,267	
Canada, French origin,	26,417	
Canada, not of French origin,	526,093	
United States,	43,732	
Nova Scotia and Prince Edward Island,	3,785	
New Brunswick,	2,634	
Germany and Holland,	9,957	
France and Belgium,	1,007	
Jersey and other British Islands,	1,351	
Various other countries,	2,251	
		952,004

The county of Upper Canada containing the largest number of Scotchmen is Middlesex. The total population of this county, situated in the heart of the great fertile peninsula between the lakes Erie, Ontario, and Huron, was in 1852 32,864, of which number 4762 were natives of Scotland, and 3171 natives of England and Wales. The Scotch settlements in the county of Middlesex, particularly in the township of Westminster and around the town of London, have been remarkably prosperous.

Many of the persons composing these settlements emigrated to Canada in order to escape the almost certain privations which presented themselves in this country to the worst-paid classes of workmen, such as the hand-loom weavers of the past generation. These men, in most instances, are now in the enjoyment of a competent independence in their well-cleared farms, of which they are the proprietors. Their abundance, it is true, may be in a manner rude enough to more cultivated tastes, but they seem quite calculated to confer contentment and happiness upon a class of persons to whom industrious toil is an enjoyment, when it can secure to them amply, even to overflowing, all the necessaries, and many of the comforts of life suited to their own simple and unambitious desires.[2] The success of Scotchmen in Canada is indeed particularly proverbial there; and it is not too much to say, that the decided majority of successful tradesmen in the towns of both Upper and Lower Canada, and of the most eminent merchants of the country, are either Scotchmen or descendants of Scotchmen.

Canada.

The county of Upper Canada containing the largest number of persons from England and Wales is York, on the shores of Lake Ontario, in which the city of Toronto is situated. In this county of York, with its total population of 48,944, there were 7749 natives of England and Wales; 3111 natives of Scotland; 9241 natives of Ireland; 25,961 native Canadians not of French origin, and 2049 natives of the United States. The city of Toronto, with its population of 30,775, numbered 4958 natives of England and Wales; 2169 natives of Scotland; 11,305 natives of Ireland; 9956 native Canadians not of French origin, and 1405 natives of the United States. These 3454 Americans residing in the county of York in Upper Canada, including the city of Toronto, so near to their own shores of the United States, is a fact not to be overlooked, testifying as it does so significantly in favour of Canada.

The county of Upper Canada containing the largest number of Irishmen is the same county, York, which contains also the largest number of Englishmen—there being in that county, as already stated, above 9241 natives of Ireland. And the city of Toronto, as we have also observed, with its population of 30,775 in 1852, included 11,305 natives of Ireland.

"Instead of my being astonished," writes an Irish gentleman from Canada to a friend in Dublin, "at the immense amount of emigration that has taken place from Ireland during the last few years, my surprise is that the whole of its peasant population has not already come, either to this country or the United States. During the few weeks that have elapsed since I landed, I have travelled 1850 miles by rail and steamboat; and although I am told that I have not as yet visited by any means the best portion of Canada (Upper or Western Canada), I have seen quite enough to convince me of its inexhaustible resources, and the glorious field that it is for the Irish people. The moment the vessel arrives at Quebec (the port to which all emigrants for Canada should come), the men are immediately engaged, either for the railroads, or for the government provincial works now in course of construction. The wages for labourers are four shillings British per day; they can be most comfortably boarded (with meat twice a-day) for about one shilling, and allowing one shilling more for other expenses, it leaves two shillings per day of savings. Then again, on the Ottawa river, one of the great sources of the inexhaustible supply of Canadian timber, 'lumbermen' earn at least one dollar per day; and, as they advance in skill and experience, their wages rise to a dollar and a half and two dollars.

"In the immediate vicinity of this river and its tributaries, throughout their entire extent, is magnificent agricultural land. The farmers, four-fifths of whom are Irishmen, or sons of Irishmen, who came to this country as lumberers, and purchased farms with their savings, sell all their produce without ever going to market as the master lumberers purchase it to feed the men in their employ. I am assured that Irishmen make better lumberers than the natives of any other country; for it appears that the good and abundant food they begin eating from the moment they arrive here expands, not only the muscular frame, but also the intellect; and no one who has not seen the contrast between the down-cast, ill-fed, and ragged Irish peasant in his own country, and the same man after even a few months' residence in these provinces, could believe in its completeness. A few days ago, the driver of a stage-coach, between two portions of the Ottawa, unnavigable for steam vessels, but which the government is now obviating, told me that he came to this district in 1841, with one dollar in his pocket; and I learned from a gentleman with whom he had originally worked as a common labourer when he first came out, that he is now worth L.1000 and has a capital farm. On my expressing surprise that a man like him could have an average of savings of L.80 a-year since he arrived, I was assured that so far from this being a solitary case, there was hardly an Irishman who is industrious and temperate (the latter is just as necessary as the former quality) that is not more or less in the same position. For myself, I can only say, that I have not seen an Irishman since my arrival who has not an air of comfort, cleanliness, and independence about him."[3]

The number of coloured persons of African descent in Upper Canada, included in the abstract of the census, but not classed as such, was computed in 1852 to be about 8000. Since 1852 this description of the population has, it is believed, very largely increased; Canada offering so freely to these persecuted victims of slavery a

[1] See *Notes on Public Subjects made during a Tour in the United States and Canada*. By H. S. Tremenheere. 1852. P. 263.
[2] See *Things as they are in America*. By William Chambers; in *Chambers's Journal of Popular Literature*, No. 16, April 22, 1854.
[3] Letter of Sir Cusack P. Roney, published in Saunders' *News Letter*, July 16, 1853.

Canada. safe and welcome refuge. These people are usually employed in the towns as waiters in hotels, as barbers, and in the performance of the most burdensome and menial descriptions of labour, such as cutting and preparing wood for fuel. Large numbers of them are employed upon the extensive railway works now going forward in Canada, and earn liberal wages. They have as labourers great powers of endurance; and when their dispositions have not been soured by ill usage, they are most generally civil and attached servants. There is also a small proportion of educated coloured persons in Canada, whose qualifications and general conduct have assisted much to remove the prejudices against their unfortunate race existing more or less all over America.

Indians. With regard to the native Indians of Canada, it may convey some idea of the thinning out of these children of the forest, to observe, that it is only on comparatively rare occasions that the white settler meets with a straggling few, or single family or individual. There are various small settlements of them scattered in different parts of Canada, where, under the civilizing influences of missionaries and school teachers, they have adopted, with some exceptions, improved habits of life, subversive of their former wild and roving dispositions. The principal Indian settlements in Canada are, Manitoulin island, near the northern shore of lake Huron; a small settlement near the head of the river St Clair; and one on Walpole island, at the foot of the same river; another on a retired part of the banks of the river Thames, in the London district; also along the banks of the Grand river, in the Niagara district; in one or two localities along the shore of lake Ontario; also on the banks of the St Lawrence, between Kingston and Montreal; in the vicinity of Quebec; and towards the mouth of the St Lawrence, around a part of the shore of the gulf. These localities on which they are settled are comparatively limited in extent, and apart from the white settlements. The Indians of the present day are almost, without exception, civil and quiet in their manners, as well as generally improved in many of their habits. They are, nevertheless, greatly addicted to indolence and intoxication. The Indians in Upper Canada have been chiefly indebted to the body of Wesleyans and to the Church of England for their missionaries; and those of Lower Canada are, perhaps without exception, brought up in the faith of the Romish Church, under the teachings of the French Canadian clergy.

The greater number of the Indians in Canada are almost directly under the care of the government. There is a special government department devoted to their affairs, the chief superintendent of which is the governor-general's secretary. There are several assistant superintendents who watch over their particular interests, and they have also government missionaries and schoolmasters.

Besides the settlements alluded to around the occupied parts of Canada, there are the Indians mentioned in the report of Lord Elgin, in the great forests along the shores of Lake Superior, and other distant points, comparatively speaking, beyond the limits of civilization. These, though much tamed by civilizing influences, extending even to them in these retreats, are yet engaged, in a great measure, in their primeval pursuits of hunting and fishing. The Hudson's Bay Company afford employment to numbers in the collection of their furs. The stations of the Company, throughout the remote regions in which they are situated, distribute European goods in exchange for the produce of the hunt; and the Company's interests are exercised paternally, in some measure, over these far-scattered inhabitants of the forest.

The Indians residing in British America are much attached to the crown of England, and not unfrequently refer to their "Great Mother across the Great Waters," with feelings of proud gratification. Major Sprague, of the United States, is reported to have related the following anecdote upon the occasion of celebrating St George's day at New York in 1853. "Some years ago," said Major Sprague, "I was engaged in removing some Indians beyond the Mississippi, and one day when encamped I saw a party approaching me. I took my glass and found they were Indians. I sent out an Indian with the *Stars and Stripes* on a flag, and the leader of the Indians immediately displayed the RED CROSS OF ST GEORGE! I wanted him to exchange flags, but the savage would not; for, said he,—'I dwell near the Hudson Bay Company, and they gave me this flag, and they told me that it came from my Great Mother across the Great Waters, and would protect me and my wife and children, wherever we might go. I have found it to be so as the White Man said, and *I will never part with it!*'"

Many of the Indian women employ much of their time in fanciful bead-worked articles, such as moccasins, and various kinds of small bags, made from prepared deer skin and the pliant inner bark of trees, which they dispose of to the white inhabitants as Indian curiosities. They make also useful as well as ornamental baskets from the prepared bark. The small and very prettily situated Indian village of Lorette, in the neighbourhood of Quebec, and not many miles from the falls of Montmorency, is much noted for this description of Indian industry.

Cultivated Land and Agricultural Products. Canada.

The number of persons occupying lands in Canada, according to the census of 1852, was 194,309. Of whom there were holding—

10 acres and under	23,237
10 to 20	4,590
20 to 50	35,876
50 to 100	85,812
100 to 200	37,029
above 200	7,765
	194,309

The number of occupiers of land in Upper Canada exceeds the number in Lower Canada by 5411. The greatest number of small holders of 10 acres and under are, in Lower Canada, owing, no doubt, to the continual subdivision of lands going on among families, caused by the working of the French law of inheritance. The number of holders of above 200 acres is also larger in Lower Canada, which is accounted for by the existence of the large original grants under the old French titles, known as seigniories. Almost quite the one-half of the farms of Upper Canada are of the medium-sized classification; there being of the 99,860 occupiers of land in Upper Canada, 48,027 holding from 50 to 100 acres.

The number of acres held by these 194,309 occupiers of land in Canada is 17,937,148; 9,823,233 acres of which are held in Upper Canada. The number of acres under cultivation in Canada in 1852 was 7,303,241, the greater proportion of this cultivated land being in the upper provinces. The increasing quantity of cultivated land in Upper Canada is another of the gratifying proofs of the substantial progress of the country; and this increase of the area of cultivation keeps full pace with the increase of population. In 1842 the population of Upper Canada, amounting to 486,055, possessed 1,927,816 acres of land under cultivation; and in 1852 the population, which had increased to 952,004, possessed an area under cultivation of 3,697,724 acres.

The proportion of occupied lands in Canada under cultivation, under crops, pasture, and used as gardens and orchards, and also in forest or wild state, were as follows:—

	Acres.
Land under crops	4,347,539
...... pasture	2,870,004
...... gardens	85,698
...... cultivation	7,303,241
...... forest or wild	10,633,907
Total occupied land in Canada	17,937,148

The distribution of the land under crops, and the produce of these crops respectively, were—

Under.	Acres.	Produce in Bushels.
Wheat	1,209,226	15,768,720
Oats	1,012,106	20,161,438
Pease	357,301	4,055,584
Potatoes	150,916	9,443,586
Buckwheat	96,046	1,169,801
Maize	93,240	2,096,800
Rye	84,975	821,094
Barley	72,843	1,294,501
Turnips	21,032	4,014,851
Fallow and other crops,	1,249,854	...
Total land under crops,	4,347,539	
Total produce of above specified crops,		58,826,375

Besides these amounts of specified produce from these 4,347,539 acres of land under crops, the Canadian farmers possessed other crops, such as hay, clover, and grass seeds, carrots, mangel-wurtzel, beans, hops, flax, hemp, and tobacco. The quantity of tobacco produced in Canada in 1852, amounted to 1,253,128 lb.; of this, 764,476 lb. were the produce of Upper Canada; and the greater portion of which was grown along the shores of the upper part of Lake Erie, and of the river Detroit, where the soil and climate seem best adapted for this description of crop, and where the farmers in those parts have had the best opportunities of receiving the services of the coloured or runaway slave population of the United States, who have been

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accustomed to the management of such produce in the tobacco plantations of the south. The produce in tobacco of the two counties of Kent and Essex alone, situated in this south-western point of Canada, amounted in 1852 to 760,300 lb.

Hemp.

The growth of hemp in Canada assumes a position of great national importance at the present time when British supplies have been so seriously checked by the war with Russia. The important towns upon the east coast of Scotland, which are the chief seats of the flax trade, have suffered severely by the check received by our being so dependent upon Russia for this great staple of a growing branch of our national manufactures. Were our own dominions in North America to supply hemp for our manufactures in future, instead of our being, as hitherto, so wholly dependent upon Russia for such supply, the change would be attended with signal advantage to both countries.

The elaborate work of the late Colonel Bouchette on British America affords a good deal of information in regard to the capabilities of Canada for the growth of hemp, and explains the causes of the comparative failure of these efforts made many years ago to introduce the cultivation of this important staple upon an extensive scale into Canada.[1] Colonel Bouchette, as is known, was surveyor-general of Lower Canada, and a corresponding member of the Society of Arts in London; and he was therefore enabled, both from his official position and general acquirements, to furnish facts and opinions of unquestionable value bearing upon the subject in question. According to calculations of Colonel Bouchette, the cost of one ton of merchantable hemp landed in England would be not quite L.21 sterling. The mean price of Russian hemp in the English market at that time was L.40, 15s. sterling.

The American navy use at present large quantities of native-grown hemp. Mr W. B. Shubrich, chief of the bureau of construction, navy department, United States, in a report to the secretary of the navy, recommends greater attention to the detail of cultivation, curing, and packing native-grown hemp, "which, in the opinion of the bureau, would be found to be very beneficial in effect, and in the course of time *make it altogether independent of a foreign market* for a material so important for naval purposes." Mr Gardiner, superintendent of the ropework of the United States navy-yard at Memphis, in a report of his department, further substantiates these views, concluding that with proper care "American hemp may (*as experiment has proved*) *be made to equal, if not to excel, any foreign importation*."[2]

The quantity of hemp and flax produced in Canada, taken together, as officially returned, amounted in 1852 to 1,917,666 lb., being above 800 tons. The value placed upon this by the government board of registration and statistics in Canada is 3d currency, or L.28 currency per ton, which reduced to sterling is L.23, 3s. The total value of the hemp and flax grown in Canada in 1852, was therefore, according to his official valuation, L.23,971 provincial currency; and very nearly the whole was the growth of Lower Canada.

We now subjoin in tabular form the official amounts of the produce for 1852, and respective values of seven articles, which, added to the great staples of grain crops produced in Canada, assist very materially to swell the value of the aggregated productions of the country.

	Lb.		Value. £ currency.
Tobacco	1,253,128	at 0s. 6d.	31,328
Wool..................	4,130,740	at 2s. 0d.	413,073
Maple sugar	9,772,199	at 0s. 4d.	162,870
Hops	224,222	at 1s. 0d.	11,210
Flax and Hemp	1,917,666	at 0s. 3½d.	23,971
Hay..................... (tons)	1,647,435	at 40s.	3,294,870
Clover and grass seeds (bushels)	61,381	at 10s.	30,690
Total value of above seven productions,			L.3,968,012

The increased cultivation of wheat, especially in Upper Canada, is particularly gratifying; and, taken in connection with the rapid increase in the amount of cultivated land, and of the various descriptions of other produce, we are enabled thus the more readily to account for the present prosperous condition of the entire colony, and to look forward upon its important prospects with the greatest confidence. While the farmers of Upper Canada have been increasing in numbers, they have, at the same time, as proved by the results of the last census, been advancing in skill and intelligence. While the average produce of wheat in Lower Canada in 1852 was about 7¼th bushels per acre, the average produce in Upper Canada was about 15 bushels per acre—a remarkable contrast between the farmers of Upper Canada and those of the lower province, the majority of whom are still the same Norman French who settled on the banks of the St Lawrence above a hundred years ago, clinging still to their ancient traditional prejudices in their laws, customs, manners, and religion, with the increasing tenacity of an uneducated and unprogressive people.

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Wheat.

This contrast in regard to the produce of wheat between the upper and lower province is nearly quite as complete and striking in almost every description of crops. Thus the average produce per acre of oats in Upper Canada is 26½ bushels per acre, while in Lower Canada it is 15 bushels per acre. Barley in Upper Canada yields, on an average, 21 bushels per acre, while in Lower Canada 15 bushels is the average, being the same as oats. Pease on the average in Upper Canada yields 15 bushels, while in Lower Canada pease yields not quite 7½ bushels. Indian corn yields in Upper Canada 24 bushels, while in Lower Canada the same crop yields 17½ bushels. Turnips yield, on the average, in the upper province 212¾ bushels per acre, while in the lower province this description of crop yields precisely, on the average, 95 bushels per acre. In the crop of potatoes alone do the provinces approach in their respective averages per acre. The produce per acre of potatoes in Upper Canada is 64 bushels; Lower Canada 60 bushels.

The average produce of wheat per acre has increased, in Upper Canada at least, since 1847. In 1847 the average produce of wheat in the upper province was 13 bushels, in 1849 13½ bushels, and in 1852 15 bushels. The quantity of wheat produced altogether in the whole of Canada has increased remarkably within the last ten years. Whilst the growth of wheat in the United States during the last ten years has increased about 48 per cent., the growth of wheat in Canada during the same period has increased upwards of 400 per cent.[3] And Upper Canada is not much assisted by the lower province in this increased production of wheat; for, whilst the produce of wheat for all Canada in 1852 amounted to 15,768,720 bushels, Lower Canada only contributed as its share of this amount 3,075,858 bushels; thus showing Upper Canada to have produced the large amount of 12,693,853 bushels of wheat. The total value of the crop of wheat in Canada for 1852 was L.3,231,190; the value of that produced in Upper Canada alone being L.2,535,121.[3]

The particular localities of Upper Canada presenting the largest returns of wheat per acre, were the township of Equesing in the county of Halton, and that of Scarborough in the county of York; both townships near the head of Lake Ontario, Scarborough being situated a little east, and Equesing somewhat west of Toronto. The return for Equesing gave 26 bushels of wheat to the acre, and Scarborough 24 bushels. Comparing Canada with the United States as wheat-growing countries, it is found that the population of Canada, reaching at present to one-thirteenth part of the population of the United States, and the area of Canada being in square miles, exclusive of the territories, equal to one-sixth of that country, the growth of wheat in Canada now reaches very nearly to one-sixth of the growth of the whole United States and territories.

[1] Bouchette's *British Dominions in North America*, vol. i., p. 470–78.

[2] *Report of the Secretary of the Navy*, December 4, 1852, included in the *Message from the President of the United States to the two Houses of Congress*, December 6, 1852.

[3] The above and all other statements in regard to these statistics of population and agriculture are founded on the authority of the *First Report of the Secretary of the Board of Registration and Statistics of the Census of the Canadas for* 1851–2; printed by order of the Board, Quebec, 1853. Also, *Returns by the Secretary of the Board of Registration and Statistics*, accompanying the Earl of Elgin's despatch, dated Quebec, December 22, 1852. The writer has also before him official statements received from the government of Canada, dated Quebec, March 25, 1854.

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Upper Canada produces $13\frac{1}{4}$ bushels of wheat to each individual of its population; and calculating one-half of that quantity to be sufficient for home consumption in the shape of food and seed, we have the result that Upper Canada is able already to dispose of about 6,000,000 bushels of its annual crop of wheat. Again, comparing Upper Canada with one of the best wheat-growing portions of the United States, it is found that it produces 6 bushels more wheat to each individual of the population than the state of Ohio. The total value of grain and other produce in Canada in 1852 was estimated by the official census report at L.10,059,421.

Live Stock.

Canada possesses large numbers of live stock. The number of cattle, including oxen, milch cows, and calves, amounted in 1852 to 1,332,544 This number included 591,438 milch cows. The number of horses amounted to 439,377, and of sheep, 1,597,849. The increase of sheep and improvement in the weight of the fleece are gratifying proofs of the advancing prosperity of the country. The total value of live stock in 1852 was estimated at L.10,947,537.

The value of occupied land in Upper Canada, including the cultivated and uncultivated taken together, is set down in the official report on the census at 74s. 7d currency per acre, and in Lower Canada at 72s. per acre. In Upper Canada farms partly cultivated may not unfrequently be procured at prices ranging from L.3, 10s. to L.7, 10s an acre. The value of cultivated land in Lower Canada may be said to range from 15s. to L.7, 10s. an acre. The government lands of Lower Canada may be purchased from 2s. to 4s. per acre, and those of Upper Canada at 8s. per acre. In both provinces there are lands which the colonial government will allot, without purchase, to the extent of 50 acres, to individuals of 21 years of age and upwards, who have not previously received a grant of land from government, on condition that they satisfy the commissioner or his agent that they can support themselves until a crop can be raised. The lands of the Canada Company in Upper Canada range from 12s. to 30s. per acre, and those of the British American Land Company in Lower Canada from 10s. to 15s per acre.[1] Both of these companies also dispose of their lands on leases for a limited term of years, the yearly payment amounting to merely interest at six per cent. upon the value of the land. This arrangement is made with a view to the parties becoming purchasers of such lands. The Canada Company, as is known, was incorporated in 1826, and the British American Land Company in 1834; and both of these companies have contributed much to diffuse a better knowledge of the resources of Canada throughout this country.

The average value of agricultural products in Canada, as estimated in the official report on the census for 1852, was, for wheat 4s., barley 3s., pease 3s., Indian corn 2s. 6d., buckwheat 2s., and oats 1s. per bushel. Hay was valued at 40s. per ton, grass seed 10s. per bushel; hemp and flax 3d., tobacco 6d., hops 1s., and wool 2s. per lb., butter $7\frac{1}{2}$d.; cheese 5d., and maple sugar 5d. per lb.

Having given these details in relation to a country the interest in which has of late years largely increased in Britain, we close this part of the subject with an extract from an official report of the commissioners of emigration. The passage is from the despatch of the government emigration agent, A. C. Buchanan, Esq., stationed at Quebec, addressed to the commissioners, on the prospects of emigrants to Canada:—"The prospects and demands for labour are most satisfactory. The immense railway system undertaken by the provinces will greatly stimulate general prosperity, involving, as it will, the introduction and expenditure of a large amount of capital, which will secure steady and profitable employment for the labouring classes for several years to come; so that Canada never presented a more favourable opening for the reception of all classes of her Majesty's subjects, or such others as seek a comfortable home. The demand for labour of every kind is on the increase. The wages paid for unskilled labour are 4s. sterling per day." Mr Hawke, the emigration agent for Western Canada, speaks in similar terms:—"I have," he says, "conversed with many intelligent persons on the subject, and they are of opinion that able-bodied, unskilled labourers will be able to command a dollar a-day. Agricultural labourers must either get equal wages, or the farmers will not be able to retain them in their service. As the extensive railway works will not be completed for several years, and as such a large outlay of money will stimulate every other branch of business, I do not think it will be possible to overstock the labour market for many years to come; in fact, the prospects before us are of the most cheering description, for capitalists, merchants, mechanics, farm-servants, and common labourers, may safely calculate on finding in Canada an abundant demand for skill, capital, and labour, to a profitable, as well as to an almost unlimited, extent."

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Trade of Canada.

The trade of Canada at a period not very distant was confined chiefly to the exportation of furs, seal-oil, and timber, little exceeding L.100,000 annually. Prior to the year 1759, when the country, with its population of 65,000 inhabitants, was transferred from the government of France to that of England, the precise amount of its annual exports was L.115,415. The principal trade was furs, in pursuit of which the great forests were traversed by bands of resolute adventurers. A few ships were occasionally built. Agriculture was neglected, if not actually despised.

Upon the conquest of the country, however, by England, the cultivation of the soil attracted the attention of the settlers, and the germs of a trade sprung up which has now grown to be one of real magnitude and importance. In 1769 the exports in furs, oil, fish, &c., amounted to L.355,000, and the imports in British manufactured goods and West India produce, reached L.273,400. This trade employed 70 vessels; about 12 vessels were at this period engaged in the fisheries of the St Lawrence, and about 6 were sent to the West Indies.

In 1799 and the three following years we find a comparatively large exportation of grain taking place. In 1802, 1,010,000 bushels of wheat, 38,000 barrels of flour, and 32,000 cwts. of biscuit, were sent abroad. The number of vessels at this period engaged in the trade of the colony, was 211, the aggregate burden of which amounted to 36,000 tons. In 1809 the first steamboat appeared in the harbour of Quebec.

In 1809, 1810, and 1812, the trade of Canada, benefiting by increased duties levied upon Baltic timber imported into Britain, seems to have been comparatively active. In the first of these years 440 vessels, having an aggregate tonnage of 87,825 tons, arrived at Quebec. In 1810 as many as 635 vessels arrived in the St Lawrence, with an aggregate tonnage of 138,057 tons; and in the same year 26 vessels, having a tonnage of 5836 tons, were built in the province. In 1812, 532 vessels, with a tonnage of 116,687 tons, cleared at the port, 37 of which had been built at Quebec.

The war which commenced in 1812 between the United States and Britain severely checked the commerce of the St Lawrence, which was greatly dependent upon the Americans. And, notwithstanding that Britain slightly relieved the import duties on wheat in favour of Canada in 1814, we find that the trade of the colony from 1810 to 1820 remained almost stationary. The aggregate tonnage which arrived at Quebec in 1820 (a more prosperous year, if shipping be taken as the criterion, than any of the preceding ten), amounted only to 9697 tons over that of 1810. In 1810 26 vessels had been built in the colony, and only 7 were built in 1820.

According to the old system of colonial monopoly, the St Lawrence was rigidly closed against the entrance of foreign vessels, nor was any Canadian vessel allowed to enter a foreign port. The prosperity of the colony during this period of its infancy was believed not to have been materially checked by these restrictions, as the mother country at all times afforded an outlet for its surplus produce. After the United States had achieved their independence, their vessels were excluded from the ports of the British

[1] When not otherwise mentioned, all monies introduced in this article in connection with Canada are stated in provincial currency, which may be reduced to sterling by deducting a fifth. The sovereign is valued in Canada at 24s 4d., currency. The exact rule to reduce this currency into sterling is to multiply by 60 and divide by 73. To convert sterling into currency add 1-5th to the sterling, and 1-12th to the 1-5th.

colonies; and Canada, as a reward for its loyalty, received the exclusive privilege of supplying the West India islands with timber and provisions.

In this manner, as the trade of Canada had been confined and shackled for the supposed benefit of the mother country, so now was she to receive compensating privileges to the direct injury of the sister colonies of the West Indies. The United States ports were the natural resorts of the West Indies for timber and provisions, their distance from these being about one-half less than the ports of the St Lawrence. But the additional freight, which on such bulky articles constitutes a great proportion of the expense, was not only enhanced by this circuitous route, but the West Indies had to pay besides for transhipment upon such as were supplied by the United States to Canada for the West Indian market. The West India planters were thus laid under contribution for the support of the Canadian shippers and farmers.

These regulations were, however, so far relaxed in favour of the West Indies in 1822, that the wheat and lumber of the United States were allowed to be imported directly on payment of certain duties; but at the same time duties were imposed upon agricultural produce entering the British American colonies as well as the West Indies.

The immediate result of this measure, so far as it affected Canada, was that one-half of the export trade of the St Lawrence was at once destroyed. The simultaneous abundance of the English harvest, together with the restrictions then in force upon the importation of grain into Britain, even from her own colonies, forbade any exports thither, and thus seriously aggravated the depression of Canadian commerce, and afforded another illustration of the ruinous policy of bolstering up one class by privileges and exemptions, and shackling another by restrictions and duties.[1]

In 1825 Britain admitted Canadian flour and wheat into her ports at a fixed duty of 5s. sterling per quarter. Meanwhile a fresh trouble had already arisen to try the vexed fortunes of Canada. Previous to 1822, American exports to a considerable extent, as we have observed, sought the route of the St Lawrence, as if they had been of Canadian origin, very materially, of course, to the benefit of the trade of the colony. The opening of the Erie and Champlain canals in the United States, however, in 1825, drew off into a different channel those American exports which had formerly sought the Atlantic by way of Quebec, and the trade of the St Lawrence was thus seriously injured.

In 1826, however, we find the prospects again brightening. The Americans were allowed, after four years of exclusion, to export timber and ashes for the British market into Canada free of duty. The duty upon Canadian flour for the West India market was also reduced.

The trade of the colony likewise profited by the disputes between Britain and the United States, which led to the interdiction of the American export trade to the West Indies, which was reduced from L.500,000, in 1826, to less than L.500 in 1830.[2] While the results were such to the United States, we find the trade of the St Lawrence in 1830 not only fairly recovered from the effects of the imperial acts of 1822, but far surpassing its position at any former period. The arrivals at Quebec in 1830 were 967 vessels, having a tonnage of 238,153 tons.

In 1831 the trade of the colony was still further favoured by the action of the home government. The forest and agricultural products of the United States were admitted into Canada free of duty, and could be exported by the St Lawrence, as Canadian produce, to all countries except the United Kingdom. A differential duty was also at the same time imposed upon foreign timber entering the West Indian and South American possessions, greatly to the benefit of the colony, which also profited by the scarcity of food existing in Britain at this time. The arrivals at Quebec during this favoured and prosperous year, were 1016 vessels, with a tonnage of 261,218 tons, and the exports of flour and wheat by the St Lawrence were about 400,000 barrels, chiefly to Britain.

Between 1831 and 1836 we find a complete reversal of the order of trade between the colony and the mother country. The crops in England during that period being unusually abundant, and a scarcity of bread-stuffs existing in the United States, wheat was in 1833 shipped from Britain to Quebec. A supply also came from Archangel. These imports from Europe to the St Lawrence amounted in 1835 and 1836 to about 800,000 bushels.

The departure of the mother country from the protective policy in 1842 was viewed with alarm by the colonists, as fraught with disastrous consequences to their interests. Up to 1842 Baltic timber had paid an English import duty of 55s. per load, while Canadian timber entered England upon payment of 10s. per load. The duty on foreign timber was now reduced to 30s. and Canadian to 1s. per load; being a reduction of 25s. on Baltic and of only 9s. on Canadian timber. At the same time the free importation of United States flour into the colony was stopped, and the West Indies were allowed, on the payment of a duty of 2s. per barrel, to import their flour direct from the Americans.

These serious blows to the trade of the St Lawrence fell upon the colony at the period of a commercial crisis, and were therefore felt more severely. The number of vessels that entered the St Lawrence in 1842, from the sea, was 377 less than during the previous year.

In 1843, Canada was allowed to import American wheat under a comparatively nominal duty, and to export it through the St Lawrence as native produce to the British market. This measure, which may be viewed as having been the first indirect blow at the English corn-laws, amounted to a virtual premium of about 6s. sterling per quarter upon American exports to Britain through the St Lawrence.[3] The British ports were thus at once in a great measure thrown open to all the great wheat-growing countries of North America. Canadian exports were rapidly swelled in consequence; and in 1846 half a million of barrels, and as many bushels of wheat and flour, were shipped by the St Lawrence. The timber trade of the colony, which was also seriously threatened in 1842 by the large reduction of the duty on Baltic timber imported into England, witnessed likewise in 1845 and 1846, not merely a revival, but a very material increase. The number of vessels that entered the St Lawrence was 1699 during each of these years, having an aggregate burden of over 620,000 tons; this being far the largest amount of shipping that had ever in any previous years entered the St Lawrence.

This flush of prosperity to the trade of the colony was the result of the last in the series of those fitful changes which had characterized the commercial policy of the mother country in dealing with the colony.

In return, however, for the concessions which she made in favour of the timber and corn trade of the colony, England prevented the Canadians from employing any other than British vessels for exporting her produce from the St Lawrence. The result of such a restriction was, that a class of vessels making only two voyages in the year to Quebec or Montreal, and seeking no cargoes elsewhere, secured a monopoly at privileged rates, thus virtually imposing a tax both upon the exports and imports of the colony. Besides, Canada was not allowed to choose the best or cheapest market for the purchase of the tea, coffee, sugar, and manufactured articles she required. No foreign ship could enter the St Lawrence with a cargo, unless such ship were built

[1] *The Canals of Canada*, by T. C. Keefer, C.E., p. 24.

[2] Ibid. p. 24.

[3] Ibid. p. 27.

and owned in England, and sailed by a master and three-fourths of a crew the subjects of the country, proof of all which was exacted. Again, no foreign ship could take a cargo from the St Lawrence, except under these and other restrictions still more stringent.

The abolition of the British corn-laws, repealing all privileges in favour of Canadian bread-stuffs in the British market, seemed at first sight to be a heavy blow to the interests of the colony. Much of the trade of the St Lawrence appeared to be placed in jeopardy, and at the same time the trade of the colony with the United States was in a great measure interdicted by a hostile tariff. The changed and more enlightened views, however, which now entered into imperial legislation, materially assisted the growing energies and intelligence of the colonists. The imperial government formally abandoned in 1847 all control over the customs of the colony, which immediately set itself to the task of regulating its own trade. One of the first measures of the colonial legislature was to abolish in a great degree the differential and prohibitory duties on colonial imports along the United States frontier; and the Americans upon the other side of the St Lawrence were by this measure placed, as regards matters of trade, upon an equal footing with England. The beneficial effects of this measure showed itself at once in increased commercial activity and prosperity over the whole of Canada.

On the 1st January 1850, England crowned her free trade measures by relieving the colonies from the very injurious effects of the British navigation-laws.

The value of the more enlightened views which thus entered into both imperial and colonial legislation have since been most satisfactorily tested in the growing wealth and prosperity which have attended the progress of the colony; the trade of which has never been more flourishing, its financial position more satisfactory, its general interests more hopeful, than at the present moment.[1]

Exports.

The exports of Canadian produce and manufactures, shipped chiefly to Great Britain and the United States, amounted in 1853 to..L.5,945,757
The value of exports during 1852 was.............. 3,826,901

Showing an increase on the previous year of..........L.2,118,856

Comparing the exports of 1853 with those of 1848, we find that, during these six years, their value had more than doubled. Thus—

Exports, 1853..........................	L.5,945,757
Exports, 1848..........................	2,302,830
Showing an actual increase of.....	L.3,642,927[2]

The staple exports of Canada are timber, ashes, and bread-stuffs, besides other agricultural and forest products. The principal of these articles is timber. The amount of white pine exported in 1851 was 453,435 tons, valued at L.406,972; of this Britain received to the value of L.381,370, and the United States to the value of L.24,747. The supply of this single article of white pine has increased more than 50 per cent. during the last five years. Although the extinction of the duties which operated as a protection to Canadian timber in the British market has thus in a very marked manner been attended by an increased trade in white pine, yet the amount of red pine which leaves the country has greatly declined. In 1849, the export of red pine was 4,070,600 feet; it had fallen in 1853 to 2,315,160. The trade in pine deals has increased from 2,282,390 pieces in 1849, to 2,425,309 pieces in 1853.

The value of deals shipped in 1851 amounted to L.239,369, nearly the whole of which was for the British market. The quantity of planks and boards exported the same year amounted to 120,175,596 superficial feet, valued at L.209,138, nearly the whole of which was bought up for the United States market. The trade in Canadian forest products has increased in all from the value of L.1,600,000 in 1852, to an amount in 1853 of probably not less than L.2,250,000.

The duty upon Canadian square timber now entering Britain is 1s. per load, and upon sawn timber, such as battens, deals, and planks, the duty is 2s. per load. The great competition for freights, too, by the entrance of foreign vessels now into the St Lawrence, affords further facilities for the increase of the timber trade of Canada. With regard to the exports of sawn timber to the United States, Canada is enabled to carry on this trade in the face of a hostile tariff of 20 per cent. *ad valorem;* and notwithstanding this, the trade continues largely on the increase.

The United States government has not as yet acquiesced in the growing desire manifested in both countries to have the trade with Canada placed upon terms of reciprocity. Meanwhile it affords facilities to Canada for exporting and importing in bond through the United States territory, to the great benefit of its own shipping, as well as of its inland carrying trade by canal or railway, and consequently to the diversion of a large amount of the trade by the St Lawrence. These facilities of exporting and importing in bond are no doubt beneficial to the general interests of Canada. The exporter and producer are both benefited, to the extent of the greater saving either by lessened rates of inland transit or ocean freight. Were there no advantages to be gained, the mode of thus exporting or importing in bond through the United States would not be resorted to. The quantity of wheat and flour exported by Canada in bond to the United States from the shores of Lakes Erie and Ontario, by way of the river Hudson and New York, exceeded in 1850 the quantity exported by sea through the St Lawrence.[3]

Besides timber and bread-stuffs, Canada likewise largely exports pot and pearl ashes, classed under the head of products of the forest; this valuable staple of the colony being manufactured from the ashes of the burnt timber, collected chiefly in the process of clearing forest land preparatory to the labours of the husbandman. The value of ashes shipped from Canada in 1851 amounted to L.216,361, the greater part of which were destined for Great Britain. Horses appear in the exports from Canada to the United States in 1851 to the value of L.53,193. Furs and skins are also exported from Canada,—the largest amount being to the United States. Among other items of Canadian produce may be mentioned fresh, dried, and pickled fish; cows, oxen, sheep, butter, lard, pork, candles, wool, eggs, beans and pease, oats, hops, malt, flax and other seeds, iron, copper ore, and fine copper. Nearly the whole of these articles find a ready market in the United States. The chief exception is butter, of which exports to the value of L.36,402 in 1851 were shipped to Britain. The trade in copper and copper ore which has sprung up within the last few years, since the discovery of the mines along the shores of lakes Huron and Superior, promises soon to become very valuable and important.

Not the least important of Canadian exports now only remain to be mentioned. The trade in colonial-built ships is now one of considerable magnitude in British America, and is carried on under great facilities by the colonies. These facilities may be stated to be, the cheapness of materials on the spot where such are produced, the reasonable rates of wages at the ports during winter, and the advantage at all times secured of outward freight to Britain, where these ships find a

[1] A document of some weight bearing directly upon the subject, while illustrating and proving what has been here stated in the above brief historical review of the trade of Canada, has just reached England from the colony. This is the report of the council of the Quebec Board of Trade, dated April 3, 1854. "The year just passed," observe the Quebec merchants in this report, "has been one of great and general prosperity to the province, in which this city in every branch of export trade has fully shared. And the majority of this council, having been always strong advocates of free-trade principles, cannot but advert to the great advantages which have resulted to the Canadas since the establishment of such; and they refer with marked satisfaction to the yearly increasing numbers of foreign vessels frequenting the St Lawrence employed in carrying away our staple articles of export."

[2] Return from Inspector-General's Office, Customs Department, Quebec, March 24, 1854.

[3] Report to the United States Senate, by I. D. Andrews, United States Consul, &c. p. 412.

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market. During the ten years previous to 1852 the number of ships annually built at Quebec had varied from 37 to 70, with an aggregate burden of from 13,785 tons up to 41,505 tons. There are about 25 ship-building establishments at Quebec, and 8 or 10 floating docks, capable of receiving largest-class vessels. The class of vessels built range from 500 to 1500 tons and upwards; and a resident "Lloyd's surveyor" has recently been established at Quebec to inspect and class ships. The average cost is stated by Mr Israel D. Andrews to be from L.5, 10s. to L.7, 10s. currency per ton, and complete for sea for L.8 to L.10 currency per ton.[1]

The trade of Canada is chiefly carried on with Great Britain and the United States, the latter being now a rapidly growing market. Canada also exports to the sister North American colonies, to the West Indies, and to foreign countries.

Imports.

The imports of Canada, to which we have now to direct attention, comprise the very varied catalogue of necessaries and luxuries in demand by a highly prosperous people. According to official returns—

The imports of 1853 were	L.7,995,539
The imports of 1852,	5,071,623
Showing an increase on the previous year of	L.2,923,916[2]

Upon making a comparison with the returns for 1848, we find the value of Canadian imports of 1853 more than triple the amount of 1848, which only represented a value of L.2,429,584. The actual increase during these six years was L.5,365,955.

One item alone has materially assisted this rapid increase. Railroad iron is now being very largely introduced through the St Lawrence, a great part of which is for the gigantic railway undertakings now in progress. The larger proportion, however, imported in 1853 was for the consumption of the United States; the St Lawrence being the most economical route for heavy goods, and for emigrants destined for her western territories.

The value of railway bars imported through the St Lawrence in 1853, for use in Canada, was	L.205,846
Imported for use in the United States	220,333
Total value	L.435,179

representing not less than 39,810 tons railway bars, dead weight, imported in 90 British and 7 foreign vessels.

The appearance of foreign vessels in the St Lawrence is also a new and promising feature, and will prove of great benefit to Canada, as freights will thus be lessened by increased competition. Not fewer than 187 foreign vessels entered the port of Quebec during 1853; 53 of which were United States vessels, 88 Norwegian, 27 Prussian, 7 Portuguese, and 4 Swedish. The total number of arrivals at Quebec was—

	Vessels.	Tonnage.	Men.
1853	1351	570,738	19,360

The greater number of these vessels cleared for Great Britain, chiefly with cargoes of timber, others cleared for Nova Scotia, New Brunswick, Newfoundland, the United States, &c.

The class of manufactures most largely imported into Canada is cottons. In 1851 Canada purchased cottons to the value of L.976,366, of which L.741,292 were obtained from Britain, and L.234,689 from the United States. We here present a tabular view of some of the chief articles of import of 1851, distinguishing the proportions received from Great Britain and the United States.

	Great Britain.	United States.
Manufactures and Goods paying 12½ per cent. Duty.		
Cottons	L.741,292	L.234,689
Linen	102,436	11,198
Silk	156,901	35,602
Wool	591,337	136,143
Iron and hardware	316,902	144,746
Machinery	1,715	40,276
Paper	14,744	12,077
Leather, tanned	11,823	35,522
Oil	L.28,040	L.19,499
Glass	12,387	9,873
Fur	13,838	11,554
Articles not enumerated,	466,229	233,027
Goods paying 2½ per cent. Duty.		
Hides	L. 191	L.51,278
Iron-bar, rod, and sheet	119,144	1,642
Boiler plate, and railway bars	44,136	701
Pig-iron and scrap	45,444	1,282
Steel	18,095	762
Goods admitted Free.		
Books	L.13,230	L.55,027
Wheat	118	73,621
Settlers' goods	4,146	32,149
Unenumerated	3,591	6,183
Goods paying Specific and ad valorem *Duties.*		
Tea	L.21,196	L.237,490
Coffee	1,096	28,943
Sugar, refined	11,207	8,585
Do., other kinds	25,307	60,637
Tobacco, unmanufactured	239	14,933
Do., manufactured	449	94,479
Goods paying 30 per cent. Duty.		
Fruit, green	L. ...	L. 6,371
Do., dried	8,680	13,653
Spices	6,129	5,690

Trade with the United States.

Besides the value of these returns, in throwing some light upon the nature and extent of the demands of the colony for our manufactures and other goods, they afford some startling revelations of the extent to which our rivals of the United States supply the market. We find nearly one-fourth of the total demands of Canada for cotton manufactures are supplied from the manufactories of the United States.

The silks purchased by Canada from the United States are to a large extent the manufactures of France imported by the Americans, who also buy similar stuffs largely in the Indian market, besides bandanas and other handkerchiefs.

The description of goods classed as iron and hardware with which the United States supply the Canadian market, embrace large quantities of edge tools. These the Americans produce of a very excellent kind, and most ingeniously adapted to the required uses of the particular article.

It only now remains to mention another class of Canadian imports from the United States, and of which that country has almost a monopoly. Teas, coffees, sugars, fruits, wines, and spirits, are in a great measure purchased by the United States themselves, directly from the countries producing these commodities, and sold by the American merchants to Canadian retailers. The United States command the Canadian market for tea and coffee, for this reason, that American vessels, or foreign vessels entitled by reciprocal treaties to be exempt from discriminating duties, are allowed to introduce such articles into the United States direct from the place of growth duty free. The duty on tea supplied to Canada is 1d. per lb., with a further impostof 12½ per cent. Coffee pays from 4s. 8d. to 14s. per cwt., and a further *ad valorem* duty of 12½ per cent. Sugars pay from 9s. to 14s. per cwt. and an *ad valorem* duty of 12½ per cent. The above goods, such as teas, sugars, &c., classed as "paying specific and *ad valorem duties*," imported into Canada during 1851, are those which perhaps show the most considerable balance in favour of the United States as compared with Britain. The native manufactures of the United States, of almost every description, are, however, finding a rapidly increasing market in Canada. Those who have seen the reports of Messrs Whitworth and Wallis, the commissioners sent from England to the New York Industrial Exhibition, will be best able to form an opinion of the rivals British manufacturers have to meet in the people of the young republic.

Upper Canada, owing very much to its greater proximity to

[1] Report to the United States Senate, by I. D. Andrews, p. 421.

[2] Returns from Inspector-General's Office, Customs Department, Quebec, March 24, 1854.

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the United States, is already an important customer of America. The city of Hamilton, at the head of Lake Ontario, with a population in 1851 of 14,112, imported during that year from the United States goods to the value of upwards of *one million dollars*. The city of Toronto purchased from the United States in the same year to the amount of $1,525,620. The value of similar imports at the port of St John, foot of Lake Champlain, Lower Canada, amounted to $1,774,596. Other inland towns of Canada deal on an equally large scale with the United States. The subjoined official returns, from the valuable report to the United States Senate by Mr I. D. Andrews, present at one view the rapidly increasing trade of Canada, and the extent of that trade with the United States, which is almost wholly conducted through the inland ports.[1]

Value of Imports into Inland Ports of Canada from all Parts.

Ports.	1848.	1849.	1850.	1851.
Toronto.........	$788,900	$1,315,452	$2,538,888	$2,601,932
Hamilton	941,380	1,123,024	1,583,132	2,198,300
St John.........	1,106,692	1,213,640	1,477,784	1,948,460
Kingston	303,788	384,044	499,040	1,025,492

Value of Imports, 1851, *into Inland Ports of Canada from United States.*

Ports.	Total Imports, 1851, from all parts.	Amount from United States.
Toronto	$2,601,932	$1,525,620
Hamilton................	2,198,300	1,049,756
St John	1,948,460	1,774,596
Kingston	1,026,292	915,912

Mr Andrews gives the following statement of the total export and import trade between Canada and the United States in 1851.[2]

United States Imports from Canada, 1851.

Paying duty..............	$1,624,462	
In bond	1,593,324	
Free	94,464	
Total..........................		$3,312,250

United States Exports to Canada, 1851.

Domestic...................................... .	$5,495,873	
Foreign under bond, and Foreign not under bond, ...	3,440,363	
		$8,936,236

Showing a total amount of export and import trade between Canada and the United States of ... . } $12,248,486

The exports from Canada to the United States consist chiefly of sawn and roughly prepared timber, classed as lumber and shingles; and of bread-stuffs, chiefly flour and wheat. Cattle and horses, ashes, wool, butter, and eggs, are also in the list of exports. The returns of the Canadian customs and those of the United States customs for 1851 differ in amount to a considerable extent. It is probable, however, the different periods of the year at which the respective returns are made up explain this discrepancy.

The United States returns of imports from Canada in 1851 represent the value as .... } $3,312,250

The Canadian returns of exports to United States, 1851, represent the value as... ... . } $4,929,084

The amount of produce exported from Canada to the United States in bond for shipment at New York and Boston, amounted in 1851 to $1,546,534. This produce consisted chiefly of bread-stuffs, ashes, furs, and butter. The amount of Canadian wheat shipped at New York during the three years 1849, 1850, and 1851, was 1,478,704 bushels, valued at $1,040,914, of flour 633,722 barrels, valued at $2,337,124.

The great proportion of the lighter and more valuable articles of trade, such as dry goods and jewellery, which are introduced under bond into Canada through the United States, is received through Boston; and the heavier goods, such as railroad iron, chiefly through New York.

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Imports in bond into Canada through New York, 1851,	$548,142
Do. do. Boston, 1851, ...	590,771
Total imports into Canada in bond through United States, 1851, ...	$1,138,913

Trade of the great lakes.

The large and increasing amount of shipping on the great American lakes affords peculiar facilities for carrying on a prosperous trade between the countries on their northern and southern shores. These lakes, which are estimated to drain an area of 335,515 square miles, presented little more than 50 years ago, namely, in 1800, scarcely a craft above the size of an Indian canoe. The first American schooner on Lake Erie was built in 1797. The first steamer was launched on Lake Ontario in 1816. The American licensed tonnage of these two lakes, Erie and Ontario, amounted in 1851 to 176,852 tons, a large and increasing proportion of which was steam. The value of American commerce on the two lakes was estimated in 1851 at $239,712,520, which is nearly L.48,000,000 sterling. The precise American traffic of all the lakes was estimated by Mr Andrews in 1851 thus:—

	Tons.
Steam vessels.......	74,000
Sailing vessels	138,000
Total tonnage	212,000
Value of traffic...	$326,000,000

being upwards of L.65,000,000 sterling.

The total number of Canadian vessels, including those belonging to the ports of Quebec and Montreal, stood in 1849 thus:—

		Tons.
Steam vessels........................	103	14,149
Sailing vessels......	620	71,295
Total vessels and tonnage.........	723	85,444

The average capacity of the 157 American steam vessels on the lakes in 1851 was 437 tons; but the average of 25 of the largest fell little short of 1000 tons. The average of the 25 largest lake steamers in 1839 was not quite 500 tons.

With a summary in tabular form, we shall now close this important part of our subject, embracing the trade of Canada—

1. *Value of Canadian Imports*, 1851, *distinguishing Rates of Customs Duties, and Amount of Importations from respective Countries.*

	Great Britain.	United States.	British North America	West Indies.	Various foreign countries.	Total value.
	L.	L.	L.	L.	L.	L.
Goods paying specific and *ad valorem* duties	86,332	495,622	70,763	2902	87,640	743,261
30 per cent. duty..	15,263	26,460	974	299	5,153	48,151
20	1,879	12,450	3	—	81	14,414
12½	2,484,876	1,049,510	8,536	70	38,079	3,581,073
2½	350,372	161,389	1,287	6	6,070	519,126
Free..................	73,309	346,007	27,678	128	5,548	452,671
Grand total imp.	3,012,033	2,091,441	109,242	3406	142,574	5,358,607

2. *Value of Canadian Exports*, 1851, *showing Amounts exported to respective Countries.*

To Great Britain	L.1,505,351
To United States...........	1,017,836
To British North America	259,380
To West Indies.......	987
Other foreign countries	41,026
Total as above	L.2,824,630
Add ships built at Quebec.......	416,550
Add also 20 per cent. on exports from inland ports to make up for presumed deficiency in returns..	211,471
Total exports, 1851..............................	L.3,452,651

of which L.2,183,825 were by seaports, and L.1,268,826 by inland ports.

[1] Report to the United States Senate, by I. D. Andrews, p. 430.

[2] Ibid. p. 428.

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3. *Value of Canadian Exports and Imports annually, during four years ending* 1853.

	Exports.	Imports.
1850	3,235,948	4,245,517
1851	3,452,651	5,358,697
1852	3,826,901	5,071,623
1853	5,945,757	7,995,359

4. *Arrivals and Tonnage at the Port of Quebec annually, during five years ending* 1853.

	Vessels.	Tons.
1849..............	1064	431,953
1850..............	1078	436,379
1851..............	1185	505,034
1852......	1055	454,102
1853............ ..	1188	531,648

5. *Foreign Vessels engaged in the Quebec Trade during* 1851–53.

	1851.		1852.		1853.	
	Ships.	Tons.	Ships.	Tons.	Ships.	Tons
Norway	47	17,640	58	21,577	93	33,459
United States.... ..	35	20,062	51	34,172	55	39,174
Prussia	21	6,677	0	...	26	9,146
Sweden........	8	989	3	979	4	1,016
Mecklenburg.......	2	478	2	467	0	...
Portugal............	0	...	4	732	7	1,083
Bremen.	0	...	1	131	0	...
Hamburg...........	0	.	1	599	4	1,496
Russia...............	8	3,668	32	10,314	1	451
Holland	0	..	0	...	1	217
Spain	0	. .	0	...	1	145
Hanover.....	1	212	0	...	0	..
Total...... ..	177	50,726	152	68,774	192	86,190

It will be observed from the above table, that notwithstanding the withdrawal of 31 Russian vessels which traded to the St Lawrence in 1852, the number of foreign vessels in 1853 has upon the whole largely increased.

The various movements that have taken place in connection with the trade between Canada and the United States, diverting a considerable portion of the trade of the colony from the St Lawrence, would prepare us for some marked effect in this direction, showing itself in the arrivals of vessels and tonnage at Quebec. Any such diversion of trade from this route of the St Lawrence seems not to have as yet caused any diminution, at least in the Quebec arrivals. And every vessel arriving there is believed to receive outward freight. The operation of the Canada Corn Act of 1843 gave a temporary impulse to the trade of Quebec and Montreal by the preference accorded in the British markets to produce conveyed by the St Lawrence. At present the facilities afforded by the United States government for the transportation of Canadian exports and imports in bond through its territory, and the multiplication of railways connecting the bank of the St Lawrence with different points on the coast, have contributed largely, however, to divert trade from the usual seaports of the colony.

Emigration.

It may be laid down as a fundamental principle, that colonies are as much governed by the laws of demand and supply in regard to the amounts of the various descriptions of population required, as are individuals, companies, or communities in their ordinary transactions; and any departure from those laws inflicts injury as much in the one case as in the other. Grand schemes of emigration, conducted, as at present, in the absence of precise and detailed information with regard to our colonies, would most probably present similar disheartening results which grand schemes of other shipments would which had not been "ordered," or had been sent without full acquaintance with the particular necessities or demands of the country. The history of every colony affords ample illustration of the truth of these remarks.

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The slight decrease upon previous years of the emigration of 1852 and 1853, both to the United States and to Canada, is owing, no doubt, to the improved condition of the working classes in Britain, and also in some measure to the larger flow of emigration to the Australian colonies. The emigration of 1853 to Canada is reported, by the chief agent for the superintendence of emigration stationed at Quebec, to have been of a satisfactory nature; the emigrants generally having afforded indications of the present improved condition of the home population. The present unsettled state of the continent of Europe will most probably direct a considerable flow of emigration to North America, and, as Canada is now becoming better known and appreciated, it will receive a share of these expected emigrants to swell its population.

The St Lawrence emigration embraces a large number destined for the western regions of the United States; while at the same time it is believed also a large number of the emigrants arriving at New York proceed to Canada. Of 7526 foreign emigrants referred to by Lord Elgin in his despatch of 22d December 1852, as having arrived in Canada in that year, 5159 were Germans and 2197 Norwegians. The whole of the Norwegians, Mr Buchanan, the chief emigrant agent, states in his report, proceeded direct to Milwaukie, on Lake Michigan. Of the Germans about 2000 are estimated to have remained in Canada.

The parliamentary papers relative to the emigration of 1853 present the following statement of arrivals at Quebec for the years 1852 and 1853, distinguishing the number of emigrants from the respective countries, thus:—

	1852.	1853.
From England, ...	9,585	9,276
„ Ireland, ...	14,417	15,983
„ Scotland,..............................	4,745	5,477
„ Germany,.............................	2,400	5,159
„ Norway,...............................	5,056	2,197
Lower ports of the Gulf of St Lawrence,	496	1,184
Total,..........................	36,699	39,276[1]

These "Lower Ports" which contributed to Canada in 1852 1184, and in 1853 496 emigrants were, it is believed, chiefly Scotch, or their descendants, from Cape Breton, Prince Edward's Island, and New Brunswick, who having disposed of their farms were removing to settle in Upper Canada.

The number of vessels engaged in the passenger trade to the St Lawrence in 1853 was 324, measuring 155,673 tons, and navigated by 5601 seamen. This shows a smaller number of vessels, but with a larger tonnage than during the previous year of 1852. Of this number, 47 were foreign vessels, 37 of which came from continental ports, and 10 from the United Kingdom. We here observe the gratifying fact of a further increase of foreign vessels to the St Lawrence during 1853, which shows the growing preference given to the St Lawrence for the conveyance of emigrants even for the western regions of the United States. Nearly the whole of the Norwegian emigrants of 1853 proceeded, as in 1852, direct to the Western States. A large number of the Germans of 1853, like those of 1852, settled in Upper Canada. Mr Buchanan estimates the number of emigrants who proceeded to the United States in 1853 at 11,504, the largest number of whom were Norwegians and Germans. Of the

[1] Papers relative to Emigration to the North American Colonies, presented to Parliament, April 1854.

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remaining 25,195, 19,000 are reported to have proceeded to Upper Canada; 1800 up the river Ottawa, the chief seat of the lumbering trade; and 4395 were absorbed into the populations of the Montreal and Quebec districts, and the eastern townships of Lower Canada, and employed on the railways and public works. In addition to the numbers who proceeded to Upper Canada by the St Lawrence, from 4500 to 5000 are believed to have entered the colony through the ports of Boston and New York, in addition to large numbers of labourers from the public works of the Western States, to be employed on the railways. The establishment of the Canada line of steamers had been already beneficially felt, by a large increase of cabin passengers from Liverpool during the season of 1853.

The numbers of persons who appear to have received assistance to emigrate in 1853, were, according to the report from the emigration department at Quebec, 122 from England, 1600 from Ireland, 351 from Scotland, and 31 from the Continent. The assistance was contributed by parishes, poor-law unions, and private individuals. Of the 351 persons who had received assistance to emigrate from Scotland, 332 were highlanders from the Glengary estate in Inverness-shire, who were provided with free passages by their landlord. They are reported by the emigration agent to have been a fine body of settlers. The remaining 19 persons were from Colonsay, Argyleshire. Of the 1600 persons assisted from Ireland, 1464 were sent out by poor-law unions, and received L.1665 sterling on landing at Quebec. It may be mentioned as somewhat remarkable in connection with this Irish emigration, that of the 1464 persons 1172 were females. This large proportion of females is accounted for by their having been sent out from the poor-law unions; coupled also, as Mr Buchanan observes, "with the pecuniary means afforded to females for joining their husbands, brothers, or male friends already established in the province." Mr Buchanan speaks very favourably of the orderly conduct and correct demeanour of those persons. They at once proceeded up the country; and the great majority who were in search of employment received such a few hours after landing at their destinations.

Many intelligent emigrants brought out with them a considerable amount of capital, and settled in Upper Canada. Importations of valuable stock had also taken place during 1853; a favourable indication, as Mr Buchanan remarks, of the wealth and progress of the country. Emigration is greatly assisted by the information and means transmitted by settlers in the colonies to their relations and friends in Britain. Very large sums are annually sent by settlers, to enable their friends to join them in the colony. The lowered rate of postage to Canada will tend much to increase the intercourse between the colony and parent country.

The following official return gives the number of emigrants who arrived at the ports of Quebec and New York respectively, during each of the five last years ending 1853

Years.	Quebec.	New York.
1849,	38,494	220,603
1850,	32,292	212,796
1851,	41,076	289,601
1852,	39,176	299,504
1853,	36,999	284,945
Total,	188,037	1,307,449

The returns of the annual emigration from Great Britain for the last ten years, presents the proportion of emigrants for British North America compared with those who have sailed for other countries.

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Annual Emigration from the United Kingdom during the last ten years, from 1844 to 1853 inclusive.[1]

Years.	North American Colonies.	United States.	Australian Colonies and New Zealand.	All other Places.	Total.
1844	22,924	43,660	2,229	1,873	70,686
1845	31,803	58,538	830	2,330	93,501
1846	43,439	82,239	2,347	1,826	129,851
1847	109,680	142,154	4,949	1,487	258,270
1848	31,065	188,233	23,904	4,887	248,099
1849	41,367	219,450	32,191	6,490	299,498
1850	32,961	223,078	16,037	8,773	280,849
1851	42,605	267,357	21,532	4,472	335,966
1852	32,873	244,261	87,881	3,749	368,764
1853	34,522	230,885	61,401	3,129	329,937

Revenue, Debt, and Public Works.

The revenue of Canada is chiefly derived from customs and excise duties, from public works, and the proceeds of public lands and forests, and an impost of one per cent. on the circulation of the notes of the chartered banks of the colony. The net revenue in 1853 amounted to L.1,193,497, thus:—

Customs,	L.986,597
Excise,	22,523
Public Works,	77,665
Territorial,	63,961
Bank Imposts,	23,053
Miscellaneous,	19,695
Total net revenue, 1853,	L.1,193,497[2]

Upon comparing these figures with former periods, we find the revenue to have almost quadrupled in twelve years. For 1854 it is estimated to exceed L.1,500,000. The expenditure of the country, for all purposes, is now about L.700,000; and for 1854 it will probably amount to L.750,000. The increase in the revenue since 1843 is shown in the following table:—

Years.	Revenue.
1843	L.320,987
1850	704,234
1851	842,184
1852	880,531
1853	1,193,497

Public debt.

The public debt of Canada is L.3,448,318. Of this amount, L.1,500,000 was raised with the guarantee of the British government. The amount recently authorized to be increased to aid in the construction of the Grand Trunk and Great Western railways, will increase the amount of the public debt to very nearly L.5,000,000 sterling. L 75,000 sterling is annually carried to a sinking fund for the extinction of the provincial debt, which amount is invested in consols in England for that purpose. Consols have lately been purchased by means of the surplus revenue, to provide for four years of the sinking fund in advance.[3]

Public works.

The public works of Canada have already attained some degree of celebrity both in America and England. "There is no country," observes Mr I. D. Andrews, in his report to the United States senate, "which possesses canals of the magnitude and importance of those in Canada." The Erie canal, which is the rival American water route for carrying the produce of the great western wheat-growing countries to the Atlantic sea-board, is capable only of transporting barges of 75 tons burden; whereas the canals of Canada are on a scale to allow of ocean-going vessels of from 350 to 500 tons, and carrying 4000 barrels of flour, to proceed through them, and thus accomplish an inland navigation into the heart of the continent for a distance of 1587 miles from tide water at Quebec.

The public productive works of Canada, consisting of canals, lighthouses, &c., yielded a net revenue in 1851 of L.58,738. The work yielding the largest amount of revenue was the Welland canal, extending from the head of Lake Ontario to the foot of Lake Erie, thus overcoming the interruption to navigation caused by the Falls of Niagara. The length of the main trunk of this canal is 28 miles, and of a feeder branch from the Grand river to the main trunk 21 miles. Its width at bottom is 35 feet, at top 71 feet, and the

[1] Colonization Circular. Issued by H. M. Colonial Land and Emigration Commissioners, May 1854.
[2] Statement, Inspector General's Office, Quebec, March 25, 1854.
[3] Official communication, Government House, Quebec, March 25, 1854.

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depth is 10 feet. The dimensions of the locks are from 150 to 200 feet in length, the width from 26½ to 45 feet, and the depth on meter 9½ feet. The amount of lockage is 346 feet, and the number of locks 27. This canal is also important as affording an unlimited supply of water-power to numbers of mills and factories on its banks. The St Lawrence canals, connecting Lake Ontario with the river St Lawrence at Montreal, extend in all to 40½ miles, having 27 locks, and an amount of lockage of 204¾ feet. The whole of these have the dimensions of their locks as large as those of the Welland canal, and have all 9 feet of water in these locks. The Lachine canal, cutting through the island of Montreal, is 8 miles in length and 10 feet deep. It is now in contemplation to construct another important canal, connecting Lake Champlain with the St Lawrence, and thus afford a more desirable route for the trade between the Hudson river and Canada and the western states.

Railways.

The gigantic railway enterprises now in progress in Canada are intended to embrace a railway system traversing nearly the entire length of the province from east to west, with branch feeders running into the main trunk line, and carrying off traffic to the leading American cities and Atlantic sea-board.

Besides the government aid to this complete railway system through Canada, these undertakings are understood to receive substantial support from United States interests, the great western country, as well as the north-eastern states of the Union, being directly interested in the success of these Canadian lines; more expeditious routes between the agricultural districts of the west and their centres of trade being opened up by them. One of the most valuable features of these railways to Canada will be their affording the province increased facilities of trade during winter, and uninterrupted communication with ocean traffic when inland navigation is closed.

The most important line of this comprehensive railway system is the Grand Trunk railway. The entire length of this line, when completed, will be 1112 miles. Its eastern terminus is at Trois Pistoles, in Lower Canada. Thence upwards it proceeds along the south shore of the St Lawrence, passing opposite to Quebec, and continuing thus westward, reaches Montreal. Before reaching Montreal, the line effects a junction at Richmond, in the Eastern Townships, with a line of railway to Portland, on the Atlantic, in the state of Maine. The part of the line between Montreal and Portland, a distance of 292 miles, is now open. The communication between Portland and Quebec will be opened in August 1854.

At Montreal, one of the most stupendous structures of modern times will carry the railway across the river St Lawrence, which is here two miles in width. This gigantic undertaking is now in course of construction, under the superintendence of Mr Robert Stephenson, whose name is associated with the well-known Britannia tubular bridge. The Victoria tubular bridge of Canada, will, however, far surpass Mr Stephenson's earlier work. The total span of the arches will be 6168 feet, besides piers on either side, running into the river, each about half a mile long. The span of the centre arch is 360 feet. The number of arches is 25, and, with the exception of the centre one, each has a span of 242 feet. The tube, which is of iron, is 25 feet high and 18 feet wide. The other parts of the work, including the half mile of piers on either side, are wholly of solid masonry. The height from the water level of the river to the floor of the iron tube, will be 60 feet. In order to impart some idea of the strength of this stupendous work, it may be mentioned that each buttress is calculated to resist the pressure of 70,000 tons of ice. The estimated cost of the Victoria tubular bridge is stated to be L.1,400,000.

From Montreal the Grand Trunk line follows the north bank of the St Lawrence, touching the towns of Cornwall, Prescott, and Brockville, to the city of Kingston on Lake Ontario. This distance from Montreal to Kingston is about 180 miles, about 120 of which, from Montreal to Prescott, will be opened in October 1855

A branch line of 55 miles, connected with this part of the main trunk, will be opened probably during 1854, from Bytown to Prescott, opposite to the American port of Ogdensburgh, where an important connection will be here formed with United States lines of railway. Another line of about 80 miles will also be constructed in connection with this section of the Grand Trunk from Montreal to Kingston. This is one from Bytown to Montreal, following the course of the Ottawa, and joining the Grand Trunk at Vaudreil, close to the Ottawa, and to the junction of that river with the St Lawrence.

The Grand Trunk line, proceeding westward from Kingston, skirts the shores of Lake Ontario, passing the Bay of Quinte, through the towns of Belleville, Cobourg, and Port Hope to Toronto, the capital of Upper Canada. The length of this section of the line, from Kingston to Toronto, is about 200 miles; the length of the line from Montreal to Toronto being 380 miles.

A branch of this section of the Grand Trunk from Kingston to Toronto, extending to 30 miles from Cobourg to the town of Peterborough, on the river Otanabee, will be opened in October 1855. Another line is also contemplated from Belleville to Peterborough. The most important line branching from this main section of the Grand Trunk, 45 miles of which are already open, is that from Toronto northward, passing Lake Simcoe, and thence continuing to the great Georgian Bay on Lake Huron. From Toronto the Grand Trunk railway proceeds directly westward through the fertile peninsula of Upper Canada, passing the towns of Guelph and Stratford, and terminating at the flourishing town of Sarnia, at the head of the River St Clair and south-eastern extremity of Lake Huron. The entire length of the Grand Trunk line which is now being pushed towards completion, namely that from St Thomas, 40 miles below Quebec, to Guelph in Upper Canada, will be opened in September 1856. The remaining portions of the system will not be so actively proceeded with. The direct distance from Trois Pistoles to Sarnia is 850 miles.

At Toronto another important railway system commences, known as the Great Western. This railway commences from a joint station at Toronto in connection with the Grand Trunk railway, and skirts the head of Lake Ontario to Hamilton, a distance of 45 miles. It thence proceeds westward through the heart of the settled parts of the great peninsula, situated between the lakes Ontario, Erie, and Huron, passing through Brantford, London, and Chatham, and terminates at Windsor, on the River Detroit, directly opposite to the American city of Detroit, in the state of Michigan. At this point an important connection takes place with United States railways.

The Great Western line, besides its terminus at Hamilton, diverges to the Falls of Niagara. The Great Western railway is now open from Windsor to Hamilton and Niagara Falls, a distance of 220 miles. That portion of it from Hamilton to Toronto, 45 miles in length, will be opened this year, 1854.

We have now (returning to Lower Canada) to mention the St Lawrence and Champlain railway, which connects the south bank of the St Lawrence, opposite to Montreal, with the head of Lake Champlain at Rouse's Point, a distance of 45 miles. At Rouse's Point this railway connects with the system of railways to Albany, Boston, New York, and other parts of the United States. The Plattsburg railway commences at Caughnawaga, on the south shore of the St Lawrence, opposite to Lachine, and runs to the town of Plattsburg on Lake Champlain, a distance of 28 miles. The Montreal and Lachine railway, a short line of 9 miles, connects the city of Montreal with the upper part of the island at the village of Lachine. This railway, as also a portion of the St Lawrence and Champlain line, have been in active operation for several years.

The average cost of the construction of railways in Canada will be about L.9500 per mile. The average fares are from 1d to 1½d. per mile, according to distance of journey. The electric telegraphs in Canada convey messages at much more moderate charges than in England.

Banks and Currency.

There are eight banks in Canada, besides the Bank of British North America, which has its chief office in England, and spreads its branches all over British America. This bank, which was incorporated in 1840, has a capital of L.1,000,000 sterling. Of the eight more strictly colonial banks, four are in Lower, and four in Upper Canada. The most important of these is the Bank of Montreal, incorporated with a capital of L.750,000 currency. The three other banks in Lower Canada are the City Bank of Montreal, with a capital of L.300,000; the Banque du Peuple in Montreal, with a capital of L.200,000; and the Quebec Bank. The banks in Upper Canada are the Bank of Upper Canada, Toronto, incorporated 1821, with a capital of L.500,000; the Commercial Bank of the Midland District, Kingston, incorporated 1832, with a capital of L.500,000; the Gore Bank, Hamilton, incorporated with a capital of L.100,000; and the Farmers' Joint Stock Banking Company, Toronto.

Almost all of these institutions have branches in various parts of the country, and issue notes, payable on demand, from one dollar upwards. The least denomination of the notes of the Bank of British North America is four-dollar notes, representing one pound colonial currency. The greater number of these institutions are now understood to be paying from 6 to 7 per cent. per annum upon their paid-up stock; and the stock of the most successful among them was selling, in April 1854, at from 16 to 25 per cent. premium. All accounts are kept in Canada in pounds, shillings, and pence, provincial currency. The present one pound of provincial currency is about equal to 16s. 4d. sterling. The English sovereign is equal to 24s. 4d. currency; the shilling within a fraction of 1s. 3d.; and the halfcrown about 3s. 1½d.

Post-office.

The control of the post-office of Canada was transferred from imperial to colonial authorities in 1851.

Previous to 1851, rates averaging 9d. currency, or about 7½d. sterling, the half-ounce, varying according to distance, were charged on all letters passing through the Canadian post-office. After that

date, a uniform rate of 3d., or about 2½d. sterling the half-ounce, for any distance within the province, was substituted for the old rates. The returns of the Canadian post-office department show that, in the year ending April 1852, 2,931,375 miles were travelled by the mail—being an increase of 444,360 miles over the previous year, when the post-office was under the control of imperial authority. As many as 243 new post-offices were also added to the establishment during this first year of colonial control. The gross revenue of the first year of reduced rates amounted to L.59,800.

General Government and Political Constitution.

The government of Canada is designed to resemble, as closely as possible, that of the mother country. A governor-general, appointed by the crown to represent sovereign interests—a ministry, termed the executive council, chosen by the governor, to act as his advisers, and to conduct chief public offices—two houses of legislature, one, the legislative council, nominated by the governor; the other, the legislative assembly, elected by the people.

Members of the house of assembly require to be possessed of freehold property of the value of L.800. Electors in counties, by a law which takes effect in 1855, require to be possessed of or to occupy property of the assessed actual value of L.50, or the yearly value of L.5. Electors in towns to be possessed of or to occupy property of the yearly value of L.7, 10s. Members of the house of assembly, during session, have an allowance for their services, and the body undergoes a new election every four years. The present number of members of the house of assembly is eighty-four. The act passed last session of the Canadian legislature increases the number of members of assembly after the present parliament, that is, in 1855, to 130. These are chiefly elected by counties, a small proportion being elected by incorporated towns and cities. The cities of Montreal and Quebec elect by the new act each three representatives, and Toronto two. Members of the legislative council are selected by the governor from among individuals of distinction and influence in the colony. The appointment is for life, and the individuals so appointed have the title of *Honourable.* The present number of members of the legislative council is forty. The members of the executive council or ministry require to possess seats in the house of assembly, and retain their offices so long as they have the confidence of this branch of the legislature.

The basis of the political constitution of Canada is the act of the imperial parliament, commonly known as the constitutional act, which was passed in 1791, during the ministry of Pitt In dividing the old province of Quebec (which then embraced the whole of Canada) into the two distinct governments of Upper and Lower Canada, this act of 1791 endeavoured to make full provision for establishing and carrying on a certain form of representative government for each of the new provinces. The practical working of the government of the colony has since then been further explained and modified, particularly since the re-union of the provinces by the imperial act of 1841. The result of this has been the introduction of a more harmonious action between the executive branch of the government and the representative assembly.

Bills passed by both houses have to receive the sovereign's assent previous to their becoming law, either at once, through the delegated authority of the governor, or within a limited period, when the sovereign's pleasure may be consulted on the particular measure.

Territorial Divisions and Municipal Government.

Lower Canada, chiefly for judicial purposes, is divided into five chief districts. These districts are subdivided by the new Parliamentary Representation Act into 58 counties, for legislative and municipal purposes. The counties are further subdivided into seigniories, townships, and parishes. The seigniories comprehend the original individual grants of land of the French government under the feudal system, and which were afterwards partitioned into parishes. The townships are divisions of counties made under the English government since 1796, in free and common socage.

Upper Canada was, until quite recently, divided into districts, and these were subdivided into counties and townships. The old territorial division of Upper Canada into districts has been abolished, and that of counties and unions of counties substituted, for judicial, municipal, and all other purposes. The size of a township is ten miles square, which territory again is subdivided into concessions and lots. A township is divided into eleven concessions or ranges, usually running east and west, with roads along the division lines; and each range or concession is further divided into twenty-eight lots, each lot containing two hundred acres.

Under the old division of Upper Canada into districts, the highest municipal bodies were the district councils. By the Colonial Act of 1849, abolishing the districts for judicial, municipal, and other purposes, the powers of these district municipalities were transferred to counties. Townships, cities, towns, and villages have also corporate powers for their respective local purposes.

The qualification necessary to be elected as a township councillor, is to be assessed on the roll for rateable real property, as proprietor or tenant, to the value of L.100. All resident householders are qualified to vote as electors. The number of councillors elected in each township is five. The elections are annual.

The county municipalities are composed of the presiding councillors of the townships, villages, and towns in each county. The duties of the county council are similar to those of the township council, with the exception that they embrace a higher range in regard to affairs connected with a more enlarged jurisdiction—such as the county roads and bridges, erection and maintenance of county hall, court-house, gaol, house of correction, house of industry, and also the support of grammar-schools.

Laws and Administration of Justice.

In Lower Canada the old French law, which was introduced into the country in 1663, during the reign of Louis XIV., is still, with some exceptions, the law of property. The laws enacted in France after that period extended only to the colony when enregistered there. At the time of the country being ceded to England, the laws, language, and customs of the French population in Lower Canada were guaranteed to them by treaty. The tenure of property in Lower Canada is therefore feudal, with the exception of that of lands in the townships. These lands have been laid out of late years in the district of St Francis, and partially in other districts, where new townships have been surveyed. These township lands are held in free and common socage. In order, in some measure, to remove the inconveniences of the feudal system in the seigniories, and to render titles to property more secure, a system of registration has recently been established. The commercial law of Lower Canada is understood to be regulated partly according to the English custom of merchants, and partly by the old French code. The criminal laws of England were introduced into Canada by 14th Geo. III., cap. 83. No English laws passed since that period became laws of Canada, unless particularly so specified, or unless made laws of the colony by acts of the colonial legislature. This state of the criminal law extends both to Upper and Lower Canada.

An act (12th Vict., cap 38) passed in 1849 by the legislature of Canada, abolished the old courts of queen's bench in the judicial districts of Lower Canada; and the offices of two judges of districts; and established for Lower Canada a court called the Superior Court, consisting of a chief justice and nine puisne judges; four of these puisne judges to reside at Quebec, four at Montreal, one at Three Rivers, and one at Sherbrooke. This court has original civil jurisdiction throughout Lower Canada, except in admiralty cases, and cases expressly confided to the circuit courts. Appeals are allowed to it from the inferior courts.

The circuit courts have original civil jurisdiction to the extent of L.50 currency, that is, about L.40 sterling. In cases not exceeding L.15 currency, or not relating to property titles, the proceedings are summary. Where the matter in dispute does not exceed L.6, 5s., the case is decided according to equity. In cases exceeding L.15, appeal is allowed to the superior court. The circuit courts have sittings each month at Quebec and Montreal, and at longer intervals in the lesser and more thinly-settled districts.

The court of appeals, which is also the court of queen's bench, by the late new act, has appellate civil jurisdiction, and also the jurisdiction of a court of error; and original jurisdiction in all criminal matters, except admiralty cases. This court consists of a chief justice and three puisne judges. The court of error and appeal has two terms yearly, in each of the cities of Quebec and Montreal. Appeals are allowed in certain cases to the Queen in privy-council. The criminal court holds two terms yearly in each district, with the exception of Gaspé. The admiralty court has its sittings in Quebec.

Commissioners' courts are held monthly in the country parishes, for the summary trial of small causes, affording an easy and expeditious mode of recovering petty debts not exceeding L.6, 5s. currency. The circuit judges are *ex officio* commissioners of these courts. These commissioners' courts only date from the passing of the Colonial Act, 7th Vict., cap. 19.

The advocates, barristers, attorneys, solicitors, and proctors-at-law, in Lower Canada, are incorporated under the name of the Bar of Lower Canada. Barristers may act as attorneys and solicitors at the same time in Canada. Pleadings may be written in French or English in Lower Canada, and both languages are spoken in the courts. Judges of the Superior Court are selected from barristers of ten years' standing, and judges of the circuit courts from barristers of five years' standing.

Such, at present, are the more prominent constituted arrangements for the administration of justice in Lower Canada. We have now only briefly to enumerate the arrangements for Upper Canada.

The new provincial act, passed in 1849, 12th Vict., cap. 63, established two superior courts of common law in Upper Canada.

Canada. These are the court of queen's bench and the court of common pleas; and it also provides for a court of error and appeal. The court of queen's bench and common pleas are each presided over by a chief justice and two puisne judges. The court of error and appeal is composed of the judges of the courts of queen's bench, common pleas, and chancery. The court of chancery is presided over by a chancellor and two vice-chancellors. All the fees of these courts are paid into the consolidated fund, out of which stated salaries are paid to the clerks and other officials. The courts all sit at Toronto. The circuits are held twice a-year in each county, except in the county of York, in which Toronto is situated, where there are three a-year.

The county courts of Upper Canada have original jurisdiction in civil matters to the extent of L.25 currency, in open account, and L.50 in cases of notes or bills, with trial by jury. Appeals are allowed to the courts of queen's bench or common pleas. The division courts are held in different places in each county, by the county judge, for the summary disposal of cases not exceeding L.10. A jury is allowed in certain cases, though seldom applied for. The probate court is in Toronto, and there are surrogates in each county. The heir and devisee court has its sittings in Toronto twice a-year, to determine claims to lands in Upper Canada, for which no crown patent has issued in favour of the proper claimants, being heirs, devisees, or assignees. The commissioners are the judges of the court of queen's bench, the vice-chancellor, and other persons specially appointed. Then there are the quarter-sessions, the chairman of which is the county judge, who, with one or more justices, holds a court four times a-year for trials of petty offences by jury.

Education.

The principal features of the system of education in Canada have been derived from those of the states of New York and Massachusetts, assisted by the text-books of the National Board of Education in Ireland, and the normal school system of training teachers. The system is carried out with the aid of a grant of L 41,095 annually, set apart by government, and divided between Upper and Lower Canada according to their respective populations. Every school municipality, however, before it can obtain its share of this fund, must raise an equal amount. In Upper Canada the sums greatly exceed the required minimum. The total amount available for educational purposes in Upper Canada in 1852 was L.176,074.

At the head of the whole system is a council of public instruction and a chief superintendent of schools for each division of the province, both appointed by the crown. The councils have the entire management of the provincial and model schools.

"The system of public instruction in Upper Canada," observes Dr Ryerson, the chief superintendent for that division of the province, "is ingrafted upon the municipal institutions of the country. The municipal council of each township divides such township into school sections of a suitable extent for one school in each, or for both a male and female school. The affairs of each school section are managed by three trustees, who hold their offices for three years, and one of whom is elected annually by the freeholders and householders of such section. The powers of trustees are ample to enable them to do all that the interests of a good school require—they are the legal representatives and guardians of their section in school matters. They determine whatever sum or sums are necessary for the furnishing, &c., of their school and the salaries of teachers, but account for its expenditure annually to their constituents, and report fully to the local superintendent by filling up blank forms of annual reports which are furnished to them by the chief superintendent of schools from year to year. The township council imposes assessments for the erection of school-houses, or for any other school purpose desired by the inhabitants of school sections through their trustees. The inhabitants of each school section decide as to the *manner* in which they will support their school according to the estimates and engagements made by the trustees, whether by voluntary subscription, by rate-bills on parents sending children to the schools, or by rates on the property of all according to its assessed value, and opening the school to the children of all without exception. The latter mode is likely to supersede both the others; but its existence and operation, in connection with each school, depend upon the annual decision of the inhabitants of each school section at a public meeting called for that purpose.

The law also provides a system adapted to the circumstances of cities, towns, and incorporated villages. In each city and town there is one board of trustees for the management of all the schools in such city or town—two trustees elected for each ward, and holding office for two years—one retiring annually. In each incorporated village not divided into wards, there is a board of six trustees elected—two retiring from office and two elected, each year. These boards of trustees, thus constituted, appoint the local superintendent, and determine upon the number and kinds of schools, the employment of teachers, and all the expenses necessary for the schools in each such city, town, or incorporated village; and the municipal council is required in each case to raise the sum or sums estimated by the board of trustees for all their school purposes, and in the manner that they shall desire. There is also the same provision for the establishment of libraries in each city, town, and village, as exists in respect to their establishment in each township and county."[1] Canada.

The principle of recognising and combining in their official character all the clergy of the country, with their people, in the practical operation of the school system of Upper Canada, Dr Ryerson states, has been found to be eminently successful. Absolute parental supremacy is maintained by the people in the religious instruction of their children, providing for it according to circumstances, and under the auspices of the elected trustee-representatives of each school municipality. And with regard to the clergy, the same authority observes, that while they have free access to each school, "no instance has been known in which the school has been made the place of religious discord, but many instances, especially on occasions of quarterly public examinations, in which the school has witnessed the assemblage and friendly intercourse of various religious persuasions, and thus become the radiating centre of a spirit of Christian charity and potent co-operation in the primary work of a people's civilization and happiness."[2]

The returns for 1852 showed that in Upper Canada there were in that year 3010 common schools in operation, attended by 179,587 pupils, and that the total sum available for teachers' salaries, and for the erection and repair of school-houses, was L.139,285, this sum exceeding by three-fourths most probably the amount of the parliamentary grant. "In Lower Canada," observes the Earl of Elgin in his despatch of December 22, 1852, "where direct taxation is especially distasteful, the levy of a local rate was made compulsory, and attended for a time with some difficulty. The people in this part of the province are, however, becoming generally reconciled to a tax from which they derive so palpable a benefit, and the common school system is making satisfactory progress among them likewise."

Table showing the State and Progress of Education in Upper Canada, from 1849 to 1852 inclusive.[3]

Subjects Compared.	1849.	1850.	1851.	1852.
Population of Upper Canada	...	809,493	950,551	953,239
Population between the ages of 5 and 16 years	253,364	259,258	258,607	262,755
Colleges	7	7	8	8
Normal and Model Schools	2	2	2	2
Grammar Schools and Academies	40	57	70	98
Common Schools	2,871	3,059	3,001	3,010
Private Schools, as far as reported	157	224	159	167
Total Educational Institutions	3,077	3,349	3,240	3,285
Students attending Colleges	733	684	632	751
Students and Pupils attending the Normal and Model Schools	400	376	380	545
Pupils attending Grammar Schools and Academies	1,120	2,070	2,550	2,894
Pupils attending Common Schools	138,465	151,891	170,254	179,587
Pupils attending Private Schools as far as reported	3,648	4,663	3,948	5,133
Total Students and Pupils	144,366	159,684	177,764	188,910
	L.	L.	L.	L.
Amount available for Salaries of Common School Teachers	88,478	88,536	102,050	113,991
Amount expended for Building, Rents, Repairs of School-houses	...	14,189	19,334	25,094
Amount received by Colleges, Academies, Grammar and Private Schools	...	...	32,834	36,989
Total for Educational Purposes	88,478	102,725	154,218	176,074
Common School Teachers	3,209	3,476	3,277	3,388
Total number of Libraries, as far as reported	505	675	870	1,045
Total number of volumes therein, as far as reported	68,571	96,165	130,934	164,147

[1] Proceedings at the ceremony of laying the foundation stone of the Normal and Model Schools and Education Offices for Upper Canada, July 2, 1851. With sketch of the system of Public Instruction. By the Chief Superintendent of Schools. Toronto 1851, pp. 7, 8.

[2] Ibid. p. 7.

[3] Appended to *Canada, its Present Condition, &c.,* by William Hutton, Secretary to the Government Board of Statistics in Canada. London, 1854.

The Normal and Model School for Upper Canada, the support of which is provided for by appropriating a small portion of the common school fund, was established by the legislature in 1846, and has been very successful. The commodious building for this school and for education offices, the foundation stone of which was laid in 1851, is designed to accommodate 200 teachers in training, and 600 pupils to the model school. Rooms are also set apart for a school of art and design, in which it is proposed, by the aid of a legislative grant, to give a special course of instruction adapted to the interests and progress of the mechanical arts and manufactures.

There are no fewer than five universities in Canada, four in Upper Canada, and one in Lower Canada. There are also seven colleges, six of these in the upper, and one in the lower province. The universities are, the University of Toronto—Trinity College, Toronto—Queen's College, Kingston—Victoria College, Cobourg—and M'Gill College, Montreal. The colleges are, University College, Upper Canada College, Knox's College, St Michael College, Toronto, College of Regiopolis, Kingston, College of Bytown, and Bishop's College, Lennoxtown, Lower Canada. The charge for board and tuition at several of these higher educational institutions, where the system of education is similar to that of the English universities, is understood to vary from L.30 to L.50 per annum.

Religion.

The prevailing creed in Lower Canada is that of the Church of Rome, and in Upper Canada the largest denomination is that of the Church of England. The following tables from the census for 1851, present a classification of the chief religious bodies of Upper and Lower Canada.

1. *Upper Canada.*

Church of England,		223,190
Church of Scotland,	57,542	
Free Presbyterian Church,	65,807	
Other Presbyterians,	89,799	
		213,148
Wesleyan Methodists,	96,640	
Episcopal Methodists,	43,884	
Other Methodists,	67,132	
		207,656
Church of Rome,		167,695
Baptists,		45,353
Lutherans,		12,089
Congregationalists,		7,747
Quakers,		7,460
Other denominations and creeds not classed,		67,766
Total population,		952,004

2. *Lower Canada.*

Church of Rome,		746,866
Church of England,		45,402
Church of Scotland,	4,047	
Free Presbyterian Church,	267	
Other Presbyterians,	29,221	
		33,535
Wesleyan Methodists,	5,799	
Other Methodists,	3,449	
		9,248
Baptists,		4,493
Congregationalists,		3,927
Other denominations and creeds not classed,		46,790
Total population,		890,261

The Church of England, presided over by the bishops of Quebec, Montreal, and Toronto, had in 1851 these three dioceses, and 242 clergymen. The Church of Rome had seven dioceses and 543 clergymen. The Presbyterian Church of Canada, in connection with the Church of Scotland, had in 1853, 70 ministers, and about 40 vacant charges. The Presbyterian Church of Canada, in connection with the Free Church of Scotland, had in 1853, 90 ministers, and also about 40 vacant charges. The United Presbyterian Synod in Canada had 50 ministers, and about 15 vacant charges. The Wesleyan Methodists had 216 ministers and 9 vacant charges. Other Methodists had 175 ministers, and a number of vacant charges. The Congregational denomination had 48 ministers and 10 vacant charges. The Baptist denomination had 136 ministers and 16 vacant charges. The clergy of all denominations in Canada amounted in 1851 to 1500, of which number 641 were in Lower, and 859 in Upper Canada.

In Lower Canada the Roman Catholic religion is secured in the immunities and privileges it possessed under the French government. The lands which then belonged to that church, and the twenty-sixth part of the grain raised on farms cultivated by Catholics, are secured to it by law. One-seventh part of all the lands in the townships of Lower Canada, as well as of Upper Canada, were secured by an act of the imperial parliament, which has been called the Constitutional Act of 1791, for the support of the Protestant clergy. This government appropriation of lands, known as the Clergy Reserves, has given rise to lengthened and embittered party discussions, both in the imperial and colonial legislatures. The imperial legislature have recently, however, by act 16th Vict., cap. 24, passed May 9, 1853, given over the question, to be settled by the colonists themselves. The colonial legislature has not yet dealt with the question, and at present the proceeds of these lands are distributed to the leading religious denominations in the colony, the Church of Rome in Lower Canada excepted. The following is a statement of the

Appropriation of the Clergy Reserve Funds in 1851.

1. *Upper Canada.*

Church of England,	L.10,394	5	11
Church of Scotland,	5,847	16	7
United Synod of the Presbyterian Church,	464	18	4
Roman Catholic Church,	1,369	17	3
Wesleyan Methodists,	639	5	0
Total—Upper Canada,	L.18,716	3	1

2. *Lower Canada.*

Church of England,	L.1,786	15	0
Church of Scotland,	893	7	3
Total—Lower Canada,	L.2,680	2	3

History.

If we except the ancient Scandinavian voyages, the discovery of the American continent may be ascribed to John and Sebastian Cabot, who, under the auspices of Henry VII., visited the coast of Labrador in June 1497, nearly four months before Columbus came in sight of the mainland.[1] To Gaspar Cortereal, the next voyager in the course of the Cabots, is said to be due the discovery of the Gulf of St Lawrence. Other parts of the country were from time to time discovered by various expeditions, French and English; but not until 1535 were these attended by any material results of extended knowledge of the country. In that year Jacques Cartier, under the auspices of Francis I. of France, entering the St Lawrence, ascended the river to the spot where Montreal now stands, where there was then a circular Indian village surrounded by palisades, and situated amidst cultivated fields of Indian corn. In the year 1608 these and other discoveries were first turned to some practical account, when Champlain laid the foundation of the city of Quebec, and a French colony was established in the country. The settlement, however, continued to maintain a precarious existence; its administration being committed chiefly to trading companies, whose object was immediate gain, or to military governors who involved the colonists in perpetual feuds. For a century and a half the history of French colonization in the New World, occasionally relieved by the efforts and achievements of able and good men, is little else than a mere chronicle of bloody and harassing warfare with the native Indians, and latterly with the rival settlements of Great Britain. Some slight improvement, indeed, took place in the prospects of the colony in 1663, when Louis XIV., under the direction of his minister Colbert, erected Canada into a royal government with the laws and usages of France.

The treaty of Utrecht in 1713 gave a short peace to Canada, and enabled the governor, Marquis de Vaudreuil, to direct his attention to the improvement of the province, the trade and agriculture of which continued to prosper under his wise and vigilant administration. War again breaking out between Great Britain and France, the co-

[1] *History of the Travayles in the East and West Indies.* By R. Eden and R. Wills, 1577, fol. 267. Bancroft's *History of the United States*, vol. i., p. 11.

Canada. lonies were involved in hostilities. It had been the policy of France to hem in the English settlements in North America by a chain of forts extending from the Gulf of St Lawrence to the Gulf of Mexico. The jealousy of the English being kindled by this and other circumstances, it was resolved, in the course of the war, which was begun in 1755, to send an overwhelming force to North America, for the purpose of expelling the French from that quarter of the world. The army under General Amherst having, however, made indifferent progress, an expedition against Quebec was despatched from England in 1759, the chief command of which was confided to Major-General Wolfe, who, landing above Quebec on the 13th September 1759, carried the heights of Abraham, and defeated the French under the Marquis of Montcalm, who, along with Wolfe himself, was killed in the action. Quebec submitted in a few days, and soon afterwards Montreal and the whole country, which was finally ceded to Great Britain by the peace of 1763. So much had the country suffered during the French sway, chiefly through the combined ravages of war and want, that in 1759 the population had only reached 65,000. The Catholic religion was confirmed in all its rights and privileges to the French settlers; and the French laws were retained. The original inhabitants, thus conciliated, became the faithful subjects of the new sovereign; and when all the other American colonies rebelled against the tyranny of the mother country, they submitted to the imposition of the stamp act, and even took up arms to defend the country against an inroad of the American forces in 1775 under Generals Montgomery and Arnold. In 1791 the colony received a constitution, and was divided into Upper and Lower Canada; and the first parliament was held in Upper Canada in 1796. While the country was advancing in a career of prosperity, the war of 1812 broke out between the United States and Great Britain, and the frontier of Canada again became the scene of military operations. In the summer of that year the American forces under General Hull entered Upper Canada, and were completely defeated, and the greater part made prisoners by General Sir Isaac Brock. Another body of American troops collecting on the Niagara frontier, passed over into Canada in November, and were routed with severe loss on the heights of Queenstown by General Brock, who was unfortunately slain in the action. The Americans renewed their attempts on the Niagara frontier with no better success than before. Early in 1813, however, they succeeded in taking possession of York and Niagara, and shortly afterwards the British were foiled in an attack on Sackett's harbour. In January 1813, the American general, Winchester, was made prisoner, with the whole of his troops. To counterbalance this success, the American commodore captured all the British vessels on Lake Erie; and General Proctor was defeated near Detroit. The British were consequently obliged to retire, and an American army advanced in three divisions towards Montreal. One of these divisions, amounting to 7000 troops, was defeated by the Canadian militia; and another division meeting no better fortune, the whole American army retreated within their own territory, and thus terminated the campaign of 1813. The campaign of 1814 was decidedly favourable to the Americans. They were repelled at first in attempting to invade Canada. But the capture of Fort Erie by General Brown was an important success; whilst Sir George Prevost, who attacked Plattsburg with a force of 11,000 men, was repulsed with great loss; and the British squadron fitted out on Lake Champlain was defeated by the American force under Commodore Macdonough. The British were making great exertions to recover their ascendancy both by sea and land, when the treaty of Ghent, signed in December 1814, happily terminated the war, in which the loyalty of the Canadians both of British and French extraction was nobly vindicated.

Canada The subsequent history of Canada has been chequered by a course of dissensions between the provincial houses of assembly in Upper and Lower Canada and the respective executive governments, in which the home government also shared. The working of the system of provincial government, especially in the executive departments, had ceased to harmonize with public feeling, and acted in opposition to the expressed wishes of the popular branch of the legislature. Various abuses had crept into the administration, which were fostered by the high functionaries who held irresponsible offices, who guided the counsels of the successive governors more to their own advantage than to the interests of the province. The control and appropriation of the revenues and public offices were urgently demanded in Lower Canada, and were in part conceded; but many of the grievances remaining unredressed, disaffected leaders made use of them to goad the people to the brink of insurrection in 1836; the concessions of Lord Gosford and the home authorities being deemed insufficient. The disaffected of Lower Canada were joined by the malcontents of the upper province, and in the following year the whole of Canada broke out into open rebellion. On the 6th November 1837, the city of Montreal was disturbed by a body of 250 members of a secret association called *Les Fils de la liberté*. In various other parts of the country serious outrages were perpetrated. In the neighbourhood of Toronto, a large body of insurgents, who were organizing an attack upon the town, were routed and dispersed by a force of militia under Sir Francis Head. Their leader, after many adventures, escaped into the United States in female attire. The influence of the disaffected had in the meantime extended itself across the American frontier, and troops of "sympathizers" passed into Canada with the view of assisting the rebels. This outbreak, which continued throughout 1837 and 1838, elicited in a very decisive manner the loyalty of the great majority of the colonists; and as they were now in possession of the means to repel any assault, the numbers of the insurgents gradually melted away, and tranquillity was again restored. It was some time, however, before the rancour of party feeling was allayed, and the colony once more assumed an aspect of progress and prosperity.

The appointment of the Earl of Durham as governor-general and high commissioner in 1838, for the adjustment of the affairs of the colony—followed by that of Mr Poulett Thompson, afterwards Lord Sydenham, in 1839—the success and remarkable vigour of his government—and the prudent administrations of subsequent governors, aided by discreet and able counsels of colonial ministers in the home government, together with the late recognition of colonial control of internal affairs—have completely gained the confidence of the colonists, and insured the uninterrupted welfare of Canada. (J. B. B.)

CANAL. See Navigation, Inland.

Canal, in *Anatomy*, a duct or passage through which any of the juices flow.

Canal de Principe, a channel on the N.W. coast of North America, formed by Banks' Island on the S.W., and Pitt's Archipelago on the N.E. It was first explored by Señhor Camaano, a Spaniard, who represented it as fair and navigable. It is about fourteen leagues long. The southern shore is compact and nearly straight, and has no soundings. The northern shore is much broken, bounded by many rocks and islets, and affords soundings in several places. Both sides of this canal are entirely covered with pine trees; and the shores abound with sea-otters.

CANALE, or Canaletto, Antonio, a Venetian painter, was bred with his father, a scene-painter at Venice. In 1719 he went to Rome, where he employed himself chiefly in delineating ancient ruins, and studied the effect of light and shade, in which he became an adept. On returning home he devoted his powers to views in his native city, which he painted with a clear and firm touch, introducing groups of figures with much effect. In his later days he resided some time in England. His pictures are greatly esteemed. According to Zanetti, he died in 1768, aged seventy-one.

CANANDAIGUA, the capital of the county of Ontario, in the state of New York, situated on the western side of the lake of the same name, 177 miles west of Albany. It is pleasantly situated, and has numerous elegant buildings. Pop. 6212. The lake is about 14 miles in length, with an average breadth of one mile, and by means of the river of the same name its waters are conveyed to the Seneca river.

CANANORE, a town and small district of Hindustan, on the sea-coast of the province of Malabar. The town is situated at the bottom of a small bay, which is one of the best on the coast. It is defended by a fortress situated on the point that forms the bay, and which, since the province has been ceded to the East India Company, has been strengthened with works after the European fashion, now forming the headquarters of the province. The town contains several good houses that belong to Mohammedan merchants; and although the exports have been diminished by the prevailing disturbances of the country, it still carries on a flourishing trade. The people have no communication with the Maldives, although the sultan and the inhabitants of these islands are Mohammedans.

The small district around Cananore extends nowhere more than two miles from the glacis of the fort. It consists of low hills, very bare, but not of a bad soil, interspersed with narrow valleys; and the whole is cultivated once in three, six, or nine years, according to the quality of the soil. A very small proportion of it consists of low rice ground, which is well drained, and carefully irrigated.

The proper name of Cananore is Canura. The Portuguese landed here in 1501, and were the first Europeans who visited this coast. They built a fort, the walls of which have been recently improved. The Portuguese were expelled by the Dutch in 1664, who sold it to a native family, now represented by a female sovereign, a Mohammedan, who is also sovereign of the Laccadive Islands, and who pays an annual tribute of 14,000 rupees to the East India Company. The family were, prior to this, of very little consequence, and entirely dependent on the Cherical rajahs; but having acquired a fortress which was considered as impregnable, they became powerful and were looked up to as the head of all the Mussulmans of Malayala. This princess has but a very small territory, and would be unable to support herself without the assistance of trade. She possesses, accordingly, several vessels that sail to Arabia, Bengal, Sumatra, and Surat, whence horses, almonds, piece goods, sugar, opium, silk, benzoin, and camphor, are imported. The exports principally consist of pepper and cardamoms, sandal-wood, coir, and sharks' fins. A proposal has been recently made to the Beebee or princess for the transfer to the British government of the Laccadive Islands, in consideration of a pecuniary equivalent. Cananore is fifteen miles N.E. of Tellicherry, and 100 W.S.W. of Seringapatam. E. Long. 75. 25., N. Lat. 11. 51.

CANARA, a province of Hindustan, extending between the twelfth and sixteenth degrees of north latitude. It is a narrow strip of territory running along the western coast of India, 200 miles in length by thirty-five in breadth; and is hemmed in on the east by the great ridge of the Ghaut Mountains. It is bounded on the north by the Portuguese territory of Goa, on the south by Malabar, on the east by Mysore and the Balaghaut territories, and on the west by the Indian Ocean.

Canara is a corruption of Karnata, the table-land above the Ghaut Mountains. It is a rocky and uneven country, where cattle are scarce, and where, even when they can be procured, they cannot always be employed; where every spot, before it can be cultivated, must be levelled by the hand of man; and where even the land that has been brought under cultivation, if it be neglected for a few years, is soon broken into deep gullies by the heavy torrents of rain which fall during the monsoons. The land is divided into small properties, and the country flourishes from the minute attention bestowed by each proprietor on his own little spot. It is not likely that Canara will ever become a manufacturing country, as it does not produce the necessary materials, and also on account of the heavy rains, which oppose insurmountable obstacles to all operations which require to be carried on under a clear sky. But these same rains give it a never-failing succession of rice crops, which are exported to Malabar, Goa, Bombay, and Arabia. "Canara," says Sir Thomas Munro,[1] "produces nothing but rice and cocoa nuts; its dry lands are totally unproductive, so that the little wheat or other dry grain that is raised is sown in the paddy fields, where the water has been insufficient for the rice. It produces hardly any pepper. The sandal-wood for exportation comes all from Nuggar and Soonda. The soil is perhaps the poorest in India. The eternal rains have long washed away the rich parts, if ever it had any, and left nothing but sand and gravel." In another letter he observes, "there is hardly a spot in Canara where one can walk with any satisfaction, for the country is the most broken and rugged perhaps in the world. The few narrow plains that are in it are under water at one season of the year; and during the dry weather the numberless banks which divide them make it very disagreeable and fatiguing to walk over them. There is hardly such a thing as a piece of gently rising ground in the whole country. All the high grounds start up at once in the shape of so many inverted tea-cups, and they are rocky, covered with wood, and difficult of ascent, and so crowded together that they leave very little room for valleys between." It was in ancient times in a very flourishing state, while it remained under its Hindu sovereigns, principally owing to the moderate land-tax to which it was subjected. An increase was made of fifty per cent. to this tax under the Bednore family, besides many smaller additions, making twenty per cent. more. But all these taxes were easily paid by the inhabitants; and the country, if it did not advance in population and wealth, fully maintained the position to which it had attained. Canara was conquered by Hyder in 1762; and at that time it was a highly improved country, filled with industrious inhabitants, who enjoyed a greater degree of prosperity, and were more moderately taxed, than the subjects of any native

[1] See *Life of Sir Thomas Munro*, chap. iv. Letter dated Huldipore, 20th December 1799.

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power in India. But no sooner was its conquest completed than Hyder ordered an investigation into every source of revenue, for the purpose of augmenting it wherever it could be done. These exactions were augmented by his son Tippoo, who was determined to relinquish no part of his father's revenue, and whose policy it was to hold one part of the proprietors and husbandmen liable for the deficiencies of their neighbours. The effect of these violent regulations was to hasten the extinction of all the ancient proprietors of the soil, and to deteriorate the value of the lands until they became unsaleable. In this manner the agriculture of the country was heavily oppressed; and Canara, when it came into the possession of the British, had completely fallen from its ancient prosperity. It is said, in the report of the principal collector of Canara,[1] "the evils which have been accumulating in the country since it became a province of Mysore have destroyed a great part of its former population, and rendered its inhabitants as poor as those of the neighbouring countries." The value of landed property has been greatly reduced; and those lands which are worth anything are reduced to a very small portion, and lie chiefly between the Cundapoor and Chundergherry rivers, and within five miles of the sea. But it is only here and there even in this tract that lands are to be found which can be sold at any price. There is scarcely any saleable land even on the sea-coast to the northward of Cundapoor, or anywhere except on the banks of the Mangalore and some of the other great rivers. The inland tracts near the Ghaut Mountains are generally waste and overgrown with wood. By the oppressions of its conquerors the population of the country has been diminished about one-third; and the value of property has been reduced in an equal proportion. "It may be said," observes the principal collector, in his report, "that this change in the condition of the country was brought about by the invasion of Hyder; by the four wars which have happened since that event; by Tippoo himself destroying many of the principal towns on the coast, and forcing their inhabitants to remove to Jumalabad and other unhealthy stations near the hills; by his seizing in one night all the Christian men, women, and children, amounting to above 60,000, and sending them into captivity to Mysore; by the prohibition of foreign trade; and by the general corruption of his government in all its departments." These circumstances, according to the opinion of the collector, accelerated the change; "but they probably," he adds, "did not contribute to it so much as the extraordinary augmentation of the land rents." "Whole villages," says Colonel Munro, who after the conquest of the country was appointed by the Company to survey it, and to reclaim it from its wild and unsettled state, "have in some places been abandoned by the owners, from the exorbitance of the assessment; in others they are barely able to keep their ground and to subsist; in others the rent is so moderate that the lands are saleable."[2]

On the fall of Tippoo in 1799, Canara passed to the East India Company. The territory was in the first instance placed under the management of Colonel Munro, by whose vigilance and activity order was gradually restored. The people rejoiced in the protection they received; and under the equal rule of the British government the country soon began to revive from the state in which it had languished under its former tyrants. The assessment of this district has long been a subject of discussion among the local authorities, and much difference of opinion has been manifested in regard to the best mode to be adopted for placing it on a satisfactory footing. The government demand, though upon the whole moderate, is stated to be unequally distributed; but notwithstanding this inequality, the country has greatly increased in wealth and population, and a marked improvement is reported to have taken place in the condition of the people, which is exhibited in the dress, in the mode of living, and in the increase of their personal comforts. The lands are held for the most part under the Ryotwar tenure; and a maximum rent fixed for the best lands, which cannot be exceeded. Inferior lands, so long as they remain inferior, are of course assessed at lower rates, and the contracts with the cultivators are renewed from year to year, when remissions of rent are made if the unfavourable character of the season or the circumstances of the cultivator render such a measure expedient. Doubtless the greatest blessing which the British government could confer on the country would be the abandonment of the annual settlement, and the introduction of the revenue system which prevails in the north-western provinces of Bengal, where the government demand is limited to a fixed proportion of the net rent, and leases are granted for periods of thirty years. By this limitation of the public demand, a valuable and marketable private property is created in the land, and every cultivator, however petty his holding, becomes to a certain extent a capitalist. But before such an arrangement can be carried out, a new survey of the district must be made, and such a measure is in contemplation. In the mean time a regulation has been promulgated, under which the full benefit of all agricultural improvements effected by the cultivators has been secured to them, and no additional assessment is to be imposed on that account so long as the general rates of the district remain unaltered. The district consists of two divisions, North Canara and South Canara; and their aggregate population is officially returned at 1,056,333.

Canara, North. This division of Canara is situated between the thirteenth and the sixteenth degrees of northern latitude, and contains three smaller districts—Cundapoor, Onore, and Ancola. Its sea-coast, which is 100 miles in length, has scarcely any sinuosities, and within its whole extent there is hardly a safe station for large vessels. Here the Western Ghauts, although steep and stony, are by no means rugged or broken with rocks. On the contrary, the stones are buried in a rich mould; and the sides of the mountains are clothed with the most stately forests, in which are seen the finest bamboos and the most stately palms. There is no underwood or creeper to interrupt the passage through these woods; but they are infested with numerous tigers, and the climate is very unhealthy. The district of Ancola is larger than the other two, though, having suffered more severely from the ravages of Mahratta warfare, it does not yield above half the revenue of the other two. North Canara produces sandal-wood, sugar-canes, teak, wild cinnamon, nutmegs, and pepper. About midway up the Ghauts the teak becomes very common. In many parts, as in the western districts of Soonda, the cultivation of gardens is the chief object of the farmer. In these gardens are raised promiscuously betel-nut and betel-leaf, black pepper, cardamoms, and plantains. Towards the eastern side of the province there are very few gardens, but along the courses of the streams, and those of the plain country in general where water may be obtained by digging to the depth of a few feet, the lands are well suited for cultivation. Here the great object of cultivation is rice; and although the rains are not so heavy as to the westward, yet in cooler seasons, on a moist soil, they are sufficient to bring to maturity a crop of rice that requires six months to ripen. A few of the highest fields are cultivated with a kind of rice that ripens in three months. To the north of Battacolla a great portion of the soil is poor. About Beiluru are many groves of the tree from the seeds of which is expressed the common lamp-oil of the country. The

[1] See *Fifth Report of a Select Committee on India Affairs*, Appendix, p. 808.

[2] See *Life of Sir Thomas Munro*, containing his instructive Letters, which give an account of his proceedings in this country.

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climate of the lowlands is considered unhealthy, producing intermittent and other fevers.

The principal towns in North Canara are Cundapoor, Battacolla, Ancola, Carwar, Mirjaow, and Onore. The rivers by which the country is watered, from the short intervals between the country and the sea, are of no great magnitude, being generally mountain streams.

CANARA, SOUTH, is situated between the twelfth and fourteenth degrees of northern latitude; and is separated from the province of Malabar by a wide inlet of the sea. It is called Tulava by the Hindus, and South Canara by the British. It is a strip of land along the sea-coast, rising as it approaches the Ghaut Mountains; and the soil becomes gradually less adapted for grain as it recedes from the sea. The best in quality extends from Mangalore to Buntwalla. The banks of the river Mangalore, which in the rainy season is very large, are rich and picturesque; and the whole country resembles that of Malabar, only that the terraces on the sides of the hills have been formed with less care than in that district. Much of the rice land is so well watered by springs and rivulets, that it produces a constant succession of crops of that grain, one crop being sown as soon as the preceding one is cut. The second soil in point of quality is that which extends from Buntwalla to Punjalcutta, and the worst is that which extends from this place to the hills. There the rains are so excessive that they injure the crops of rice; but this inland portion of the country is very favourable for plantations. About Cavila, east of Mangalore, some of the hills are covered with tall thick forests, in which the teak tree abounds. From Urigara to Hopodurga the country near the sea is low and sandy, and too poor to produce even cocoa-nuts. This country has been dreadfully depopulated by the ravages of war. It suffered severely in its conquest by Tippoo. It had been previously shared among petty princes and numerous feudatories, who were all forced to retire before the armies of Tippoo, and to fly into the woods to avoid circumcision, a rite which was invariably forced upon them, in order to make them good Mohammedans; and it generally had this effect, for after suffering such an infliction from Tippoo, they lost their caste, and had therefore no alternative left. The inner parts of the country are much overgrown with woods, and very thinly inhabited.

The sugar-cane is cultivated on the low ground; but very small quantities only are raised. Between the rows are raised some cucurbitaceous plants, and kitchen stuffs that soon come to maturity. On the highest of rice land, where water may be had by digging to a little depth, capsicum is cultivated, as are also ginger and turmeric. The exports consist chiefly of salt, salt-fish, betel-nut, ginger, cocoa-nuts, cocoa-nut oil, and raw silk. The imports are chiefly cloths, cotton, thread, and blankets.

The chief inhabitants are Moplays (Mohammedans), who possess the sea-coast, as the Nairs do the interior. It is observed by Dr Buchanan, that the occupiers of land in this district are richer than those of Malabar; but he adds, that the universal cry of poverty which prevails all over India, and the care with which, owing to long oppression, every thing is concealed, render it extremely difficult to know the real circumstances of the cultivator. He concludes, however, from the obstinate contest which takes place for the possession of the land, that the cultivators have still a considerable interest in the soil. It appears, however, from the evidence of other collectors, that the inhabitants manifest in this way their regard to their paternal inheritance, for which they contend to the last; and when their interest as proprietors is lost in the increase of the assessment, they remain tilling the ground in the humble capacity of cultivators. There is no doubt that they never were so completely subdued by a foreign conqueror as the greater part of the Hindus, and always retained the title to their lands, which their rulers were never able entirely to take from them. When the province accordingly was conquered by the British, they found the landholders possessed of the clearest titles to their respective properties, which were recognised by the law of the country, as well as by immemorial usage. The chief towns of South Canara are Barcelore, Mangalore, and Callianpoor.

Canary Islands.

A number of Christians, to the amount of about 80,000, had been ordered to settle in this country by the ancient Hindu princes, with whom they had been in great favour. They were all of Concan descent, and had been instructed in the Portuguese and Latin languages, and in the doctrines of the Roman Church. About this period twenty-seven Christian churches existed in Tulava, each ruled by a vicar, and the whole under the control of a vicar-general, subject to the archbishop of Goa. Tippoo, when he conquered the country, proved himself to be the great persecutor of the Christian religion, throwing the priests into dungeons, destroying the churches, and forcing the laity to embrace the Mohammedan creed. After the conquest of the country by the British, many of these persecuted refugees returned and resumed their former faith; 15,000 came back to Mangalore and its vicinity; 10,000 made their escape from Tippoo to Malabar. These people are of quiet, sober, and industrious habits, and their superiority is acknowledged by the neighbouring Hindus. The Jain sect abound more in this province than in any other throughout India, and many of their temples are to be seen. Like other Hindus, they are divided into many sects, which cannot intermarry. (F. Buchanan's *Journey from Madras through the Countries of Mysore, Canara, and Malabar.* (D. B—N.) (E. T.)

CANARY ISLANDS (The) lie in the North Atlantic Ocean, between the parallels of Lat. 27. 40. and 29. 30. N., and the meridians of Long. 13. 30. and 18. 20. W. The names of the seven principal islands, their respective area in English square miles, and their population in 1835, are given in the following table:—

	Teneriffe.	Grand Canary.	Palma.	Lanzarote	Fuerteventura.	Gomera.	Hierro.
Area, .	877 7	758 3	718 5	323 5	326·1	169·7	82·2
Population,	85,000	68,000	33,000	17,400	13,800	11,700	4400

Fuerteventura lies nearest to the African coast, the interval being between 50 and 60 miles. Besides these, there are many islets, most of which are uninhabited.

History.—There is ground for supposing that the Phœnicians were not ignorant of the Canaries. The Romans, in the time of Augustus, received intelligence of them through Juba, king of Mauritania, whose account has been transmitted to us by the elder Pliny. He mentions "Canaria, so called from the multitude of dogs of great size," and "Nivaria, taking its name from perpetual snow, and covered with clouds," doubtless Teneriffe. Canaria was said to abound in palms and pine trees. Both Plutarch and Ptolemy speak of the Fortunate Islands, but their description is so imperfect that it is not clear whether the Madeiras or the Canaries are referred to. There is no farther mention of them until we read of their re-discovery about 1334, by a French vessel driven amongst them by a storm. A Spanish nobleman thereupon obtained a grant of them with the title of king from Clement VI., but want of means prevented him carrying out his project of conquest. Two expeditions subsequently set out from Spanish ports, and returned without having taken possession. At length three vessels, equipped by Jean de Bethencourt a gentleman of Normandy, sailed from Rochelle in 1400, and bent their course to the Canaries. He landed at Lanzarote and Fuerteventura, but being opposed by the natives, and finding himself deficient in means to effect his purpose, he repaired to the court of Castile; and obtaining from Henry III. a grant of the islands, with the title of king, he sailed in 1404 with a strong force, which mastered Lanzarote, Fuerteventura, Gomera, and Hierro,

without bloodshed. Being repulsed in his attempts on Palma and Canary, he returned to Europe in 1408 to obtain farther assistance. He was well received at the Castilian court, where he was promised the aid he sought; but he died shortly afterwards in France, whither he had gone to visit his patrimonial property. Bethencourt's nephew had been left governor of the islands, and claimed to succeed to his uncle's rights. Being charged with many acts of misgovernment, he went to Spain to clear himself, and whilst there sold his rights to Don Henrique de Guzman, who, after expending large sums in fruitless endeavours to reduce the unconquered islands, sold them to another Spaniard named Paraza. His successors, about 1461, took nominal possession of Canary and Teneriffe, but the natives effectually resisted their occupation of them. Meantime it appeared that Jean de Bethencourt's nephew had fraudulently made a second sale of the islands to Don Henry of Portugal, who sent 1000 men and 100 horse to take possession. The difference thus arising between the crowns of Spain and Portugal was ended by the cession of the islands to the former. Grand Canary, Teneriffe, and Palma remaining unsubdued in 1476, Ferdinand and Isabella of Spain compelled Paraza's successors to sell those islands to the crown; and the following year 1000 men were despatched to reduce them. After much bloodshed, and with reinforcements from the mother country, the Spaniards, under Pedro de Vera, became masters of Grand Canary in 1483. Palma was conquered in 1491, and Teneriffe in 1495, by Alonzo de Lugo. All the islands have continued in the possession of the Spaniards to this day.

Inhabitants.—As to the derivation of their original inhabitants nothing certain is known. The most probable supposition is, that they came from the adjoining coast of Africa. Pliny states that the islands were uninhabited at the time of which he wrote. If this were so, we might infer from the absence of any trace of Mohammedanism amongst the people found there by the Spaniards, that the migration took place between the time to which his account refers, and the time of the conquest of Barbary by the Arabs. They were called Guanches. Many of these people fell in opposing the Spanish invasion—many were sold by the conquerors as slaves—and many conformed to the Roman Catholic faith, and intermarried with the Spaniards; so that all trace of them as a distinct race is lost. They have always been celebrated for their tall stature, and Humboldt styles them the Patagonians of the old world. Spanish writings mention one chief who was 14 feet high, and another who measured 9 feet. Probably the Spaniards encouraged fables of this kind to magnify their conquest. The skeletons of eight or nine Guanche mummies were lately examined by Dr Hodgkin, who found them all to be less than average skeletons of Europeans. The Guanches embalmed the bodies of their dead, and placed them in caves. Many mummies have been found at different times in a state of extreme desiccation, each weighing not more than six or seven lbs. A recent traveller (Captain Grey) states, that there are two inaccessible caves in a vertical rock by the shore, three miles from Santa Cruz (Teneriffe), which still contain bones. A few words of the languages spoken by the ancient inhabitants have been preserved, and a resemblance of some of them to words of North African dialects has been noticed. On the other hand, the Guanches had customs, such as that of preserving their dead, in which they differed from the Berbers.

The present inhabitants are slightly darker than the people of the mother country; but in other respects scarcely distinguishable. The men are of middle height, well made and strong: the women are not striking in respect of beauty, but they have good eyes and hair. Spanish is the only language in use. The people have most of the traits of the people of the peninsula; they are sober, but given to gambling, quick, but lazy, faithless, and grossly superstitious. The lower classes are quite illiterate, and the better classes not very enlightened. A few booksellers' shops of a minor description exist at Santa Cruz and Las Palmas. At the former place two newspapers, and at the latter one, are published. Emigration to the extent of about 200 persons annually takes place to Cuba. The sustenance of the lower classes is chiefly composed of salt fish, potatoes, and *gofio*, which is merely Indian corn or wheat roasted, and then when ground mixed with water.

Government, &c.—The Archipelago is politically considered part of the province of Andalucia. The governor-general, who resides at Santa Cruz, has chief command both in civil and military affairs. The actual administration of affairs is in the hands of two lieutenant-governors, each with a district to himself, one of whom is resident at Santa Cruz, and the other at Las Palmas. On the other islands are deputy-governors, acting under the lieutenant-governor to whose district they belong. The military force is composed of a battalion of soldiers of the line, numbering about 1000 men; six regiments of militia amounting to about 8000 men, distributed amongst the islands; and a few companies of artillery. There is a military commander on each island. The great court of appeal sits at Las Palmas. Courts of first instance sit at Santa Cruz, Orotava, and Las Palmas. The laws of Spain are administered here. The land in great part is strictly entailed; the law of landlord and tenant is very bad. The islands form two bishoprics, Teneriffe, and Grand Canary. The whole ecclesiastical revenue is estimated at upwards of L.36,000. The monkish establishments have been suppressed, and such of the monasteries and convents as are not kept up for secular purposes are falling to ruin. No form of religion except the Roman Catholic is tolerated.

Climate and Meteorology.—From April to October a N. or N.E. wind of more or less strength blows upon these islands, commencing at 10 A.M., and continuing until 5 or 6 P.M. Foggy weather accompanies an easterly wind, but it becomes clear when the wind changes to the northward. On the S.W. coasts there is no regular sea or land breeze. In winter they are occasionally visited by a S.E. wind, called Levante. This is a hot wind from the African continent, producing various disagreeable consequences on the exposed parts of the person, besides injuring the vegetation, especially on the higher grounds. Locusts have sometimes been brought by this wind. In 1812, it is said that locusts covered some of the fields in Fuerteventura to the depth of four feet. Their last visit was in 1844. Hurricanes at distant intervals, accompanied by waterspouts, have caused much devastation; but, on the whole, these islands are singularly free from such visitations. The climate generally is mild, dry, and salubrious. On the lower grounds the temperature is equable, the daily range seldom exceeding 6°. On the mountains, of course, the range is greater, and the air much more cold and damp. The rainy season occurs at the same period as in southern Europe. The dry season is at the time of the trade-winds, which extend a few degrees farther north than this latitude. "In no part of the world is the barometer more susceptible of atmospheric changes than amongst the Canary Islands. A rapid rise is the sure precursor of an easterly wind, whilst the contrary as certainly indicates a change to W. or S.W." (Lieut. Arlett.)

Agriculture, Manufactures, and Commerce.—In ordinary years, sufficient grain and potatoes are produced to supply the wants of the islands. The soil on the lower part of the islands, where water is plentiful, is productive; in some places two crops of Indian corn and one of potatoes can be obtained from the same piece of ground in a twelvemonth. Except at Fuerteventura, the vine is much cultivated, but chiefly at Teneriffe, the best wines being produced on the N.W. coast. None, however, is considered so good as the wine of Madeira. The most esteemed kind is sent to Eng-

land under the name of Vidonia. The grape disease made its appearance at the Canaries in 1853, and destroyed nearly the whole crop. Previously the total annual produce was estimated at about 40,000 pipes, of which 25,000 pipes were produced in Teneriffe. Between 8000 and 9000 pipes were exported. The price per pipe on board ranged from L.8 to L.20. Some of the wine is distilled into good brandy. Sumach for the tanners, canary-seed, and a little flax, are grown. The gardens produce, in addition to the vegetables of English gardens, pumpkins, gourds, yams (taro), garlic, red pepper, and the castor-oil plant. The fruit trees are badly managed, so that the fruit is generally inferior. Here are found fruits from every quarter of the globe, including oranges, figs, bananas, dates, pine apples, pomegranates, papaws, guavas, custard apples, and prickly pears (the fruit of the cactus). There are no cocoa-nut trees or bread-fruit trees, as Humboldt reports. A little oil is obtained from the olive in Grand Canary. The agave is abundant, and supplies a material for ropes, girths, &c. The leaves of the date palm are made into hats and baskets. A good deal of orchilla-lichen is gathered for exportation; and the ice-plant is cultivated for barilla. The sugar manufacture, once so largely carried on, has fallen before the American and West Indian trade; the only two existing mills are on Palma. Wine having been for some time so little remunerative, other things have received attention, the chief of which is cochineal. This insect, which feeds on the common cactus (*Opuntia tuna*), is now largely produced on all the islands, land formerly occupied by grain and vines being devoted to its cultivation. The insect has not been long introduced, but the cultivation has rapidly extended. In 1849, 800,000 lb. were exported, principally to France and England. Since that year the exports have much increased; the price paid to the Canary exporter is about a dollar per lb. The silkworm is reared to a small extent, chiefly on Palma. Raw silk is exported, and some is manufactured on the spot into stockings, ribands, &c. Some linen and woollen stuffs of a coarse kind are made for home consumption, but the great bulk of the clothing in use is of British manufacture. The island goats (a peculiar and esteemed breed) furnish milk, from which butter and cheese are made. Sheep of a small coarse-woolled breed are numerous. Horses and cattle are scarce; domestic fowls and rabbits plentiful. Asses and mules are much used. A fishery on the African coast, at present engaging from 40 to 50 vessels, and giving employment to many persons, has existed since an early period. It was deemed of such importance, that the home government lately sent out a commissioner to report on it with a view to its improvement. The fish taken is principally bream. It is salted, and largely consumed at the Canaries.

There is a good deal of intercourse by means of boats and small sailing vessels amongst the different islands. In this way wine, raw silk, cochineal, barilla, and dried fruits are taken to the places of export; and grain is conveyed from those islands where it is abundant to those where the supply is deficient. The principal foreign trade is with England, the chief articles of export being wine, cochineal, barilla, and orchilla. The imports consist of iron, metal goods, glass, crockery, leather, silk, cotton, and woollen manufactures. There is also a considerable trade with the United States, and the countries bordering the Mediterranean. With Hamburg and France an exchange of commodities takes place. The ships employed in this commerce are foreign, chiefly British, but the islanders send a few vessels of their own with brandy, coarse earthenware, and silk goods to the Spanish West Indies, bringing back cigars, sugar, coffee, rum, cacao (the material of chocolate), and a few other articles. Santa Cruz, Orotava, and Las Palmas, are the only ports engaged in foreign trade; nearly 200 vessels enter these ports in the course of a year. In 1852, the ports were practically made free—the small duty of 2s. per cent. only being now levied upon imported goods, with the exception of tobacco, which pays 5d. per lb., and cigars which pay 10d. per lb. A Spanish steamer from Cadiz makes two voyages to Santa Cruz every month. The Spanish government packet on her outward voyage to Havannah touches at Santa Cruz once a month; and the same port is visited monthly by the English mail steamers to Brazil and the African coast, both on their outward and homeward voyages.

Zoology.—The indigenous animals, reptiles, and insects of the Canary Islands, are very few in number. As to mammals, only species of dog, of swine, of goat, and of sheep, were found upon the island by the Spanish conquerors. The race of large dogs which gave a name to Canary has been long extinct. A single skeleton was lately found and deposited in one of the museums at Paris. The ferret, rabbit, cat, rat, mouse, and two kinds of bat, have become naturalized. The ornithology is more interesting, both on account of the birds native to the islands, and the stragglers from the African coast. The latter are chiefly brought over in winter when the wind has blown for some time from the east. Amongst the former are some birds of prey, such as the African vulture, the falcon, buzzard, sparrow-hawk, and kite. There are also two species of owl, three species of sea-mew, the stockdove, quail, raven, magpie, chaffinch, goldfinch, blackcap, canary bird (green in its wild state), titmouse, blackbird, house-swallow, &c. The bird with the sweetest song is the capirote, a variety of *Sylvia atricapilla.* As to the insects, we need only mention a species of gnat or mosquito, which is sometimes troublesome especially to strangers, and the cockroach. The list of reptiles is limited to a small scorpion originally brought from the West Indies, a scolopendra, and the frog. The only fresh-water fish is the eel. The marine fishes are not numerous, the reason perhaps being, that the steepness of the coast does not allow of seaweed to grow in sufficient quantity to support the lower forms of marine animal life. M. Valenciennes states, that the fishes frequenting these coasts, like those of St Helena and Ascension, closely agree with the fishes of South America. Whales and seals are occasionally seen. Little is known as to the molluscs of these islands. Professor E. Forbes remarks, that the presence of *littorina striata*, a marine conchiferous mollusc, is a fact supporting the hypothesis that the Canaries, the Azores, the Madeiras, and the Peninsula, were once united. The cuttle fish is abundant, and is sought for as an article of food.

Botany.—The position of mountainous islands like the Canaries, in the sub-tropical division of the temperate zone, is highly favourable to the development within a small space of plants characteristic of both warm and cold climates. Von Buch refers to five regions of vegetation in Teneriffe. 1. From the sea to the height of 1300 feet. This he styles the African region. The climate in the hottest parts is similar to that of Egypt and southern Barbary. Here grow amongst the introduced plants the coffee tree, the date palm, the sugar-cane, the banana, the American agave, and the cactus; and amongst indigenous plants, the dragon tree on the N.W. of Teneriffe. A leafless and fantastic euphorbia, and a shrubby composite plant, *Cacalia Kleinia*, give a character to the landscape about Santa Cruz. 2. Between 1300 feet and 2800 feet is the region of South European vegetation, the climate answering to that of southern France and central Italy. Here flourish the vine and the cereals. 3. The region of indigenous trees, including various species of laurel, an *Ardisia*, *Ilex*, *Rhamnus*, *Olea*, *Myrica*, and other trees found wild also at Madeira. The clouds rest on this region during the day, and by their humidity support a vegetation amongst the trees, partly of shrubs, and partly of ferns. It extends to the height of 4000 feet. 4. The region of the *Pinus canariensis*, extending to the height of 6400 feet: the broad-leaved trees

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have ceased to grow, but arborescent heaths are found in its whole extent, and a few specimens of *Juniperus oxycedrus* may be met with. 5. The region of Retama, (*Spartium nubigenum*), a species of white-flowering and sweet-scented broom, which is found as high as 11,000 feet. At the upper edge of this region a violet clings to the soil, and above there is nothing but a little lichen. The number of indigenous phanerogamous plants may be estimated at between 700 and 800, upwards of 160 of which are peculiar to the Canaries. The forms of vegetation must in the main be considered North African, since the origin of many of those which they have in common with southern Europe should be looked for in Africa. The character of the vegetation in Lanzarote and Fuerteventura islands, composed of extensive plains and low hills, with few springs, is different from that of the other islands, which are more elevated and have many springs. The wood is more abundant, and the vegetation more luxuriant.

Geology.—The lower and exterior portion of these islands consists for the most part of basalt, compact, vesicular, or scoriaceous, interstratified with beds of variously coloured tufa. In some cases the rock is chiefly trachyte. The basalt presents an abrupt and precipitous face to the sea. The compact variety frequently contains scattered grains and crystals of augite and olivine. In Teneriffe, the basalt and tufa form an exterior mass, through which in the centre emerge the felspathic or trachytic rocks forming the nucleus of the volcanic cone, and over them fragments of pumice and streams of modern lava have been thrown. These trachytic rocks contain numerous disseminated crystals of glassy felspar. The few minerals that have been found in the Canary Islands are those characteristic of volcanic regions. A little iron exists, but is not turned to account. In no part of Teneriffe has there been discovered any sedimentary rock. The old lavas in Lanzarote are covered by a thin layer of white concretionary limestone, the origin of which is obscure. In Grand Canary and Fuerteventura there is also calcareous stone, but its nature does not appear to be known. It has long been conjectured that the Canaries, the Azores, and the Madeiras, were once connected with each other, and with the continents of Europe and Africa. Recent investigations seem to yield results that give some colour to the hypothesis.

Teneriffe, the largest island of the group, lies between Canary and Gomera. It is of an irregular shape, 60 miles in length, with an extreme breadth of 30 miles. Not more than one-seventh is cultivable. A chain of mountains traverses the island in the direction of its greatest length, and in the middle of the broadest part rises the celebrated peak locally known as the Pico de Teyde, which, with its supports and spurs, occupies nearly two-thirds of the whole island. It has a double top; the highest, El Piton, is 12,180 feet above the sea; the second, Chahorra, connected with the first by a short narrow ridge, has a height of 9880 feet. They are both orifices in the same grand dome of trachyte. Neither reaches the line of perpetual snow. There is, however, a natural cavern, 11,000 feet above the sea, where snow is preserved all the year. Snow remains about four months on the upper part of the peak.

For more than one-half of its circumference the base of the true peak rises from an elevated but comparatively level tract called by the Spaniards *El Llano de la Retama* (*retama* is a local name for the *Spartium nubigenum* which abounds there), and by the English the Pumice-Stone Plains. Three miles from the base of the cone, on the S.E., south, and S.W., there is a high ridge overlooking the Pumice-Stone Plains, and presenting a very steep face to the peak. Between the ridge and the sea the slope is more gradual, and there are intervening table-lands. Peaks rise from the ridge, one of which attains the height of 9400 feet. The aspect of this ridge, the Llano, and the cone, is described by Von Buch as resembling a fortress with ramparts and a foss. He says that there would be a similar rampart on the N.E., north, and N.W., had not comparatively late eruptions filled up the foss. The peak, then, is a pile of lava, trachyte, and ashes, thrown up, either in an immense rent, where older volcanic rocks, consisting principally of basalt and tufa, have been torn asunder, or in an ancient crater which had become greatly enlarged. Both El Piton and Chahorra have craters on their summits, from which issue steam and a little sulphureous vapour, forming what is called a solfatara. The crater (*Caldera*) on El Piton is surrounded by a wall of lava which would prevent access to the interior if it were not broken away on one side. The lava of the interior has been made white by the action of sulphureous vapours, and every crevice contains crystals of sulphur. The thermometer rises considerably when thrust into the ground. It is not perfectly circular; its dimensions are given as 300 feet across in one direction, and 200 feet in another, with an average depth of 100 feet. It takes more than an hour to walk round the crater on Chahorra, but its depth is scarcely 150 feet. The view from the highest point, when no clouds intervene, is very extensive. All the islands of the Archipelago are visible, and the horizon is 140 miles distant. The coast of Africa and the island of Madeira are not within the range of vision. Pico Ruivo, the highest peak of Madeira, must be three times higher than it is to bring it into view. Humboldt estimates the height of the peak to be $\frac{1}{28}$th of the circumference of its basis, and he says that if the slope were uniform from the summit to the base, it would have an inclination of 12° 29′. The steepest part of the cone has an inclination of 40°.

The ascent of the peak is usually made from Orotava, on the northern side of the island. After leaving the cultivated grounds, a belt of chesnut trees is crossed, and then the regions of arborescent heaths and ferns, as far as a pass (Portillo) which admits the traveller between two basaltic hills (part of the rampart above spoken of), into the *Llano de la Retama.* The scenery here is in striking contrast with what it has previously been. Instead of a steep and rugged ascent among black basaltic rocks, the traveller enters upon gently sloping ground, covered to a considerable depth with white pumice gravel, amongst which spring tufts of *spartium.* The tender shoots of this shrub serve the wild goats for food, and the flowers yield a rich honey to the bees. The entrance to the Llano is nearly 8920 feet above the sea. Between two and three hours are consumed in crossing the Llano to the base of the cone, the lower part of which (*Monton de Trigo*) is ascended to a point 9750 feet above the sea, called *Estancia de los Ingleses* (Englishmen's station), where the mules must be left, and where travellers frequently pass the night. The rest of the way is very steep and fatiguing, the cone being here composed of loose stones, ashes, and pumice, upon which narrow streams of obsidianic lava are laid like black ribands. The pumice is in such quantity, that at a distance it has the appearance of snow coating the peak. From 20 to 24 hours are consumed in ascending the peak and returning to Orotava.

To the N.W. of the grand cone, some thousands of feet below Chahorra, there are many small cones of eruption, showing that the intensity of volcanic action was greatest on this side. Eastward from the ridge bounding the pumice-stone plain, extends a chain of mountains to the north-eastern extremity of the island. The highest peaks are Izana, 7374 feet; Perexil, 6027 feet; and Cuchillo, 5467 feet. The road from Santa Cruz to Orotava crosses the chain at a point near Laguna, where it is less than 2000 feet high.

We have no account in history of eruptions from either crater of the peak. In 1795 a great quantity of lava was poured out from three vents on its eastern side; and in the same year lava streams issued from a crater near Guimar,

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half way between Santa Cruz and the peak. In the following year, a vent on the north-western side of the peak discharged a copious stream, which flowed down to the sea, and nearly filled up the harbour of Garadrico. For three months in 1798, much lava and other volcanic matter was ejected from orifices to the west of Chahorra.

Santa Cruz de Santiago, on the south coast, is the residence of the governor-general of the Canaries, the civil lieutenant-governor of the Teneriffe district, and the military governor of the island. Its position is N. Lat. 28. 28. 30., and W. Long. 16. 16. 0. It is a well-built and tolerably clean town of 9000 inhabitants, lying on a strip of level ground, at the foot of a vertical wall of black barren rocks. Scarcely any vegetation except thorny cactuses and euphorbias is to be seen in the neighbourhood. The streets are at right angles to each other, narrow, but provided with side walks. There are three public squares. The houses are generally low, with flat roofs; those of the better class are large, with a court-yard in the middle, planted with shrubs in the Spanish fashion. The market is well supplied with meat, fruits, and vegetables. Good water is brought from a distance, passing at one part of its course along an aqueduct 180 feet in length, with a depth of cut of 120 feet. A British consul resides here, as well as four or five English families. The accommodation for strangers is neither plentiful nor good. The Spanish cloak is much worn by the men, and the white mantilla by the women. Dromedaries, though not bred on the island, are in use for the conveyance of merchandise, and in agricultural operations. They are brought from Lanzarote and Fuerteventura. A good animal costs from 30 to 40 dollars. A few wheel-carriages are in use. Much ground in the neighbourhood is planted with cactus (*Opuntia tuna*) for the support of the cochineal insect. The town is defended by several batteries; and it was by a shot from one of these that Lord Nelson lost his arm, when he unsuccessfully attacked the place in 1797. Some of our flags lost on that occasion are still hanging in one of the churches. The anchorage is good, and landing is assisted by a mole. About 100 vessels annually visit the port. The climate is dry and temperately warm, the annual mean being 71° Fahr. The mean of the coldest month is 63°·8 F., and of the hottest 78°·8 F. Rain falls on an average on 36 days in the year.

Laguna (pop. 10,000), the capital of the island, and the seat of the political, judicial, and ecclesiastical establishment, stands at the distance of four miles from Santa Cruz, in the centre of a plain where much grain is produced, elevated 1725 feet above the sea, and nearly surrounded by mountains. The situation is beautiful, but the town itself is gloomy. Here are several deserted convents, and a cathedral. In summer the temperature is refreshingly cool, and for that reason Laguna is then resorted to by the rich of Santa Cruz. In winter it is cold and damp, the plain being frequently laid under water by rain. The mean temperature of the year is 63°·2 Fahr. Snow has never been known to fall here. The humidity of the atmosphere is shown by the numbers of semperviva growing on the houses and walls.

The road from Santa Cruz to *Orotava*, 25 miles distant, lies through Laguna and Matanza—a place deriving its name from an overthrow received by the invading Spaniards from the Guanches in 1494. All travellers speak in terms of warm admiration of the scenery in this part of the island. Humboldt's words are: "Under the torrid zone I found sites where nature is more majestic, and richer in the display of organic forms; but, after having traversed the banks of the Orinoco, the Cordilleras of Peru, and the most beautiful valleys of Mexico, I own that I have never beheld a prospect more varied, more attractive, more harmonious in the distribution of the masses of verdure and of rocks, than the western coast of Teneriffe." The town of Orotava is 1040 feet above the sea. It contains about 8000 inhabitants. The houses are solidly built, but it has a deserted aspect. A stream of water is conducted through every street. The famous Dragon-tree grows in the garden of of the Marquis of Sanzal. It is quite hollow, and is a mere wreck of what it has been. It has a height of between 50 and 60 feet, the circumference just above the roots is nearly 48 feet, and the opening into the interior is 13 feet wide.[1] *Port Orotava*, three miles from the villa, is a clean place, with between 4000 and 5000 inhabitants, amongst whom are three or four English families. The streets are broad, and the houses well built. The roadstead, protected by a fort and some batteries, affords little or no shelter against wind. The botanic garden, founded by a patriotic Spanish nobleman, has gone to ruin since it came into the possession of the government. *Icod de los Vinos*, a pretty town of 4000 inhabitants, farther to the west in a fertile district, has a manufacture of silk, but it is not flourishing. There are several other towns on the island, but none so large as these. They stand principally on the N.W. side, not far from the coast. The highest inhabited place is Chasna, on a plain more than 4000 feet above the sea, to the south of the peak.

Grand Canary (*Gran Canaria*), the most fertile island of the group, is nearly circular in shape, with a diameter of 24 miles, and a circumference of 75 miles. The interior is a mass of mountain, with ravines radiating to the shore. Its highest peak, Los Pexos, is 6400 feet above the sea. Large tracts are covered with native pine (*P. canariensis*). There are several mineral springs on the island. From the nature of the ground, only a small part is under cultivation. The fishery on the African coast gives employment to a large number of persons. Las Palmas (pop. 10,000), the seat of the local government, is a well-built and clean town in a small bay on the east coast. It contains a handsome cathedral, a hospital, a college, several secularized convents, and an alameda or public walk. Its climate is more humid than that of Santa Cruz. Water is brought into the principal streets and squares by an aqueduct. The harbour, Puerto de la Luz, affords good anchorage and shelter against all winds except the S.E. It is formed by a rocky peninsula (*Isleta*), connected with the mainland by a low neck of land. The mole is still unfinished. Several forts defend the bar and harbour. A British vice-consul resides here. In 1851 the cholera visited the island, and 9000 persons died. Not a single case occurred on any other island. Telde, the second place in the island, stands on a plain surrounded by palm trees. At Atalaya, a short distance from Las Palmas, the making of earthenware vessels employs some hundreds of people, who inhabit holes made in the tufa.

Palma (correctly, San Miguel de la Palma) is 26 miles long, with an extreme breadth of 16 miles. It lies 67 miles W.N.W. of Teneriffe. Its shape is somewhat like that of a pear. It is traversed in its longest direction (north to south) by a chain of mountains, the highest of which is 7900 feet above the sea. At the broadest part is a crater nine miles in diameter, known as the Caldera (*i.e.* cauldron), from which, on its S.W. side, runs a ravine to the sea. The bottom of the crater has an elevation above the sea of 2300 feet, and it is overhung by peaks that rise more than 5000 feet above it. Some of these peaks are covered with snow for several months in the year. Extensive woods, principally composed of chestnut and pine, lie on their flanks. Palma contains several mineral springs, but there is great want of fresh water. The only stream which is never dried up is that which issues from the Caldera. In 1677 an eruption, preceded by an earthquake, took place from a vol-

[1] Humboldt in describing it says—"Among organized beings this tree is undoubtedly one of the oldest inhabitants of our globe. It is remarkable that the *Dracæna Draco* is not a native of these isles nor of Africa, but of Eastern Asia. How at a remote period it came to this island is a matter of curious speculation."

cano at the southern extremity of the island, and much damage was done by the ejected ashes, stones, and lava. The sugar-cane is grown on an elevated plain called Los Llanos. Ribands and stockings are manufactured from silk produced on the island. The poor make much use of the roots of the *Arum colocasia* to mix when ground with flour. Grain is imported. Sheep, goats, and cattle are numerous. Santa Cruz, on the eastern coast, is the principal town; it has 6000 inhabitants. The anchorage is good. The cultivated soil is fertile, but the labouring classes are in a wretched condition notwithstanding their industrious habits. The enormous dimensions of the Caldera are supposed by Sir C. Lyell (on the facts supplied by Von Buch) to have resulted from the action of the sea, exerted as the island was slowly lifted upwards by subterranean forces from beneath the waves. The cone, which, according to Von Buch, is composed of alternating beds of basalt and conglomerates pierced by basaltic dikes, had been previously formed by a long series of volcanic eruptions; and the great ravine may have been caused by the sea entering the crater at the lowest point of the rim, and cutting a passage for itself that went deeper and deeper as the mountain was pushed up. The exterior of the cone is seamed by ravines that radiate on all sides towards the sea, but none penetrate the Caldera except the single one already mentioned.

Lanzarote, the most easterly of the group, has a length of 31 miles, and a breadth varying from 5 to 10 miles. It is naked and mountainous, bearing everywhere marks of its volcanic origin. Montaña Blanca, the highest point, attains a height of 2000 feet, and is cultivated to the summit. In 1730 the appearance of half the island was altered by a volcanic outburst. A violent earthquake preceded the catastrophe by which nine villages were destroyed. In 1825 another volcanic eruption took place, accompanied by earthquakes, and two hills were thrown up which still emit smoke. The port of Naos on the S.E. of the island affords safe anchorage. It is protected by two forts. A short distance inland is the town of Arecife, with a population of 2500, where a British vice-consul resides. The climate is hot and dry. There is only a single spring of fresh-water on the island, and that is in a position difficult of access. From the total failure of water the inhabitants were once compelled to abandon the island. The inhabitants are now chiefly employed in agriculture, in the fishery off the African coast, and in the callings to which the fishery gives rise. Grain, wine (which is of superior quality), brandy, barilla, orchil, and raisins made from the muscatel grape, are the principal articles of export. The cattle are small, and horses few. Dromedaries are used as beasts of burden. Teguise on the N.W. coast is the residence of the local authorities, and has a population of 1000. A strait of about 6 miles in width separates Lanzarote from Fuerteventura.

Graciosa, a small uninhabited island, is divided from the north-eastern extremity of Lanzarote by a channel a mile in width, which affords the most capacious and only safe harbour for large ships at the Canaries; but basaltic cliffs 1500 feet high prevent intercourse with the inhabited part of Lanzarote. Forty persons reside on the little island Allegranza, a mass of lava and cinders ejected at various times from a now extinct volcano, the crater of which has still a well-defined edge.

Fuerteventura lies between Lanzarote and Grand Canary. It has a length of 52 miles, and an average width of 12 miles. Though less mountainous than the other islands, its aspect is barren. The springs of fresh water are only two, and they are confined to one valley. The larger vegetation is composed of an inconsiderable number of date palms, and fig trees. Lava streams and other signs of volcanic action abound, but there have been no signs of igneous activity since the Spaniards took possession. At each of its extremities are high mountains which send off branches along the coast so as to inclose a large arid plain. The highest peak is in the peninsula of Handia; it is 2500 feet in height. In external appearance, climate, and productions, this island greatly resembles Lanzarote. An interval of three years without rain has been known. The inhabitants are poor and indolent, but a strong and well-built race. Various kinds of grain and potatoes are cultivated. The wine is bad. Barilla and orchilla are largely exported. Oliva is the largest town; it has 2000 inhabitants. A smaller place in the centre of the island named Betancuria is the residence of the authorities. Cabras, on the eastern coast, with a population of 1000 persons, is the chief port. Goats are numerous. Dromedaries are bred here. The peninsula of Handia, a mass of high mountains that presents a precipice to the N.W., and a steep slope furrowed by ravines to the S.E., is joined to the rest of the island by a low isthmus of sand. This peninsula affords pasturage to many herds of cattle and goats. Much orchilla is collected here.

Gomera lies 20 miles S.W. of Teneriffe. Its shape is rudely triangular. The longest straight line that can be drawn in it is about 23 miles long. Its coast is precipitous and its interior mountainous, but it is the most wooded and best watered of the group. The inhabitants are deeply impoverished and half-famished. Wine, brandy, orchilla, raw silk, and dried fruits are sent to Teneriffe. Dromedaries are bred on Gomera, and there are thousands of them here. St Sebastian, the chief town and a port, has 1000 inhabitants. Columbus resided here before sailing in quest of the New World.

Hierro or *Ferro*, the most westerly and the smallest island of the group, is somewhat crescent-shaped. Its length is about 18 miles, its greatest breadth about 15 miles, and its circumference probably 50 miles. It lies 92 miles W.S.W. of Teneriffe. Its coast is bound by high steep rocks, which only admit of one harbour, but the interior is tolerably level. Its hill-tops in winter are sometimes wrapped in snow, which however does not lie long. Better and more abundant grass grows here than on any of the other islands. The island is exposed to westerly gales which frequently commit great damage. There is here a sulphureous spring, the water of which has a temperature of 102° F. The springs of fresh water are few. The once celebrated and almost sacred Til tree, which was reputed to be always distilling water from its leaves in sufficient abundance to fill two large tanks, no longer exists. Only a small part of the cultivable land is under tillage, the inhabitants being principally employed in pasturage. Wine, brandy, orchilla, excellent dried figs, and sheep, are sent to Teneriffe. At Valverde, the principal town, the local authorities reside. Geographers were formerly in the habit of measuring all longitudes from Ferro. (J. Y. J.)

CANARY-BIRD. See ORNITHOLOGY.

CANCALE, a seaport-town of France in the department of Ille-et-Vilaine, 10 miles east of St Malo, on the bay of St Michael. A considerable trade is carried on in oysters, which are found in the bay in great numbers and of excellent quality. Pop. about 3000.

CANCAO or CANCAR, a seaport-town of Cambodia, situated on the gulf of Siam, in N. Lat. 10. 18., E. Long. 105. It carries on a considerable trade in iron and the more valuable kinds of timber, but has of late years begun to decline.

CANCELLI, a term used to denote windows made of cross bars disposed latticewise. It is also used for rails or balusters, and for the net-work in the inside of hollow bones.

CANCER, a glandular disease, unfortunately of comparatively too frequent occurrence. It appears as a roundish, hard, unequal, schirrous tumour, which usually ulcerates, is attended with much pain, and generally terminates fatally.

CANCER, in *Astronomy*, one of the twelve signs, represented on the globe in the form of a crab, and in books marked

thus, ♋. The reason generally assigned for its name, as well as figure, is a supposed resemblance which the sun's motion in this sign bears to that of the crab-fish. As the latter walks backwards, so the former, in this part of his course, begins to recede; though others suppose the disposition of stars in this sign to have given the first hint of the representation of a crab.

Tropic of Cancer, in *Astronomy*, a lesser circle of the sphere, parallel to the equator, and passing through the beginning of the sign Cancer.

CANCHERIZANTE, or Cancherizato, in the Italian music, a term signifying a piece of music that begins at the end, being the retrograde motion from the end of a song, or other composition, to the beginning.

CANDACE, or Kandāke, a queen of the Ethiopians, mentioned in Scripture, Acts viii. 27. We learn from the testimonies of various profane authors that Ethiopia Proper was for a considerable period under the sway of female sovereigns, who all bore the appellation of *Candace;* so that it appears to have been merely a distinctive title, like Pharaoh, Ptolemy, or Cæsar. (See Plin. *H. N.* vi. 29.)

CANDAHAR, or Kandahar, an extensive province of Afghanistan, situated between the 31st and 34th degrees of north latitude, and between the 62d and 68th degrees of east longitude. To the north it is bounded by the country of Balk, to the south by Beloochistan, on the east it has Scinde and Beloochistan, and on the west a sandy desert of various breadth divides it from the province of Seistan, in Persia. Part of this province consists of mountains, and part of arid and uncultivated plains, crossed by ranges of hills running westward from the Paropamisan mountains. But though the general appearance of the country be waste and barren, most parts of it supply water and forage to the pastoral hordes by whom it is frequented; and it is not destitute of many well-watered and pleasant valleys, and some fertile plains, surrounded by mountains. The western part of this tract is by no means so mountainous as the northern; and in former times it was a fertile and well-inhabited region, as appears from many magnificent ruins that are scattered over it. From Candahar a tract of very considerable extent stretches westward for upwards of two hundred miles. Its general breadth is a hundred miles. This tract is very imperfectly defined, the hills on the north sometimes running into the plain, and the southern parts of the inhabited country not being easily distinguished from the desert on which they border. The aspect of this country approaches to that of a desert. Scarce a tree is to be found in the whole region; the plains are covered merely with low bushes. Through this arid region many various streams diffuse occasional fertility. The banks of the Furrah, the Khaush, and other streams, are well cultivated, and produce wheat, barley, pulse, and abundance of excellent melons. Even at a distance from the streams some patches of cultivation are to be found, which are artificially watered. There are villages among the cultivated lands; but the mass of the inhabitants are scattered over the face of the country in tents. The banks of the Helmund must, however, be excepted from the general unproductive character of the country, along which a fertile strip extends about two miles in breadth, beyond which the sandy desert begins, and stretches out for many days' journey. To the northward of this desert tract is a hilly region, dependent on the Paropamisan range, which includes fertile plains, that are well watered and produce abundance of wheat, barley, and rice, together with madder and artificial grasses. On these plains grow the tamarisk and the mulberry, and a few willows and poplars; and the orchards contain all the fruit trees of Europe. The country around the city of Candahar is level, of tolerable fertility, irrigated both by water courses from the rivers and by springs, and most industriously cultivated. It abounds in grain, good vegetables, excellent fruit; in madder, assafœtida, lucerne, clover, and tobacco, which is in very great repute.

The wild animals of this country are leopards, bears, wolves, hyenas, jackals, foxes, deer, hares, boars, and the wild ass. The tame animals are camels, horses, cattle, mules, asses, sheep, goats, dogs, &c. There are also a few buffaloes. The country produces no metals, nor has it any peculiar manufactures. But as the road between India and Persia passes through it, it has a considerable transit trade. Besides the Dooraunees, one of the chief tribes of the Afghan country, there are in Candahar Hindus, Persians, Belooches, and Taujiks. The Taujiks generally inhabit towns, and follow different trades. The bankers and shop-keepers are all Hindus.

Candahar, the capital of the above province, and a large and populous city. Its form is that of a square or oblong; and as it was built at once on a fixed plan, it has the advantage of great regularity. All the four great streets or bazaars in the city meet in a central point, where there is a circular space of about forty or fifty yards in diameter, covered with a dome. This place is called the Chaursoo. It is surrounded with shops, and may be considered as the public market-place, where proclamations are made, and where the bodies of criminals are exposed to the view of the populace. The four streets are each about fifty yards broad. The sides consist of shops of the same size and plan, all one storey in height, with the lofty houses of the town overlooking them from behind; and in front runs an uniform veranda, along the whole length of the street. There are gates at the entrance of the streets, with the exception of the northern one, where stands the king's palace facing the Chaursoo. All the other streets run from these four; and though they are narrow, they are all straight, and almost all cross each other at right angles. This city, however, though it is more regular in its plan than most of the cities of Asia, has but a mean appearance, being built for the most part of brick, often with no other cement than mud. It is divided into various quarters, which are attached to the respective tribes and nations which form the inhabitants of the city. Almost all the great nobles of the Dooraunee tribe have houses in Candahar, and some of them are said to be large and elegant. Among the common people the Hindus have the best houses, which they are in the practice of building very high. There are many caravanserais and mosques; but of the latter, one only near the palace is said to be handsome. The palace is not remarkable; but it contains several courts, many buildings, and a private garden. Near the palace stands the tomb of Ahmed Shah, which is not a large building, but has a handsome cupola, and is elegantly painted, gilt, and otherwise ornamented within. Twelve smaller tombs of the children of the deceased shah are ranged about the principal one, and many texts of the Koran strewed around afford solemn impressions to the Mohammedan visitors. An establishment of Moollas is attached to the tomb, and one of their number constantly attends in the building. The city is well watered by two large canals from the river Urghundaub, which are crossed in different places by small bridges. From these canals small water-courses run to almost every street in the town, which are in some parts open, and in others are under ground. Candahar is a place of great resort: its principal business arises from the transit trade, which brings a large number of foreigners in proportion to the resident population. Hence there is a surprising diversity of costumes in the bazaars. The Turcoman merchants from Buckhara and Samarcand frequent the markets of Candahar, whence they transport into their own country a considerable quantity of indigo and other commodities. Candahar so far differs from the other cities in Afghanistan, that the greater part of the inhabitants are Afghans, and of these the greater number of

the Dooraunee tribe. The other inhabitants are the same as those in the province, being an assemblage from the different nations of the East. Candahar is surrounded with gardens and orchards, and many places of worship, which are more frequently scenes of pleasure than of devotion. About two miles to the north of the city stands the fortress of Candahar, on the top of a precipitous rock, which, before the introduction of cannon, was considered impregnable. This fortress was in very early times the residence of a Hindu prince. In the beginning of the eleventh century it was in possession of the Afghan tribes, from whom it was taken by Sultan Mahmoud of Ghizne. It was afterwards captured by the troops of Ghenghis Khan in the beginning of the thirteenth century, and by those of Timour in the fourteenth. In 1507 it was taken by the Emperor Baber, but was soon afterwards recovered by the Afghans. In 1521 Baber again got possession of it, after a long siege. Homayon, the son of Baber, when he was expelled from the throne of Hindustan, agreed to make over the fort and district of Candahar to the Persian monarch, in return for the aid which he gave them. But repenting of his promise, he again got possession of the fortress, which by its strength defied all the efforts of the Persians to reduce it. It remained an appendage of Hindustan until the year 1625, when it was taken by Shah Abbas the Great, and being surrendered by treachery, was recovered in 1649, and was successfully defended against Aurungzebe with an army of 50,000 men. Three years after, he was again compelled to retreat from it with disgrace. It remained in possession of Persia till 1709, when it was taken by an Afghan tribe. It was retaken by Nadir Shah, after a siege of two years; and on his assassination, it was taken in 1747 by Ahmed Shah, the chief of the Abdallies, who thereby laid the foundation of the Afghan power. Under Ahmed Shah, Candahar was the seat of government, which was removed to Cabul by his successor. On the dismemberment of Afghanistan, subsequent to the expulsion of Shah Shooja, the brothers of Dost Mahomed established themselves in Candahar, and levied contributions over the neighbouring districts. Their weak and pernicious rule was terminated by the occupation of their capital by a British force in 1839. The army of occupation, notwithstanding the frequent and desperate attacks of the natives, made good the defence until the autumn of 1842, when it finally evacuated the place, and commenced its triumphant march on Ghuznee and Cabul. Lat. 31. 37., Long. 65. 28. See Afghanistan.

CANDAULES, called also Myrsilus, king of Lydia, was assassinated by his favourite Gyges, at the instigation of the queen, who took this revenge because her husband, through excess of vanity, had secretly exhibited to that officer her naked charms. She then married the murderer, who mounted the throne, B.C. 715. (See Herod. i. 7–13; Justin, i. 7; Plat. *De Repub.* ii., p. 359.)

CANDELABRUM, a high and ornamental kind of candlestick or stand for lamps. The candelabra of the ancients were frequently very magnificent, combining exquisite design with admirable workmanship. They were generally made of bronze, but sometimes of marble, &c. Perhaps the finest collection of ancient candelabra is to be seen in the museum of the Vatican.

CANDESH. See Khandesh.

CANDIA (the ancient Crete), an island in the Mediterranean, S.W. from the Morea, and extending from 34. 55. to 35. 42. N. Lat., and from 23. 30. to 26. 20. E. Long. Its extreme length is about 160 miles; in breadth it varies from 6 to about 45 miles. It is traversed from east to west by a range of hills, the highest of which, Psilorati (the ancient Ida), rises to an elevation, according to Sieber, of 7674 feet, and is capped with snow till midsummer. Its sides are steep and cavernous. On the S.W. are the White Mountains, which descend almost to the coast, and are infested by the Sphakiotes, a tribe of native banditti and pirates, who have defied all the efforts of the Turks to exterminate or subdue them. The northern coast of the island is deeply indented with bays, which are protected by the headlands of numerous offshoots from the central chain, and afford tolerably good anchorage. The ports and principal towns of Candia are ranged along this coast at the entrance of the valleys, which form the only accessible points from the sea. The southern coast is precipitous and inaccessible. The climate in the uplands of Candia, where the rain is rapidly drained off by the mountain torrents, is exceedingly good; but the low grounds in autumn are often flooded and rendered unhealthy by exhalations. The mountains on the north are covered with forests, and afford pasture for sheep, goats, and black cattle, besides being abundantly stocked with game. The soil of the valleys, though highly fertile, is too light for the cultivation of grain, which the inhabitants are obliged to import in considerable quantities from Egypt and Barca. The principal source of profit to the inhabitants is derived from the culture of the olive, and the extensive manufacture of oil and soap, which form the staple of their exports. There is an inconsiderable trade in wine, silk, flax, and cotton; but the oppressive exactions of the Turkish government are gradually diminishing the industrial resources of the island. Linen, woollen, and cotton stuffs, are generally manufactured only for domestic use. The peasantry are a rude and uncultivated race, and their mode of agriculture barbarous in the extreme. No trace has been found of the iron mines which are said to have existed here. The island is divided into eight bishoprics, belonging to the Greek church; the metropolitan resides at the capital. For the purposes of administration, it is divided into the three provinces of Candia, Retimo, and Canea, which are governed by distinct civil officers under the Turkish viceroy of Egypt. The population of Candia is estimated at 163,000, of which by far the greater part consists of Greek Christians.

The golden age of Candia, if we except the fabled reign of Saturn in the island, was during its subjection to the Venetians, to whom it was sold by the Byzantines in 1204. Notwithstanding the prolonged and vexatious resistance of the Sphakiotes to the Venetian governors, the inhabitants were placed under a popular administration, and enjoyed for nearly four centuries the greatest political and religious freedom. With very little foreign aid, they continued to repel the hostile invasions of the Genoese and Turks till the middle of the seventeenth century. In 1644 began the contest between the Venetians and Turks for the occupation of Candia, which lasted for nearly 25 years, and resulted in the transference of the island into the hands of the latter. The Candiots were assisted by grants of money from the Western powers, and reinforced by bands of French, German, and Maltese crusaders, who sallied out against the Turks at the especial command of the pope. The resources of so small an island could not, however, long hold out against the overwhelming numbers of the besiegers; but it was not till nearly 31,000 Christians had been slain on the ramparts and in sorties, and the fortifications were crumbling to pieces under the severe cannonade, that the town of Candia was surrendered to the enemy in 1669. Since that time Candia has never regained its commercial prosperity, and the inhabitants have been involved in perpetual contests with the Turkish government. In 1830 the Turks were compelled by the European powers to cede it to the pacha of Egypt, but it was again restored to Turkey in 1840; and the improvements in the island, which in the interval Mehemet Ali had projected and begun, were frustrated by an unsuccessful rebellion, which broke out in the following year.

Candia, the capital of the above island, is situated about the centre of its northern shore, in N. Lat. 35. 20., E. Long. 25. 9. It was once a strongly fortified seaport, but its de-

fences have been allowed to fall into disrepair, and the harbour, which was formed by a mole, is so choked with sand as to be inaccessible to vessels drawing more than 8 feet of water. The houses of the Turkish residents are well-built and pleasantly adorned with gardens, but the rest of the town is somewhat dilapidated and ruinous. The principal buildings are the pasha's palace, the bazaars, the mosques, and the public baths. Candia is the residence of a Greek archbishop, and contains a large cathedral which was founded by the Venetians. Its principal trade is in oil and soap: its exports and imports are conveyed almost exclusively in Greek and Turkish bottoms. Pop. 12,000.

CANDIAC, Jean Louis Pierre Elizabeth de Montcalm de, a child of astonishing precocity, born at the château de Candiac in the diocese of Nismes in France, in 1719. At four years of age he read Latin, either printed or in manuscript; and at six understood Greek and Hebrew, knew the principles of arithmetic, history, geography, heraldry, and numismatics, and had read the best authors on various branches of literature. Candiac attracted the attention of the learned at Nismes, Montpellier, Grenoble, Lyons, and Paris; and it was for his benefit that the typographic board was contrived by M. Dumas, who superintended his instruction. He died of a complication of disorders, at Paris, in 1726.

CANDIDATE (from *candidatus*, white-robed), a person who aspires to some public office. In the Roman commonwealth, candidates wore a white robe rendered shining by the art of the fuller. This garment, according to Plutarch, they wore without a tunic or waistcoat; either that they might appear more humble, or that they might more easily show to the people the scars of wounds received in battle. See Ambitus.

CANDLE, a cylindrical or slightly conical rod of solid fatty or waxy matters, in the centre of which is a wick formed of cotton fibres which are parallel, twisted, or plaited.

Until of late years, candles were solely manufactured from bees' wax, spermaceti, or tallow. The application of scientific chemical research, however, to this branch of art, coupled with the withdrawal of the vexatious excise supervision, which prevents improvements in every trade which comes under its influence, has so improved the materials used, as well as the manufacture itself, that all the best candles are now made from the pure solid and crystallizable margaric and stearic acids. These are freed from the fluid oleic acid, and from glycerine, which exist in combination with them in ordinary tallow, as well as from other analogous substances, as from paraffine (a carbo-hydrogenous substance resembling spermaceti, prepared from tar and peat), the stearic and margaric acids of the cocoa-nut oil and the palm oil (*Elais guineensis*), besides the old substances spermaceti, and wax both vegetable and animal.

Only the coarsest description of candles are now made from the tallow of the ox or sheep; but as the illuminating power of these candles is small as compared with the improved candles, while their rapidity of combustion is much greater, they are absolutely dearer as articles of consumpt than the candles of improved manufacture. The tallow, cut into small pieces, is melted, when the membranous portions, called the cracklings, rising to the surface, are skimmed off, and freed from their adhering fat by being subjected to pressure. The liquid tallow is then strained through a coarse sieve, and boiling water is mixed with it. The water carries down certain impurities to the bottom of the vessel, and, after settling, the melted tallow is lifted out and is ready for use. In making dip tallow candles the cotton wicks are arranged on sticks on a frame corresponding in size to the dipping cistern, and each frame is suspended from cross-arms which project from an upright beam turning on pivots. The workman turns these arms round, and as each frame comes over the dipping cistern, he presses the frame down so that all the wicks on it are immersed in the tallow. This coats the wick with one thin layer of tallow. The arms are then turned round, and each frame as it successively arrives over the cistern is treated likewise. The layer of tallow added in the dipping becomes consolidated before its turn arrives to receive a second dip, and the arms are turned round, and the candles dipped again and again, until all have acquired the desired thickness and weight, which is known by a counterpoise fixed to the arm.

For ordinary moulded candles, a certain proportion of sheep tallow is melted along with ox tallow, and run into moulds made of pewter finely polished inside. These moulds are not quite cylindrical, but taper slightly towards their point, so as to admit of the more easy removal of the candle. From ten to eighteen of these moulds are fixed by the larger extremity to a kind of trough, their taper points projecting downwards. The wick is then fixed in the centre of the mould, by being drawn through an aperture at the point of the mould which forms the upper end of the candle, and is retained in its place at the open extremity within the trough by means of a wire or other contrivance. The melted tallow being then poured into the trough fills all the moulds, and as soon as it is solidified the redundant tallow is removed from the trough, and the candle drawn out of the mould by means of the end of the wick which has been held by the wire.

The discovery by the celebrated French chemist Chevreul, that fats were composed of three highly inflammable bodies, stearic and margaric acids (solids), and oleic acid (a liquid), combined with a comparatively uninflammable body, glycerine,—has led to the creation of the great new manufacture of stearic and composite candles; the importance and growth of which will be understood when we state, that while in 1833 the new candles were unknown in England, and the quantity manufactured in France amounted to only twenty-five tons *annually*, a single London house (that of E. Price & Co.) manufactured last winter (1854) more than that quantity of stearic and composite candles *daily*, and employs in this business above 900 hands, and a capital of nearly three-quarters of a million.

The old process for making stearic acid may be thus described:—Tallow is boiled up with thin cream of lime, which causes the fat acids by superior affinity to forsake their glycerine and combine with the lime, the glycerine dissolving in the water; this combination is then broken by means of sulphuric acid, which, seizing on the lime, sets free the fat acids; these are then separated (the liquid from the solid), by means of pressure. This process of making fat acids is called "lime saponification." The hard matter remaining in the press is stearic, or a mixture of stearic and margaric acids, and the candles made from it are called stearine, or more properly stearic candles.

In 1840 it was discovered in England that by combining stearic acid with the solid matter, or stearine obtained by pressure from cocoa-nut oil, good candles not requiring snuffing might be made at a considerably less cost than stearic candles. These were called by the inventor "composite." The trade in these composite candles is now immense.

Since 1840 numerous great improvements have been invented, which have resulted in the present manufacture of candles having all the good qualities of the old stearic, while they are sold at prices little exceeding that of tallow candles.

The present improved process is this:—Palm-oil or other fatty matter is exposed at a high temperature to the action of concentrated sulphuric acid, which changes it into a mixture of fat acids of a very dark colour, with a high melting point; this is then distilled in an atmosphere of steam. The distilled material is either used for making the cheaper descriptions of composite candles, or is subjected to hydraulic pres-

sure, first at the temperature of the air, and then at a high heat; the result of pressure being the material used for making what are known as "Belmont sperm," corresponding with stearic candles.

It is a common fallacy to suppose that the capability of a candle to give a good light without requiring snuffing depends more upon its wick than on its material: the same piece of plaited wick which in a stearic candle would give a large good light, would in ordinary tallow give but a feeble glimmer; while a wick suited for common tallow would in stearic material flare away almost like a torch. Arsenic was formerly employed in the manufacture of stearic candles, in order that by its disturbing crystallization it might give a compact uniform appearance to the candle. Happily the modern process of pouring the candle material at so low a temperature into the moulds that crystallization cannot take place, attains the object quite as effectually. The use of arsenic has, therefore, for some time been entirely discontinued.

The mode of making moulded candles by machinery which is employed in the great manufactories, is as follows:—Each frame has a box attached to it, containing a bobbin for each mould; the same movement that expels the one set of candles from the mould uncoils a sufficient length of wick for the next; this is separated from the finished candles by means of a knife travelling on a rack; a set of forceps then holds each wick over the centre of its mould, which is now passed along a railway through a closet heated by steam pipes, by which it is raised to the required temperature by the time it arrives at the filler; having received its charge, it passes on till the material is sufficiently cooled to allow of the forceps being withdrawn without disturbing the position of the wicks. A little further on the superfluous material is scraped off; the mould is then passed across by means of a travelling truck to a parallel line of railway; by the time it has traversed the length of this and arrived at the drawer, the candles are sufficiently cold to be removed. Each machine has on an average 200 moulds, each mould contains 18 bobbins, and each bobbin, when first cottoned, 60 yards of wick.

Wax candles do not appear to have participated in the improvements which have attended the manufacture of the improved stearic or composite candles, and they appear to be still chiefly manufactured by hand. They are made of a cotton or flaxen wick, slightly twisted, and covered with white or yellow wax. Of these there are several kinds; some of a conical figure, used to illuminate churches, and in religious processions, funeral ceremonies, &c.; others of a cylindrical form, used on ordinary occasions. The first are either made with a ladle or the hand. 1. To make wax-candles with the ladle: the wicks being prepared, a dozen of them are tied by the neck, at equal distances, round an iron circle, suspended over a large basin of tinned copper, full of melted wax. A large ladleful of this wax is poured gently on the tops of the wicks one after another, and the operation is continued till the candle arrives at its destined size; with this precaution, that the three first ladles are poured on at the top of the wick, the fourth at the height of three-fourths, the fifth at one-half, and the sixth at one-fourth, in order to give the candle its conical form. Then the candles are taken down, kept warm, and rolled and smoothed upon a walnut-tree table, with a long square instrument of box, smooth at the bottom. 2. As to the manner of making wax-candles by the hand, candle-makers begin to soften the wax by working it several times in hot water contained in a narrow but deep cauldron. A piece of the wax is then taken out, and disposed by little and little around the wick, which is hung on a hook in the wall, by the extremity opposite to the neck; so that they begin with the big end, diminishing still as they descend towards the neck. In other respects the method is nearly the same as in the former case. However, it must be observed that, in the former case, water is always used to moisten the several instruments, to prevent the wax from sticking; and in the latter, oil of olives, or lard, is used for the hands, &c. The cylindrical wax-candles are either made as the former, with a ladle, or they are drawn. Wax-candles drawn are so called because they are actually drawn in the manner of wire, by means of two large rollers of wood, turned by a handle, which turning backwards and forwards several times, pass the wick through melted wax contained in a brass basin, and at the same time through the holes of an instrument like that used for drawing wire fastened at one side of the basin.

Flame has been defined to be a luminous bubble of gaseous matter; it is not, however, necessarily luminous, for the flame of pure hydrogen has but little illuminating power, although its heat is great. If, however, we project into the hydrogen solid matter in a minutely divided state, such as charcoal dust, the solid particles become white hot in passing through the flame, and greatly improve its luminosity. In the flame of candles hydrogen supplies the heat, and minutely divided carbon the light. A candle is a simple but ingenious contrivance for supplying the flame with as much melted material as it can consume without smoking. The fibres of the wick act as a congeries of capillary tubes, which convey the fluid fat into the flame, where, being exposed to a high temperature, and sheltered from the air by the outer shell of flame, it becomes subjected to a dry distillation. The inflammable vapour thus produced rises, and by constant combustion diminishes in quantity, and constantly in diameter, until at length it entirely disappears in a point. We have spoken of flame as a luminous bubble or shell, because it is in fact a hollow body, the exterior only being luminous, where the contact with the air produces perfect combustion. A current of air set in motion by the heat of the flame, causes fresh air constantly to stream up from below; the oxygen of the air, aided by the high temperature, decomposes the inflammable vapour of the fat into hydrogen and carbon; the hydrogen burns, or, in other words, unites with the oxygen of the air, and forms vapour of water; the carbon at the same moment is set free, becomes white hot, and imparts luminosity to the flame; but it does not disappear from the scene of action until it gets to the exterior of the flame, where the oxygen of the air seizes it and forms with it carbonic acid.

The flame of a candle consists of four tolerably distinct portions. 1. The dark interior, containing unburnt combustible vapour. 2. Around this the brilliant part of the flame, or the flame properly so called, where the hydrogen is united with the oxygen of the air, and the carbon, not having yet done so, is in an incandescent state. 3. Beyond this, another film or casing, where the oxygen of the air unites with the carbon. 4. The blue portion at the bottom of the flame, where the inflammable vapour undergoes perfect combustion, and no solid carbon is deposited to afford light. In a well-made candle, the hottest part of the flame is just at the top of the luminous cone where combustion is perfect, and the air not sufficiently in excess to carry away the heat so quickly as at the sides or in the blue part at the bottom.

For a long period tallow candles were subjected to an excise duty of one halfpenny per pound, wax and spermaceti candles to a duty of threepence halfpenny per pound. This was repealed from the 1st of January 1832.

CANDLE, Medicated, the same with BOUGIE.

CANDLES, Rush, are made of the pith of a rush peeled, except on one side, and dipped in grease.

CANDLE, Sale by inch of, an old kind of auction, at which persons were only allowed to bid while a small piece of candle continued burning; the moment it expired the commodity was adjudged to the last bidder.

CANDLE, Excommunication by inch of, is when the f

fender is allowed time to repent while a candle continues burning; after which, he is excommunicated.

CANDLEMAS, a feast of the Romish Church held on the second day of February, in honour of the purification of the Virgin Mary. It is so called from the great number of lights used on that occasion; a custom derived from early Christian times. This feast is supposed to have originated in the declaration of Simeon, that our Saviour was "to be a light to lighten the Gentiles." The Roman Catholics on this day consecrate all the tapers and candles which are to be used in their churches during the whole year. At Rome, the pope performs the ceremony himself, and distributes wax-candles to the cardinals and others, who carry them in procession through the great hall of the pope's palace. This ceremony was prohibited in England by an order of council in 1548.

CANDLEMAS, the second of February, is one of the four terms of the year for paying and receiving rents, interest, &c. In the courts of law Candlemas term begins 15th January and ends 3d February.

CANDLESTICK, an instrument to hold a candle, made in different forms and of different materials.

The candlestick or candelabrum which Moses was commanded to make for the tabernacle was of hammered gold, a talent in weight, and consisted of a base with a shaft rising out of it, of six arms which came out by threes from two opposite sides of the shaft, of seven lamps supported on the summits of the six arms and central shaft; and the arms and shaft were ornamented with "cups, globes (or pomegranates), and blossoms," three cups being allotted to each arm, and four to the shaft. According to Jewish tradition, each arm rose to a level with the summit of the shaft,—which is borne out by the representation of it on the arch of Titus. The extremities of the arms and shaft supported the seven golden lamps, which were filled with oil and cotton.

The seven lamps were lighted every evening, and extinguished every morning. This candelabrum was placed in the holy place, on the south side, and served to illuminate the altar of incense and the table of show-bread. When Solomon built the temple, he placed in it ten golden candelabra, five on the north and five on the south side of the Holy Place; but after the Babylonish captivity, the golden candlestick was again placed in the temple, as it had been before in the tabernacle by Moses. This candelabrum is the one which, after the destruction of Jerusalem, was carried with other spoils to Rome; then, A.D. 455, became a part of the plunder which Genseric transported to Africa; was again, about A.D. 533, recaptured from the Vandals by Belisarius, and carried to Constantinople, and was thence sent to Jerusalem, and from that time disappeared altogether. It is to this candelabrum that the representation on the arch of Titus at Rome was intended to apply; and, although the existence of the figures of eagles and marine monsters on the pediment of that lamp tends to render the accuracy of that copy questionable, yet there is reason to believe that, in other points, it may be relied upon as a reasonably correct representation of the Herodian candelabrum. (See Reland, *De Spoliis Templi Hierosolym., in Arcu Titiano*, ed. sec. Schulze, 1775.)

CANDOLLE, AUGUSTIN PYRAMUS DE, a celebrated botanist, born at Geneva in 1788, was descended from one of the most ancient families of Provence, who had been expatriated for their religion. His father was a famous printer, and syndic of the university and republic. De Candolle began his studies at the college of Geneva, by attending the courses of Saussure and Vaucher, the latter of whom first inspired him with a love of botanical science. In 1795, when Geneva lost her independence, he removed to Paris, where he soon gained the friendship of Jussieu and Desfontaines. His first productions, *Historia Plantarum Succulentarum*, and *Astragalogia*, introduced him to the notice of Cuvier (whose chair in the Collége de France he supplied in 1802), Humboldt, Biot, and Lamarck, who afterwards confided to him the publication of the third edition of the *Flore Française*. Having been elected doctor of medicine by the medical faculty of Paris, he wrote, as an inaugural work, the *Essai sur les propriétés médicinales des Plantes comparées avec leur classification naturelle*; and soon after, in 1806, his *Synopsis plantarum in Flora Gallica descriptarum*. At the desire of the French government he spent a considerable part of the following six years, during which he was professor at Montpellier, in making a botanical and agricultural survey of the whole kingdom; the results of which he published in 1813. From Montpellier he removed to Geneva in 1816, having been invited by the now independent republic to fill the newly created chair of natural history. The rest of his life was spent in an attempt to construct a new system of botanical classification. The results of his labours in this department are to be found in 2 vols. of his *Regni vegetabilis systema naturale*, and in 7 vols. of the *Prodromus systematis regni vegetabilis*. He died in 1842 at Turin, whither he had gone to attend a scientific reunion, having completed only about two-thirds of his proposed task, which has, however, been continued by his son.

CANDY. See KANDY.

CANDY, or *Sugar Candy*, a preparation of sugar made by melting and crystallizing it six or seven times, to render it hard and transparent.

CANDYING, the method of preserving fruits, &c. in substance, by boiling them in sugar.

CANE (Latin *canna*), includes several species of plants belonging to different genera, as Arundo, Calamus, Saccharum, &c. See the articles BAMBOO, BOTANY, SUGAR.

The most beautiful canes are those brought to Europe from the East. These are much used as walking-sticks, and for the handles of umbrellas.

CANE also denotes a measure of length in several parts of Europe: at Naples, 7 feet 3½ inches; at Toulouse, 5 feet 8½ inches; in Provence, &c. 6 feet 5½ inches.

CANE, a river of Hindustan, which has its source on the north side of the Vindhya mountains, in the province of Bundelcund at an elevation of 1700 feet above the sea. N. Lat. 23. 54., E. Long. 80. 13. After a winding course of about 250 miles, it falls into the Jumna on its right bank at Chilatara.

CANEA, or KHANIA, the principal seaport of Candia, is situated on the northern coast, N. Lat. 35. 28. E. Long. 24. 1. Its harbour, formed by a mole nearly 1200 feet long, and protected by a lighthouse and fort, admits of vessels of considerable tonnage. Its entrance, which has a depth of 24 feet, is much exposed to the north wind. It is the seat of a Greek bishop, who is suffragan to the metropolitan at Candia, and contains several Greek churches. The Mussulmans have numerous mosques; the resident Jews are formed into a synagogue. The principal manufacture is soap. Few British vessels touch either at Canea or the other ports of Candia. Pop. 8000, of whom 5000 are reported to be Mohammedans.

CANEPHOROS (*i.e.* basket-bearer), in *Grecian Antiquity*, a maiden whose office it was at the festivals of Minerva, Ceres, and Bacchus, to carry the sacred utensils for sacrifice in a shallow wicker basket on her head. At Athens this office was accounted so honourable, that two virgins of the highest rank were appointed for the purpose.

On an antefixa in the British museum, two canephoræ are represented standing before a candelabrum.

In architecture, *canephoræ* are figures of young persons of either sex in imitation of the above. They are sometimes confounded with *caryatides*.

Canephoræ also denoted those virgins who, when mar-

riageable, presented baskets of offerings to Diana, in order to propitiate that goddess on their renunciation of the virgin state.

CANES VENATICI, in *Astronomy*, the Greyhounds (Asterion and Chara), a constellation first established by Hevelius, between the tail of the Great Bear and Bootes's arms, above the Coma Berenices. It contains 25 stars.

CANGE, CHARLES DU FRESNE, SIEUR DU, one of the most learned writers of his time, was born at Amiens, December 18, 1610. His father, who was royal provost of Beauquesne, sent him at an early age to the Jesuits' College in Amiens, where he soon distinguished himself. Having completed the usual course at this seminary, he applied himself to the study of law at Orléans, and afterwards went to Paris, where he was received as advocate before the parliament in August 1631. Meeting with little success as a barrister, he returned to his native country, where he applied himself to the study of history. After the death of his father, Du Cange married at Amiens, on 19th July 1638, Catherine Du Bois, daughter of a treasurer of France; and, in 1647, he purchased the same office, the duties of which in no degree interfered with the great literary works in which he had engaged. The plague, which in 1668 desolated Amiens, forced him to leave that city. He established himself at Paris, where he was enabled to consult charters, diplomas, titles, manuscripts, and a multitude of printed documents, which were not to be met with elsewhere. He was often aided in his researches by his friend M. d'Héronval. Having in 1688 been seized with strangury, he died of its effects on the 23d October. To the attributes of a good son, a good husband, and a good father, Du Cange united those of extreme gentleness, affability, and modesty. His industry was exemplary and unremitting; and the number of his literary works would be incredible, if the originals, all written in his own hand, were not still extant. In his productions are united the characters of a consummate historian, an exact geographer, a profound jurist, an enlightened genealogist, a learned antiquary, and one deeply versed in the science of medals and inscriptions. He knew most languages, possessed a thorough acquaintance with literature, and from a vast number of manuscripts and original documents drew much curious information respecting the manners and customs of the darkest ages. The learned prefaces of his glossaries afford ample proofs of his philosophical genius, and are, of their kind, models in point both of matter and of style.

Du Cange published the following works:—1. Histoire de l'Empire de Constantinople sous les Empereurs François. Paris, 1657, folio. 2. Traité Historique du Chef de S. Jean-Baptiste. Paris, 1666, 4to. 3. Histoire de S. Louis, Roi de France, écrite par Jean, sire de Joinville. Paris, 1668, folio. 4. Joannis Cinnami Historiarum de rebus gestis a Joanne et Manuele Comnenis, libri vi., Græce et Latine, cum Notis historicis et philologicis. Paris, 1670, folio. 5. Mémoire sur le projet d'un nouveau Recueil des Historiens de France, avec le plan général de ce Recueil, inserted in the *Bibliothèque Historique de la France*, by Père Lelong. 6. Glossarium ad Scriptores mediæ et infimæ Latinitatis. Paris, 1678, 3 vols. fol. 7. Lettre du Sieur N. Conseiller du Roi, à son ami M. Ant. Wion d'Héronval, au sujet des Libelles qui de temps en temps se publient en Flandres contre les RR. PP. Henschenius et Papebroch, Jésuites. Paris, 1682, 4to. 8. Historia Byzantina duplici Commentario illustrata. Paris, 1680, fol. 9. Joannis Zonaræ Annales ab exordio Mundi ad mortem Alexii Comneni, Græce et Latine, cum Notis. Paris, 1686, 2 vols. fol. 10. Glossarium ad Scriptores mediæ et infimæ Græcitatis. Paris, 2 vols. fol. 11. Chronicon Paschale à Mundo condito ad Heraclii Imperatoris annum vigesimum. Paris, 1689, fol. This last work was passing through the press when Du Cange died; and, on his demise, it was edited by Baluze, and published with an éloge of the author prefixed. His manuscript autographs, and his extensive and valuable library, passed to his eldest son, Philippe du Fresne, who died unmarried, four years after. François du Fresne, the second son, and two sisters, then received the succession and sold the library, when the greater part of the manuscripts was purchased by the Abbé du Champs, who handed them over to a bookseller called Mariette, who re-sold part of them to Baron Hohendorf. The remaining part was acquired by D'Hozier, the genealogist. But the French government, sensible of the importance of all the writings of Du Cange, succeeded, after much trouble, in collecting the greater portion of the manuscript autographs of this eminent scholar. Among these manuscripts was one entitled *Gallia*, a work of incredible erudition, being a history of France, divided into seven epochs, with a number of dissertations, the greater part of which are ready for the press, whilst, in regard to those which are not so, abundant materials have been provided for its completion. (J. B—E.)

CANGI, CEANGI, or *Cangani*, ancient inhabitants of Britain, concerning whom antiquaries have been much divided. Camden discovered some traces of them in many different and distant places, as in Somersetshire, Wales, Derbyshire, and Cheshire. Baxter, again, supposed that the Cangi or Ceangi were not a distinct nation, but such of the youth of many different nations as were employed in tending the flocks and herds of their respective tribes. Almost all the ancient nations of Britain had their ceangi, or keepers of their flocks and herds, who ranged over the country in great numbers. This is the reason that vestiges of their name are to be found in so many parts of Britain, but chiefly in those parts which are most fit for pasturage. These ceangi of the different British nations, naturally brave, and rendered still more hardy by their way of life, went armed for the protection of their flocks from wild beasts; and these arms they occasionally employed in the defence of their country.

CANGIAGIO, or CAMBIASI, LUCA, one of the most eminent of the Genoese painters, was born in 1527. He was remarkable for the ease and spirit of his design. His works at Genoa are very numerous; and he was employed by the king of Spain to paint the ceiling of the choir of the Escurial. This great work represents the assemblage of the Blessed. Cangiagio died at the Escurial in 1585.

CANICATTI, a town of Sicily, in the province of Girgenti. It is well built and finely situated on the slope of a hill. The inhabitants principally devote themselves to agricultural pursuits. Pop. 18,000.

CANICULA, a star in the constellation *Canis Major*, called also *Sirius* or the *Dog-star*. It is situated in the mouth of the constellation, and is of the first magnitude, being the largest and brightest of all the fixed stars. From the rising of this star heliacally, that is, its emersion from the sun's rays, the ancients reckoned their *dies caniculares*, or dog-days. The Egyptians and Ethiopians began their year at the rising of the canicula, reckoning to its rise again the next year, which is called *annus canarius*, or canicular year. This year consisted ordinarily of 365 days, and every fourth year of 366, by which it was accommodated to the civil year. The reason of their choice of the canicula to compute time by was, not only the superior brightness of that star, but because its heliacal rising was in Egypt a time of singular note, as falling on the greatest augmentation of the Nile, the reputed father of Egypt. Hephæstion adds, that from the aspect and colour of the canicula the Egyptians drew prognostics concerning the rise of the Nile; and according to Florus, they predicted the future state of the year; so that the first rising of this star was annually observed with great attention.

CANICULUM, or CANICULUS, in Byzantine antiquity, a golden standish in which was kept the sacred *encaustum* or red ink with which the emperors signed their decrees, letters, &c. It probably derived its name from being supported by the figures of dogs.

CANINE MADNESS. See VETERINARY SCIENCE.

CANINI, GIOVANNI AGNOLO, a designer and engraver, born at Rome in 1617. He was a pupil of Domenichino, and afterwards of Barbalunga. He painted some good altar pieces at Rome, including two fine pictures for the church of St Martino a Monti, representing the Martyrdom of St Stephen and of St Bartholomew. Having accompanied Car-

dinal Chigi to France, he was encouraged by the minister Colbert to carry into execution his project of designing from medals, antique gems, and similar sources, a series of portraits of the most illustrious characters of antiquity, accompanied with memoirs; but shortly after the commencement of the undertaking, Canini died at Rome, in his 48th year. The work, however, was prosecuted by his brother Marcantonio, who, with the assistance of Picard and Valet, completed and published it in 1699, under the title of *Iconografia di Gio. Ag. Canini.* The engravings amount to 150, and a curious explanation is given, which attests the learning and taste of the brothers Canini. A reprint of this work in Italian and French appeared at Amsterdam in 1731.

CANIS, or Dog. See Mammalia.

Canis *Major*, the Great Dog, a constellation of the southern hemisphere, below Orion's feet.

Canis *Minor*, the Little Dog, a constellation of the northern hemisphere; called also by the Greeks *Procyon*, and by the Latins *Antecanis* and *Canicula*.

CANISIUS, or de Hondt, Henry, a native of Nimeguen, and one of the most learned men of his time, was professor of canon law at Ingolstadt. His principal works are, *Summa Juris Canonici* and *Antiquæ Lectiones*. This latter very valuable work was reprinted, with some curious and useful remarks, under the title of *Thesaurus Monumentorum Ecclesiasticorum et Historicorum*, &c., Amsterdam, 1725, in seven parts, usually bound in 4 vols. folio. Canisius died in 1610.

CANITZ, Friedrich Rudolph Ludwig, *Baron of*, a German poet and statesman, and privy-counsellor of state, was descended of an ancient and illustrious family in Brandenburg, and born at Berlin in 1654. After studying at Leyden he travelled in France, Italy, Holland, and England; and, upon his return to Germany, was charged with important negotiations by the Second and Third Frederics. His German poems were published for the tenth time in 1750, in 8vo. He is said to have taken Horace for his model, and to have written purely and delicately. He not only cultivated the fine arts himself, but gave all the encouragement he could to others to do so likewise. He died at Berlin in 1699.

CANKER, a disease incident to trees, which causes the bark to rot and fall.

CANNÆ, in *Ancient Geography*, a town of Apulia, near the Adriatic, on the right bank of the river Aufidus, 6 miles from its mouth. It is famous for a terrible overthrow which the Romans here received from the Carthaginians under Hannibal. See Rome. A great diversity of opinion has always prevailed as to the exact spot on which the battle was fought. The majority of modern historians and topographers, however, now agree in referring it to the south side of the river; but Swinburne, one of the best authorities on the subject, concluded from personal observation and a careful comparison of authorities that the scene of conflict lay on the northern bank; and in this opinion he is supported by Niebuhr. The modern village of Canne, 8 miles W.S.W. of Barletta, now occupies the site of this interesting town.

CANNEL Coal. See Mineralogy.

CANNES, a seaport-town of France, capital of a canton in the department of Var, on the Mediterranean, 25 miles east of Draguignan. It occupies the declivity of a hill projecting into the sea, and has an old Gothic castle, and a fine quay. The harbour, however, is accessible only to small coasting vessels. The country around is fruitful in oranges, olives, citrons, grapes, and other fruits, which, with the production of its fisheries, constitute its exports. Napoleon landed here after his escape from Elba, 1st March 1815. Lord Brougham has a seat in the neighbourhood.

CANNIBAL (probably a corruption of the word *Carib*), an anthropophagite or human being that eats human flesh. A tribe of this name inhabited a part of the Antilles before the arrival of the Spaniards, who destroyed nearly the entire race. In the island of St Vincent, where their numbers were originally very large, their descendants are still to be found greatly reduced in power, and considerably modified in character. They are, in general, downcast and given up to idleness and day-dreams. They have dark-olive complexions, and flat brows and nostrils. They are well-made, however, and possess great strength and powers of endurance. When roused from their usual apathy, they make excellent warriors, and are peculiarly formidable from their skill in archery. Their arrows are made in such a manner, that they cannot be extracted from the body against which they have been aimed without tearing the wound, and are, besides, dipped in the deadly juice of the manchineel. Polygamy is universal among them. As they have always been represented as in the habit of roasting and eating the flesh of their prisoners, their name has passed into a proverb in all languages. It is not altogether established whether they indulged in this horrid practice from the difficulty of obtaining more legitimate means of subsistence, or from a cruel desire to take the most complete vengeance over their enemies. The Caribs, however, were far from being the only savages among whom the custom prevailed. Among certain tribes of North American Indians, the flesh of conquered enemies was consumed on principle; and the greatest luxury which a successful warrior could enjoy, was the heart of some brave chief whom he had slain in battle. Considerable diversities of taste, however, prevailed among the savages in different parts of the world, as to the most delicate portions of the human frame. Among the South Sea Islanders, the palm of the hand, especially of a young girl, was long looked upon as the most dainty morsel; while the New Zealanders gave a decided preference to the foot. The epicures among the Feejee Islanders were said to regard with great aversion the flesh of the civilized white man; and instances are on record in which they are reported to have spared the crews of English and French ships wrecked on their coasts, as they had found by experience that the flesh of such persons was tainted to an unpalatable extent by the savour of salt and tobacco.

CANNING, George, a celebrated statesman and orator, was born in London on the 11th of April 1770. His father by an imprudent marriage had drawn down upon himself the displeasure of his parents, and was by them cut off with the scanty pittance of L.150 per annum. The youth, thus discarded by his family, who possessed considerable property in Ireland, left that country, and repaired with his wife to London. His efforts to extend the means of their subsistence were, however, unavailing; and exactly twelve months after the birth of his son he died, the victim, it is said, of a broken heart. The mother of Canning, thus left comparatively destitute, attempted the stage, but without success. Of her after history little is known, except that she was twice married, and to the day of her death experienced the tender regards of her illustrious son, whose success she lived long enough to witness.

The education of Canning, however, was not neglected. By the liberality of an uncle he was placed at Eton, where he greatly distinguished himself, not only in his scholastic exercises, but also as a literary aspirant. At the age of sixteen we find him editor of a periodical miscellany entitled the *Microcosm*, which was got up amongst his school associates. To this work he contributed a variety of papers, distinguished for their elegance and taste, and also for a playful humour, which afterwards became so formidable a weapon in his hands. To this period likewise is assigned the composition of a poem entitled *The Slavery of Greece*, which displays a glowing fancy, and a rare maturity of thought, whilst it breathes the warmest sentiments of freedom. This was a happy presage. For he

afterwards rose to a situation which enabled him to mitigate the destiny he thus early and feelingly deplored; and it is pleasing to add, that the fervour of the youthful bard was never altogether quenched in the after calculations of the statesman. In the year 1787 he left Eton for Christ Church, Oxford, where he rapidly rose to distinction. He gained several prizes for his Latin essays, and attracted considerable notice by his orations. The general impression of his compeers appears to have been, that he was destined to excel, and would rise to the head of whatever profession he chose to adopt. Amongst his fellow collegians was the Honourable Charles Jenkinson, with whom he contracted an intimacy which was afterwards of great advantage to him. It became necessary for him, however, to think of a profession, and he fixed upon the law as that most likely to afford scope for his talents. He accordingly quitted Oxford for Lincoln's Inn, whither his fame had preceded him. It may be doubted whether he was as laborious a student of law as he had been of learning. His disposition was highly sociable, and his wit was the theme of general admiration. Hence his society became courted by a numerous and rapidly extending circle of friends; and he also began to attend debating clubs, where he frequently spoke. These trials of skill gave him confidence as a public speaker, and tact and acuteness as a debater, whilst at the same time they exercised his powers of elocution; thus preparing him for contending with more powerful and expert antagonists in a more exalted arena. At this period his principles were liberal. He had long been in familiar intercourse with Sheridan, by whom he was introduced to Fox, Burke, Grey, and the other leading Whigs of the time, who looked upon him as the future champion of their cause, and advised him to turn his thoughts from the bar to the senate; and this he accordingly determined upon. But a change soon came over the spirit of his politics. What motives induced him to abandon the creed in which he had hitherto believed, it is difficult to conjecture. Probably he felt that even genius like his would not rise to the full growth of its ambition on the opposition benches, or that the interests of his country would be better served if he could infuse into the measures of his new associates a portion of that liberality which distinguished those of his old. But whatever may have determined the choice of the young politician, certain it is, that after a friendly and candid explanation to Sheridan, he entered into terms with Pitt, and in 1793 took his seat in parliament under the auspices of that minister. But it was not until 1794 that he ventured to address the house. The occasion was by no means auspicious; it was in support of a large subsidy to the king of Sardinia for prosecuting the war. He was brought into immediate collision with Fox, whom he ventured to treat with a considerable degree of levity; and it did not reflect much credit on Pitt, that he thus subjected his great and generous rival to the flippant attack of a man so young and so arrogant as Canning. Apart from this circumstance, the speech displayed considerable tact and dexterity in the management of an argument. From this period his support of the premier was close and undeviating, and he gradually rose to distinction amongst the party to which he had allied himself. In 1796 he was appointed one of the under secretaries of state, and for the first two years during which he held the situation he principally confined himself to the laborious duties connected with it. In 1798 he recorded his sentiments on the subject of the slave-trade, being favourable to abolition; and in the same year he electrified the house on a motion of Mr Tierney's respecting a peace with the French republic. It was a speech of masterly skill and eloquence, and fully justified the presage of his youth and the partiality of his master. The same year his consequence was materially increased by his union with Miss Joan Scott, one of the daughters and co-heiresses of General Scott. Miss Scott's two sisters were married to noblemen; and Canning's parliamentary interests were thus not only powerfully strengthened, but he was furnished with a respectable independence.

In 1800 we find him discussing in parliament the overtures of peace made by the consular government of France, the habeas corpus suspension bill, subsidies to the Emperor of Germany, and the state of the nation,—subjects on all of which he supported the minister, and in regard to some of which he displayed more devotedness as a partizan than wisdom as a statesman. Out of doors also he employed the formidable weapon of the press in the same warfare. In conjunction with his friends Mr Frere and Mr Ellis, he brought out the *Antijacobin Examiner*, a weekly paper, alike distinguished for its wit and talent and for its satire and ribaldry. The poetical compositions of Canning formed the attic salt of this print; and, keeping out of view their malignant invective and personality, they are unquestionably full of wit.

The resignation of Pitt in 1801 deprived Canning of his situation; and the ministry which succeeded he took every opportunity of strenuously opposing. The return of the former to power in 1804 again restored him to office as treasurer of the navy. From this period till the death of Pitt nothing remarkable occurred to call forth his energies, except the impeachment of Lord Melville, whose cause he warmly espoused. By the demise in 1806 of his illustrious preceptor in politics, Canning was again removed from office; and during the reign of the ministry which succeeded, he conducted himself in the same manner as he had done upon a like occasion before; strenuously opposing all measures except those which he considered as sanctified by the authority of Pitt. Nothing can more forcibly exhibit the influence of party spirit over his mind, than the manner in which he allowed the question of the abolition of the slave-trade to be carried in parliament. Under other administrations it had received his powerful advocacy, and all the resources of his genius were arrayed on the side of humanity; but now he scarcely lifted his voice upon the occasion. What he did say was cold and petulant. On a great moral question touching the rights of human nature he could not subdue expressions of hostility to the existing ministry. The latter having abandoned office, the Tory party came again into power, and Canning received the seals of the foreign department.

The office of a minister of foreign affairs at the commencement of the Portland administration was any thing but an enviable post. With the exception of the short interval of the peace of Amiens, England had been engaged in a war of fifteen years' duration. Most of the continental powers, formerly her allies, were now either leagued against her, or condemned to an inglorious neutrality. The nation, which previously divided its belief between the two great leaders now no more, looked in vain for one sufficiently prominent to command its confidence. The mantle of either prophet appeared to have ascended along with him; for as yet Canning had not gathered all his fame, and was looked upon by the country as a light and harassing skirmisher rather than a heavy man-at-arms. The administration just dissolved presented a formidable opposition; and a number of the members of it, indeed, Canning had made personal enemies of by his caustic raillery in parliament, and his reckless satire out of doors. In circumstances of such difficulty the new ministry found themselves placed. It was on Mr Ponsonby's motion relative to the expedition to Copenhagen that their strength was first properly put to trial. This attack could not be

justified on any principle of justice. Canning, however, fearlessly threw himself into the arena, and delivered a defence of the conduct of ministers, at least remarkable for its ability and eloquence. Both friends and opponents regarded him with admiration. The former saw the value of the acquisition they had made, and the latter the formidable talent with which they had to contend. From this period Canning continued to rise in importance and increase in fame. He was the most able and strenuous supporter of the administration to which he belonged. In 1809 a political misunderstanding with Lord Castlereagh led to a duel, in which Canning was wounded. Both secretaries resigned, and the consequence was a dissolution of the ministry.

During the two years which followed this event, Canning seldom appeared in the stormy arena of debate. Two speeches, however, on the resumption of cash payments by the bank of England, belong to this period, but are numbered amongst his least successful exertions. In the beginning of 1812 he advocated the claims of the Catholics to civil power, which he invariably supported, not as an abstract question of right, but as a matter of expediency. On the assassination of Mr Percival, overtures were made to him to accept a place in the cabinet; but his favourite measure of Catholic emancipation forming no part of their arrangements, he declined taking office. In this year he was chosen as representative for Liverpool, which also returned him to other three successive parliaments. In 1814 he accepted the situation of ambassador to Lisbon, and continued there till 1816, when he returned, and soon afterwards joined the ministry as president of the board of control. During the last two years great events had taken place, in bringing about which Canning had no inconsiderable share. "If there was any part of his political life," he declared on one occasion, "in which he gloried, it was, that in the face of every difficulty, discouragement, and prophecy of failure, his had been the hand which had committed England in an alliance with Spain." "Never," said he on another occasion, "ought we to relinquish our hold of the Peninsula. The ruler of France has one grand object to which he stands pledged—the establishment of his dominion there. If he fail in this, his defeat will be most signal." The result realized his prediction. By British policy and valour, which he animated and encouraged, the tide of military despotism which had overflowed the Continent was repelled beyond the Pyrenees, and the ancient landmarks of nations re-appeared above the subsiding wave.

As a member of the cabinet from 1816 till 1820, Canning was a strenuous supporter of its measures. The celebrated six acts called forth all the resources of his eloquence to prove their necessity, and to lessen the abhorrence with which a large proportion of the community contemplated them. The manner in which he treated the case of one Ogden, who was incarcerated for sedition under the suspension of the habeas corpus act, was aggravated by opponents into a serious crime, and in any view evinced a reckless and unfeeling levity, which it is easy to palliate but impossible to justify.

On the demise of George III. in 1820, parliament was dissolved, and Canning, at the next election, was for the fourth time returned for Liverpool. On this occasion he put forth all his strength in vindication of the proceedings of ministers. During his speech he also took an opportunity of expressing his unmeasured hostility to all parliamentary reform, which he afterwards reiterated in parliament in 1822, in one of his most finished orations. On the return of Queen Caroline to share the throne of her husband, Canning, who had formerly been on terms of great intimacy with her, felt constrained to absent himself from England during the progress of the proceedings which were instituted against her. On his return from the Continent he resigned the presidency of the board of control, and on his retirement received the most flattering testimony from the Court of Directors of the East India Company, of the value which they attached to his services. The golden opinions which the members of that influential body entertained of his character, and the universal conviction that no man was better qualified or entitled to occupy the highest official situation which they had it in their power to bestow, induced them ultimately to confer upon him the appointment of governor-general of India. But just as he was preparing to quit England, the Marquis of Londonderry died; and a vacancy having thus been created in the cabinet, Canning was invited by his sovereign to resume the situation of secretary for foreign affairs. He accepted the offer, and though second in office, in public opinion and in real efficiency he was considered as the first. This took place in 1822.

During the remainder of Canning's life his history becomes so closely interwoven with that of his country, that a minute detail is unnecessary. He infused into the counsels of the cabinet a degree of liberality which, for a long period, had not characterized them. The spell of the holy alliance it was his studious endeavour to break; and without altogether alienating the continental powers from Britain, he aimed at placing her in a situation where, untrammelled, she might exercise her own free will. It was his desire that his country should occupy a neutral station, and assume the character of mediator, not only between conflicting kingdoms, but between the hostile factions of individual nations. He strongly countenanced, both in theory and practice, that amelioration in regard to commerce, navigation, and manufactures, which the force of circumstances and the progress of information had rendered imperative. In June 1824 the cabinet determined on recognizing the independence of Mexico, Colombia, and Buenos Ayres. This measure was principally brought about by the exertions of Canning, and in one of his speeches he claims the merit of it. In answer to the argument that ministers had sanctioned the attack on Portugal, by having permitted the occupation of Spain by France, he said, "Was it necessary that we should blockade Cadiz? No. I looked another way. I resolved that if France had Spain, it should not be Spain with the Indies. I called the new world into existence to redress the balance of the old." In the autumn of 1826 he went to Paris, and was received with great distinction. The treaty with France and Russia respecting Greece, and the events at Navarino which followed closely after it, throw light upon the object and intent of his visit. His highest powers were also called forth on the occasion of the aggression of Spain upon Portugal. He warmly maintained the necessity of England's interference upon the occasion; and the demonstrations which were made produced the desired results. These are the three measures on which the fame of Canning, for liberal policy, principally rests.

In the beginning of 1827, at the funeral of the Duke of York, he caught a severe cold, from the effects of which he never altogether recovered. Shortly after this the Earl of Liverpool, then prime minister, was seized with paralysis; and though he rallied afterwards, he was politically dead from the moment he was struck. Canning was ultimately appointed first lord of the treasury. Considerable opposition followed this appointment, and six members of the former cabinet resigned. The new premier, however, struggled manfully against this rather unexpected opposition, and with great celerity completed the com-

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plement of the cabinet. But the harassing contest which he had to maintain against a virulent opposition visibly affected his health. Towards the latter end of July 1827 he was invited to the seat of the Duke of Devonshire at Chiswick, in hopes that the change of air might renovate his constitution; and he did recover so far as to be able again to transact business in Downing Street; but his malady, which was an inflammation of the kidneys, returned, and he expired on the 8th of August, at the age of fifty-seven. His remains were interred in Westminster Abbey, near to those of his great preceptor Pitt, on the 16th of the same month. The funeral, though private, was attended by the Duke of Clarence, afterwards William IV., a number of the nobility, and other friends.

The death of Canning was a circumstance rarely paralleled in interest amongst civilized nations. In his foreign policy he had identified himself with the march of independence. From Lima to Athens the effects of his friendly interposition had been felt, and a sorrow corresponding to the benefits he had conferred was expressed when he fell. He was cut off in the midst of designs of high enterprise, and before all his plans were completed; and thus his system, and much of his fame, was left at the mercy of his successors. The great events which have taken place since his death have also tended in some measure to eclipse his popularity. His accomplishments as an orator were of the highest order. His form was commanding, and his features handsome and impressive. His voice was richly toned and highly musical, and his attitudes were elegant and striking. His delivery was manly, and for the most part he was in complete possession of himself. These qualities and accomplishments set off to double advantage the more exalted gifts of intellect with which he was so richly endowed. His diction was splendid, his reasoning acute and refined. He exercised a sovereign command over language, and it flowed from him with classic elegance and ease. His style, strictly speaking, was not ornate. Wit was an ingredient with which he frequently seasoned his oratory, thereby imparting to it a high relish. The vein was peculiarly his own; it was lively and playful, and calculated more to ridicule than to lacerate. His poetical powers may be ranked among his elegant accomplishments; and, for the most part, the productions which resulted from them are the least worthy of his fame—not that they want the requisite talent, but that they are in general disfigured by scurrility and invective. "He was," says Sir James Mackintosh, "a man of fine and brilliant genius, of warm affections, of high and generous spirit; a statesman who at home converted most of his opponents into warm supporters, who abroad was the sole hope and trust of all who sought an orderly and legal liberty, and who was cut off in the midst of vigorous and splendid measures, which, if executed by himself, or with his own spirit, promised to place his name in the first class of rulers, among the founders of lasting peace, and the guardians of human improvement." (J. F. S.)

CANNON, a generic term under which may be arranged all pieces of ordnance which from their weight or form cannot be used as the personal weapon of the soldier, such as guns, carronades, howitzers, and mortars. A brief historical sketch of the substitution of these tubular propelling machines for the mechanical instruments of war which had been used before the invention, or at least the practical application of gunpowder as a propulsive agent, has been given under the article Artillery; and such additional particulars will be here cited from the excellent Spanish treatise on artillery by Don Claudio del Fraxuo and Don Joaquin de Bouligny, as are necessary to explain satisfactorily the progressive improvements in the manufacture of cannon. In applying the suddenly developed impulsive force of ignited gunpowder to the propulsion of heavy projectiles, it is necessary to inquire what should be the properties of the material to be used in the manufacture of the tube, cylinder, or cannon, in which the powder is intended to be ignited, and from which the projectile is to be propelled. Such material then should possess hardness sufficient to resist the shock of the projectiles; should be capable of resisting the chemical action of the air, or of the compounds generated by the combustion of gunpowder, and augmented in their destructive agency by the heat produced by ignition; should possess sufficient elasticity to resist a disruption of continuity, or a permanent change of condition, resulting from the vibrations produced, either in rapid transport or by frequent discharges; and also a tenacity sufficient to resist the enormous pressure exercised by the elastic gases at the first moment of their development, which has been estimated by Preehll so high as 18,000 atmospheres, and by Hutton as 20,000, or even in the latter case at about 15,000 lb. per square inch of the bore of the tube or cannon. A deficiency in any one of these properties must lead to the rapid deterioration of the cannon: as want of hardness to the indentation, scratching, and grooving of the bore; want of elasticity to a change in its form and a diminution of its strength after every discharge; want of tenacity to a partial separation of its parts under pressure, and, finally, to decided fracture. It often happens that guns which have withstood the severe trial of proof charges, and have been subjected afterwards to much firing, suddenly burst under the effects of a very moderate charge; a result which must be attributed to a deficiency in one or more of these important properties, and which renders very doubtful the propriety of subjecting guns to excessive proof, by which they are often, though imperceptibly, much deteriorated.

The only simple substance in which the properties of hardness, elasticity, and tenacity are sufficiently blended together to produce an efficient result (for it must be observed, that to a certain extent they are opposed to each other), is iron; excluding, of course, from that term cast-iron, as being a compound or carburet. Various attempts, therefore, have been made from a very early epoch, to manufacture guns of wrought or forged iron, and only a few months have passed since a gun of this description, invented by Captain Simmons, Royal Engineers, was submitted to trial by the artillery authorities. There can be little doubt, indeed, that excellent guns might be manufactured from forged iron, and should it be found possible hereafter, either by rifling the bore of guns, or by altering the form of the shot, to diminish the charge of powder, as in the Minie and similar rifles, it is by no means improbable that forged iron will again be adopted as a material for field guns. The difficulty of completely purifying iron from the sulphur and phosphorus usually associated with it, and which render it brittle, naturally led to many failures in the early days of artillery; and it was thus that James II. of Scotland perished before the walls of Roxburgh in 1460, from the bursting of a bombard formed of large iron bars, strengthened and bound together by iron hoops. Notwithstanding these defects, all the guns of the fifteenth century were manufactured in this manner; and the system of forging was so improved, that guns were even made of a single piece, in spite of the great labour and difficulty of managing such heavy masses in the frequent heatings to which it was necessary to subject them in forging. The manufacture of forged cannons was again revived after having been long abandoned; and in 1753, a gun weighing 1600 pounds was forged in Paris, and six years afterwards several guns of various calibres were forged in Spain. In 1813, the St Etienne Iron Company of Lyons proposed to the French government to supply guns of forged iron from their establishment at the rate of eight 24-pounders each day, and forwarded as a specimen an 8-pounder. This

gun was proved by four discharges, with 3 lb. of powder, 1 ball, and two wads, one above the powder and the other above the ball; and then by five discharges with 4 lb. of powder under the same circumstances: the recoil being 24 feet in the first four, and 35 in the last five discharges. The extreme lightness of such guns—a 16-pounder French, about equal to our 18-pounder, weighing about 1650 lb., and a 24-pounder French, equal to a 27-pounder English, about 2100 lb. only—would have rendered the recoil with ordinary charges so excessive, and the destructive effect on the carriage so great, that they could not have been satisfactorily employed in the field; still, however, it should be always remembered, that iron has great advantages over all other simple metals for the manufacture of guns, that it is quite possible to forge good pieces of artillery of iron at two-thirds the cost of bronze, and that it is desirable in the field to obtain as large a calibre for the discharge of spherical and other case shot as is consistent with a reasonable weight, which, perhaps, will hereafter be effected more readily by forged iron than in any other way. Where a long range, and in consequence a powerful charge of powder, are indispensable, this form of gun can scarcely, under existing circumstances, be adopted; or, at least, until some means of diminishing the shock and the recoil, by the intervention of springs, has been discovered; and even then it will be necessary to move the same weight, taking the gun and carriage together, though distributed in a different way.

Cannon of cast-iron.

The precise date of the first cast-iron guns is not known, but it has been asserted by General Haguenin, that a piece of this description at Bois-le-Duc bears the date 1411. Some doubt, however, has been expressed on this subject; and it has been thought more probable, with reference to the invention of high smelting furnaces, to suppose this date 1511. In 1540 Ralph Page cast eight iron guns at Rackstadt; and in 1547 the use of such artillery began to become general, and was for nearly a century exclusively adopted in some countries. In France cast-iron guns were not manufactured before 1600; but so evident were the advantages to be gained by their use, both as regards the qualities of the guns and their moderate cost, that they were speedily adopted in most countries; foundries for iron guns having been established in Silesia in 1470, in Germany in 1577, in Saxony in 1594, in the Hartz in 1626, and in Sweden in 1640; one foundry alone, in the latter country, having been said to have supplied for some time from 400 to 500 cannons annually.

Hollow casting.

All these pieces of ordnance were cast hollow until 1729, when a horizontal boring machine was established at Lyons, and, after some trials made in 1734, M. Maritz abandoned hollow casting at Strasburg in 1744–45, and adopted the boring machines.

Solid casting.

Maritz, who was appointed, in 1755, inspector-general of the foundries of France, did much to perfect the art of solid casting and boring; but, in attempting to obtain a metal which should be easily turned and bored, he led to many failures in the proof, in consequence of which his system was combated by the celebrated Montalembert, and, subsequently, in 1764, the department of the Marine undertook the manufacture of its own cannons. These imperfect trials led to the resumption, for a time, of hollow casting; but an examination of specimens of ancient guns has shewn that the real defect was in the very imperfect casting of early times, fragments of metal unreduced being sometimes found imbedded, as it were, in a paste, very much like the condition of crystals in porphyry.

Reverberatory furnace, and casting in sand.

In 1770 Wilkinson established at Indret a reverberatory furnace, and introduced moulding in sand, as explained by Monge some years afterwards; and in 1780 reverberatory furnaces were applied to the re-smelting of iron for cannons in France, Silesia, Germany, and the Low Countries. In Sweden the use of reverberatory furnaces did not gain ground, as the excellence of its ores rendered them less necessary than in other countries. The efficiency of cast-iron guns was amply tested and proved in the siege of Ciudad Rodrigo in 1812, in the subsequent siege of Badajoz, and in that of St Sebastian in 1813; as the guns used were not deteriorated by the hard work of either of these memorable sieges. At that of Badajoz more than 36,000 projectiles were discharged, and each 24-pounder contributed to that total about 1250 rounds; but, notwithstanding this general success, many examples might be cited of guns bursting in action, which at least point to the necessity of still further improvement, and, it may be added, of a reconsideration of the system of proof.

Necessity of purity.

Whilst the properties of pure iron are so eminently suited to the manufacture of guns, it is necessary to guard against the presence of any of those minerals which in nature are so often associated with it, and which are removed only with great difficulty, as their presence even in small quantities deteriorates the metal. Sulphur, in the proportion of $\frac{1}{20}$th per cent., renders it friable and brittle when hot, and tends to produce white metal. Phosphorus, in the proportion of $\frac{7}{20}$ths per cent., renders it soft and easily worked when hot, but brittle when cold. Antimony renders it brittle when hot, and friable when cold; as does arsenic if in considerable quantity. Manganese augments the hardness of iron without affecting its tenacity, but it prevents the formation of gray metal. Silicon, even in the proportion of $\frac{37}{100}$ths per cent., renders iron brittle. Of other metals, tin in the proportion of 1 per cent., gives iron a fine grain and increased hardness, and renders it more sonorous, but at the same time more brittle when cold. Copper, increasing the hardness and tenacity of iron but in the proportion of $\frac{1}{4}$th per cent., renders it brittle when hot. Titanium renders the ores refractory, but gives to the metal tenacity and hardness. Zinc, chrome, gold, bismuth, and cobalt, in small quantities, do not affect the quality of iron. Nickel renders it fusible, soft, and tenacious. Silver and platinum in small quantity give it hardness and tenacity, and the presence of aluminum causes it to lose the latter property. From a consideration of these results, it is manifest that little can be expected in such a manufacture as that of cannon from any system of alloying iron, and that the main object is to ensure its absolute purity.

Swedish ores.

In Sweden the magnetic iron ores are abundant, forming extensive masses in the granite rocks. They are a mixture of the protoxide and peroxide of iron, in the proportion of 31 protoxide to 69 of peroxide. All these magnetic ores are not equally suited for this purpose, and those are preferred which are highly crystalline in structure. The Swedish iron enjoys a well-merited reputation; and the Swedish foundries of Finspong, Aker, and Stassjo, have supplied artillery not only to Sweden, but to Norway, Denmark, Russia, Piedmont, Naples, and Egypt. The metal for the casting of cannon is obtained both in Sweden and Norway directly from the ore, which is smelted with wood in high furnaces, composed of two truncated cones joined at their bases, the lower and shorter being inverted, and connected with the chamber or crucible which receives the melted metal. The height of these furnaces varies from 30 to about 43 feet, according to the fuel made use of, and about 13 feet of the upper cone form the air or draught chamber.

Rules for selecting a fitting metal.

Mr Moritz Meyer has given the following rules for selecting the metal for casting cannons. The metal which produces the best cannons is that which, cooled in small pieces, is of a clear gray colour, is very finely granular, and exhibits on the surface distant small white facettes like crystals, with a metallic lustre, whilst the general surface is of a greasy lustre. Poured into an empty mould, the surface remains concave with sharp edges, and without hollows or air-bubbles. Cooled in large masses as for cannon, it assumes on the surface a well-defined clear gray colour, and produces an iron of an interwoven texture. The principal mass presents a fine

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white grain, and contains small separated groups of graphite-like stars, which in very good iron should not be much less nor greater than pin heads; and in less number they are uniformly disseminated over the whole mass, though in fracture these stars appear more numerous and larger towards the edges. These groups assume sometimes an ellipsoid figure, crystallized like hematite. The rays of these stars should be so small as scarcely to be discernible by the eye alone; for when larger and more visible, or as it were like lamellæ, the iron will be much weaker. The white metal appears to envelope these black groups, and whilst the former is attacked only with difficulty by the file, the latter are rapidly worn away. The recent fracture feels very harsh, and catches the fingers as if bristled with hooks. When turned in a machine, the surface seems as if marked by lines of cleavage, and the graphite groups appear of a stronger tint and more deeply incrusted.

Much difference of opinion has existed respecting the comparative merits of a clear gray, and of a dark or dull gray metal; and doubts have been expressed as to the rules or principles of Mr Meyer; but this at least is evident, that the condition of the metal in respect to the distribution of the plumbago is very peculiar, and that the greatest care must be necessary to insure satisfactory results in casting cannon, more especially those of large size.

In this country, in France, Germany, and the Lower Countries, from the difference of ore used, the first metal obtained in the smelting furnaces cannot, as in Sweden, be cast at once in cannons, but must be again melted in reverberatory furnaces, by which process the extraneous bodies still combined with the iron are removed, and the excess of carbon driven off as carbonic acid—the success of this process depending on the quantity of air admitted to the surface, and the manner in which the flame is directed over the metallic bath. This second reduction of the metal, though adding to the expense, has its advantages, as it enables the founder to mix together the products of different smeltings, and thus to correct the defects of some of them, and to use up the fragments of old guns, and generally to obtain with greater certainty a good metal.

The results of analyses of cast-iron by Gay-Lussac are as follows:—

Gray metal obtained with Charcoal.

From	Carbon.	Silicium.	Phosphorus.	Manganese.	Iron.	Total.
Champagne,	2·100	1·060	0·869	trace	95·971	100
Nivernais,	2·254	1·030	1·043	do.	95 673	100

With Charcoal and Coke mixed.

	Carbon.	Silicium.	Phosphorus.	Manganese.	Iron.	Total.
Berry, .	2·319	1·920	0·188	trace	95 573	100

With Coke alone.

	Carbon.	Silicium.	Phosphorus.	Manganese.	Iron.	Total.
Wales,	2·450	1·620	0·780	trace	95·150	100
Do.,	2·550	1·200	0·440	do.	95 810	100
Do.,	1·666	3·000	0·492	do.	94·842	100
Franche Comté	2·800	1·160	0·351	do.	95 689	100
Creuzot-Haute Saone	2·021	3·490	0 604	do.	93·885	100

The general result being, that the metal is a mixture of a carbide (carburet), in which one atom of carbon is combined with four of iron, and of a silicide of similar constitution, or quadribasic. It had long been a received opinion that the iron guns of France were inferior to those of both Sweden and England, but Soult, when minister of war in 1832, sent two artillery officers into Sweden to study the manufacture there, and admirals Rigni and Dupperré, on the part of the marine, sent officers also both to Sweden and England. At Aker and Finspong in Sweden, and at Carron these officers had guns cast of three several calibres, viz., 8-pounders, 18-pounders, and 30-pounders, which were subsequently submitted to proof in France, when it is asserted that the Carron guns stood in order of resistance the fourth or last, the French the second, and one or other of the Swedish guns in every trial the first. Whatever may be thought of these reported results, the example of the French may well be imitated by us so far as regards the personal examination by well-instructed artillery officers, not only of foreign cannon foundries but also of our own; and it would be very desirable to have specimens of guns corresponding to our own authorized calibres cast at the most celebrated foreign foundries, such as those of Sweden already named, and that of Liege, to be used in comparison with our guns. In the furnaces of Liege the hot-blast has been adopted.

Proof.

The proofs to which iron guns are subjected before they are received as fit for service vary in different countries. In some each piece is proved by itself, in others only one is proved out of each distinct lot supplied by the founder In France and Belgium iron guns are proved one by one, each gun being fastened to a strong stage or platform of wood, fixed firmly in an ordinary battery so as to prevent recoil, and in this condition making two discharges with a load of powder equal to one-half the weight of the projectile, two balls, and two wads, or one to each ball. In Sweden from three to ten discharges are made from each gun, with charges of powder varying from $\frac{5}{12}$ths to $\frac{8}{12}$ths of the weight of the projectile, and a quantity of balls, after which the guns are carefully examined to ascertain the extent, if any, of deterioration; and should one gun explode still more attention is bestowed on the examination of the others. At the beginning of this century General Hellwig proposed a system of proof varying in strength according to the weight of the gun. For a 27-pounder cannon, weighing 170 times the weight of the projectile, six discharges were to be made, the first two with $14\frac{1}{2}$ lb. of powder and two balls, the two next with $9\frac{1}{28}$ lb. and a cylinder 4 calibres long, and the last two with $10\frac{3}{4}$ lb. of powder and two balls. Gazeran substituted a different principle of proof, which has since been adopted in Sweden, the Low Countries, and Germany, and which may be called a metal proof. Bars of a determinate size were constructed of the metal used in any particular cast, and loaded until they broke, the result being supposed to afford a test of the quality of the gun; but as such a trial as this can take no account of the imperfections which are liable to be engendered in the very operation of casting *large masses*, by irregular cooling or solidification, and other causes, it is evident that no satisfactory theoretical relation can be established between the weight which breaks a bar and the force which bursts a gun. Chemical proofs are equally unsatisfactory, as it is impossible that they should embrace all the possible physical defects of a gun, which may be so local as easily to escape notice in this way. In England the proof is of two kinds—the first instrumental, being directed to the examination of the bore, having previously tested the general dimensions and weight of the gun; and the second a fire-proof, all the other proofs (by searcher, by water, and by sun) being only means of detecting any deterioration from the firing. In respect to general dimensions, not more than ·3 of an inch variation is allowed; in the diameters of the bore not more than ·033 inch in 42 to 18-pounders, and ·025 in 12 to 6-pounders; and in the position of the bore as regards the axis ·5 in the 42 to 18-pounders, and ·334 in the 12 to 6-pounders. In the fire-proof, each gun is discharged twice with charges exceeding one-half the weight of the projectile, excepting in the 68 and 56-pounders; one shot and two high junk wads, the actual charges being as below:—

Nature of gun,	42	32	24	12	9	6	3
Charge in lb.,	25	$21\frac{1}{2}$	18	12	9	6	3

The proof charge of the 68-pounders is 30 lb., and that of the 56-pounders 28.

After the firing the searcher is used, and any cavity of

·2 of an inch depth behind the first reinforce, or one of ·25 before it, condemns the gun. Water is then forced into the gun by an engine, in order to detect fissures by its percolation through the metal, and subsequently the bore is examined internally by light reflected from a mirror, in order to detect minor flaws by their retention of water, which constitutes the sun proof. Should any one gun of a lot burst, all the others are subjected to another proof.

In respect to these modes of proof by firing with extraordinary charges of powder, it may be justly objected that they are rather proofs of the strength of a gun before firing than of its strength after firing; and it is scarcely possible that the discharge of an extreme load should not more or less modify the condition of an iron gun in respect to its power of resistance. It is thus that guns are found to burst unexpectedly in service with ordinary discharges, which have gone through the proof without exhibiting any deterioration; and this is by no means surprising, as the locality of the injury may often be entirely out of the reach of the test devised for its detection. In the proof charges used in our service there is even an unnecessary exaggeration of the principle in guns of the lesser calibres; for though in the 24-pounder the proportion of the weight of the gun to that of the projectile is as 233 to 1, whilst in the 12-pounder it is 196 to 1, the proof charge in the first is only three-fourths of the weight of the projectile, or 2·25 times the service charge, and in the last equal to that weight, or three times the service charge; and it is difficult to account for such high proof charges, unless the object of proof were to determine the absolute strength of the gun rather than simply to ascertain its ability to resist a regular charge under ordinary circumstances. It may be justly said that firing a few rounds with a moderate charge, combined with a knowledge of the quality of the metal and of the care used in casting and boring, would insure more effectively safe ordnance than the use of excessive charges; but this requires that the gun foundries should be under an artillery inspector as they are in Spain, the foundry of Trubia having been especially established by the Spanish government for that purpose.

Iron guns, how procured, and result of proof.

At present the greater portion of the iron guns are cast for the ordnance by Messrs Walker of Gospel Oak, and by the Low Moor Company in Yorkshire, for which Mr Hood is the agent. The guns are cast solid, are then bored and brought to Woolwich, and having been previously weighed, are subjected to the proofs already detailed. Taking the average of ten years, 64 in a thousand are rejected by the instrumental proof, or about $6\frac{1}{2}$ per cent., and 44 in a thousand, or about $4\frac{1}{2}$ per cent. by the fire proof; and this latter number is sufficiently great to warrant the belief that many more may have suffered considerable deterioration under so severe a trial, from the defective elasticity of cast-iron, although of a nature to escape detection by the searcher, or by the auxiliary water and sun proofs. It may be here observed that the Sardinian government have obtained iron ordnance from one at least of the Yorkshire foundries, as many of the guns mounted upon the new works of Genoa are of their make; and in respect to their mounting, they possess the peculiarity of being placed on iron garrison carriages, so high as to fire "en barbette" over the parapet with only a very slight elevation of the mound or platform on which they rest. This arrangement is intermediate between the ordinary garrison carriage and a traversing platform, and may under some circumstances have its advantages.

Cannon of cast-iron reinforced by wrought iron.

The insufficiency of mechanical means to construct easily and cheaply wrought-iron guns, as well as the impossibility of giving to cast-iron a large amount of elasticity without interfering with its hardness, have led to the proposal of strengthening the cast-iron gun by reinforces of wrought-iron. Several modes have been devised of effecting this object; that of M. Thiery consists in the use of both bars and hoops applied in the following manner. Bars of the same length as the piece are heated to a suitable temperature, and then arranged in grooves formed for the purpose in the interior of the mould, at about 8 inches apart, the number and thickness of the bars depending on the calibre of the gun. Making the cast afterwards with care, it is found that the bars adhere firmly to the cast metal. and though on the surface they are found to have undergone a steel-like modification, they retain internally the texture of wrought iron. This gun is moulded without trunnions, so that the bars extend its whole length, and protect the breech as well as every other portion of the gun. In the bars are notches at regular intervals to receive the binding hoops which, being put on at a white heat, grip the bars firmly in cooling. One of these hoops is considerably strengthened, so as to receive and support the trunnions which are welded on to it. An 8-pounder corresponding to an English 9-pounder constructed in this manner, with 12 bars and 36 hoops, the former $\frac{3}{10}$ths and the latter $\frac{4}{10}$ths inch thick is stated to acquire, by such an armature, a resisting power so great that it is probable a 9-pounder might be bored up to a 12-pounder, and be then efficient for the projectile and charge of that calibre; and thus, that it would be possible to replace bronze field-guns by iron guns of this description at about one-fourth the cost. It should be observed, that casting without the trunnions simplifies the process of moulding, and induces more uniformity in the cast; but the subsequent operation of attaching the trunnions by welding them to the hoops is not without much mechanical difficulty.

The necessity of casting guns of sufficient weight to prevent a violent recoil, and the consequent rapid deterioration of the carriage, will doubtless render our authorities disinclined to adopt guns of this description; but in mortars intended to be fired at high angles, the use of a wrought-iron armature would render the adoption of very heavy projectiles more practicable than they are at present, and it is thus that in Belgium mortars of the calibre of $23\frac{1}{2}$ inches, and capable of projecting a shell weighing half a ton, are secured from bursting by wrought-iron hoops.

Compound cannon of iron and bronze.

It has been proposed to cast a compound gun of iron and bronze, and it is said that a gun of this description was cast in India in 1666. In modern times several such guns have been constructed; as at Strasburg in 1802 and 1819, at Turin in 1812, and by M. Martin in 1821 and 1822. The object of such a system is to obtain a core of either wrought or cast iron for the bore of the gun, and by covering it with a metallic envelope of higher elasticity and tenacity to diminish the chances of explosion. It is said that in these experiments a perfect union was established between the bronze and iron; but that the results of proof were not satisfactory. Again, in 1826, three 24-pounders were made on this principle, the bore in one having been formed of short tubes of forged iron placed one above the other, so as to give the necessary length of bore, whilst in the two others tubes were used only of sufficient length to form a chamber for the charge and ball, the tubes being either of wrought or cast iron.

System deserves trial

When it is remembered that the great defect of bronze guns is, that they rapidly wear, or, as it is technically called, droop at the muzzle in active service, it may be suggested that this union of a wrought-iron bore, with a casing of bronze, deserves a trial at our arsenal, and seems to admit of very easy manipulation.

Alloy of iron and copper.

The attempts which have been made to use mixtures of iron and copper by melting the two metals in separate furnaces, and then mixing them in a reservoir before taking the cast, scarcely require observation; as the great difference in the fusibilities and affinities for oxygen of the two metals, as well as the small affinity of one for the other, render such alloys unnatural.

Cannon.

Bronze cannons.

Under this term may be arranged all alloys of copper, whether binary or ternary. The epoch of the first economical application of copper is lost in the darkness of the most remote antiquity; and the first use of an alloy of that metal in the construction of arms must be also referred to a very early epoch, as bronze is mentioned by Homer. The ruins of Pompeii and Herculaneum have exhibited to the moderns the skill in working bronze attained by the ancients; and the numerous Celtic swords and other warlike implements discovered in Ireland and other countries testify to the fact, that bronze was the material commonly used for the manufacture of arms, before the more intractable metal iron had been brought under sufficient control, partly to replace it for that purpose, and entirely for many others.

Tin, the other constituent of true bronze, was also known from the very earliest epoch; but zinc was not known in Europe as a distinct metal till the twelfth century, when it was introduced as such from China; and it was only about the middle of the last century that the method of extracting it from its mineral ores was discovered. The ancients, however, had unconsciously applied zinc to practical purposes in the manufacture of brass, which they produced by the direct action of the ores of zinc, either blende or calamine, on copper. The name zinc was given to the metal by Paracelsus at the beginning of the sixteenth century.

In respect to the first use of bronze cannon, the Spanish authors we have so freely cited state that the Moors used machines of cast metal for projecting stones in 1220, which may be assumed to have been bronze cannon, as the art of casting iron is of so much more recent date—at least the art so far as concerns the casting of large objects. The train which was prepared for the Andalusian war, in the reign of Henry III., in 1406, consisted of 6 bombards, and 100 lesser pieces, many of which were doubtless bronze guns; the probability indeed is, that the Spanish Arabs were our first instructors in this branch of war, just as they appear to have been our precursors in the institutions of chivalry, and that these warlike arts passed from them, through the Spaniards, to the other countries of Europe. In the wars of Charles V. against Francis I. of France, a great quantity of bronze cannons of various kinds, cast at Malaga, were used in the emperor's army, and so rapidly were such instruments of war multiplied, that Philip III., in 1609, issued an ordinance by which the number of bronze cannon foundries was limited to four within the peninsula, and four in the Spanish territory without it; and the number of calibres restricted also to four, a remarkable anticipation of a wise simplicity in the arrangements of war. The oldest bronze gun, with a legible date attached, now existing in Spain, was found in the Alhambra of Granada, in 1814, and was cast in 1501. Several others of the date of 1542 are also in the Alhambra, and one of probably much greater antiquity, which bears, in Gothic characters, this inscription, "*Præceptum mei domini facio, fugite a me omnes.*" In France, at Toulouse, there is a bronze gun cast in 1438, and in 1478 Louis XI. ordered artillery of this description to be cast at Paris, Orleans, and Tours, the epoch of which was marked by the death, at Tours, of the founder, Jean Moqué, who was killed by the bursting of one of his own guns. In Germany bronze guns were cast at Augsburg in 1372, and in Italy in 1399, and it is very probable that both countries derived the art from Spain. In England the industrial resources of the country have naturally led to a preference for iron guns; but it would appear, from the fact that bronze guns formed part of the armament of the Mary Rose, sunk off the coast of France in 1545, that at least prior to that date bronze guns had been used, if not cast, in England. The curious compound guns of the date 1426, formed of iron bars with a brass cylinder as part of the bore, connected with a moveable breech, belong to the section of forged guns.

Cannon.

Early guns made of a ternary bronze.

The bronze guns cast before the middle of the last century are supposed, from such chemical examinations as have hitherto been made, to have been formed of a ternary compound of copper, tin, and zinc. The latter, as before observed, derived from the calamine ore, a carbonate of zinc. In the early ages, each founder had his peculiar compound, and, guarding his secret under the veil of profound mystery, transmitted it as a legacy from father to son. So many of these guns burst, or became rapidly useless in service, that during the Thirty Years' war, bells were melted and used for casting guns. The proportions of some of the foundries, after the Thirty Years' war, were as follows:—

	Keller.	Buchner.	Other foundries.
Copper,............	91·5	89·9	86
Tin,..................	7·8	8·6	11·1
Zinc,..................	0 7	1·5	2 9

The zinc being introduced into the compound through the intervention of its binary compound with copper, a proportionate quantity of brass having been actually used in forming the metal for casting. The ternary gun-metal has even very recently had its advocates, and it is said to be still used in Denmark; but when the difficulty of insuring certainty in the proportions of the alloy with a metal like zinc, so volatile at a very moderate temperature, is considered, there can be little reason to depart from the binary compound now generally adopted.

The proportions adopted are different in different countries; in France, 11 per cent. of tin; in Spain the same for large calibres, or 8 per cent. for small calibres and for mortars and howitzers; and in England 10 per cent.; and in our service the proper line appears to have been drawn in respect to the use of iron and bronze—the heavy ordnance of garrison and siege artillery being constructed of iron, and the lighter ordnance for the field of bronze.

Casting of guns.

Of the several modes of casting which have been adopted at different times and in different countries, two only are at present in use in cannon foundries, namely, casting in sand, and casting in prepared earth or mould; the first for iron and the second for bronze ordnance. By casting iron guns in sand, a hard skin, as it were, forms on the metal, and it is unnecessary to subject the gun to turning, and this is gaining a great advantage in iron guns.

Dry sand moulding.

The sand for dry sand mouldings is made by mixing a quantity of sharp refractory sand with water in which clay has been diffused. After the mixture is thoroughly made, if a handful is grasped, and on opening the hand the sand retains the form given it, then the consistence of the mixture is good. The sand should have the following qualities:—1*st*, It should not be fusible by the heat of melted cast iron; if it were, it would adhere to the metal, and make the surface of the gun rough. 2*dly*, It must be sharp, and composed of angular particles; if the particles of the sand were round, it would not hold together on taking out the model. 3*dly*, It must not contain too much clay, for in that case it would crack in drying. 4*thly*, It must contain a certain proportion of clay, to retain the form that the model impresses on it.

The model.

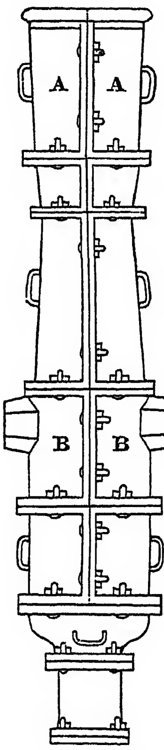
For dry sand moulding, a pattern of wood may be used, turned exactly to the form of the gun; or, to avoid expansion from humidity, the model, or pattern as it is termed in the foundries, may be of metal. Brass or pewter are preferable to iron for making patterns, as a smooth surface may be more easily given them, so that they may leave a correct impression, and may come out well from the sand. The metallic pattern is hollow, that it may be lighter and more easily handled: it is also in different pieces; and each piece fits into the adjacent piece by a rebate.

The length of each piece of the model should be a very little greater than the given length of the corresponding part of the gun, because the length of the mould is the length of the gun whilst hot, and this is longer than the

length of the gun when it comes to the temperature of the atmosphere, at which temperature the dimensions of the guns are given. It has been estimated that some kinds of cast iron contract six hundredths of an inch in a foot in passing from the liquid state to the temperature of the atmosphere. This contraction is not considerable enough to be taken into consideration in the diameter of the pattern. The shrinking of the sand in drying, though not considerable, tends likewise to make the piece shorter, and is another motive for making the pattern a little longer than the dimensions taken from a gun at the usual temperature. The patterns of the trunnions are attached to the pattern of the second reinforce by screws, so as to be unscrewed and separated when the pattern is to be lifted out of the sand.

Gun-boxes.

The gun-box, in which the dry sand mould is to be formed, is of cast iron, and cast in sand. It consists of several portions; each of these portions has a flange, by which it is fixed to the others, and the whole, when connected together, form the gun-box. In the flanges are holes through which bolts are passed; the bolts are secured by wedge-formed keys; thus the different parts of the box are firmly held together. The two portions of the gun-box which contain the breech-ring and cascabel are single, not being divided longitudinally. Each of the other five transverse portions is divided longitudinally into two. A handle is fixed to each portion of the box, for the purpose of moving it. The upper transverse portion AA contains the gun-head. In each of the two portions BB, which contain the second reinforce, there is a lateral projection for the trunnions. The figure represents the gun-box with the breech lowermost, in the position in which it is placed when the metal is poured in.



Forming the mould.

To make the mould, the pattern of the breech is first placed on a board, and the corresponding portion of the gun-box is put over it, and sand is rammed between the pattern and the box. The flat exposed surface of the sand is painted over with blacking, which consists of charcoal and clayed water, that there may be no adhesion with the sand of the next portion of the mould. The pattern of the first reinforce is now fitted into the pattern of the breech, and the corresponding portions of the first reinforce box adjusted on the flange of the breech-box. Sand is well rammed, in small quantities at a time, between the pattern and the box; and the upper flat surface of the sand is painted over with blacking. The mould is completed by adding the remaining pieces of the model and of the box, one above another, ramming the sand, and painting the transverse surface of the sand at the top of each division of the box with blacking. The sand must be strongly and equably rammed, that every part of its surface may be able to resist the pressure of the liquid metal. Three little wedges are interposed between the two adjacent transverse portions of the box, that the sand may project a little, so that after it is dry it may be flush with the box; if this were not done, there would be an interval between the adjacent surfaces of the sand, through which the metal would pass and form a fin.

Drying stoves.

When every part is moulded, the box is taken to pieces, and the parts of the pattern are carefully taken out of the sand, for which purpose they are first struck with a wooden mallet. Each part of the mould is then carried separately to the stove to dry. The stove is a room twelve or fifteen feet square, with large iron doors on one side; the fire is made in a large conical grate placed on the middle of the floor; the smoke issues by an aperture in the brick ceiling. The heat in this stove is considerable, but it must not be so great as to make the boxes red hot; for then, by the expansion of the iron, the mould would be injured; the moulds take about fifteen hours to dry in this situation. When the moulds are taken out of the stove, their interior surface is painted over with a coat of blacking, that there may be no adhesion between the mould and the metal.

Putting together the mould.

The pieces of the gun-box containing the mould are then taken to the pit, and being carefully placed the one upon the other by the crane, they are put together, and secured by their bolts. The mould is placed with the breech undermost; the axis of the mould is made perpendicular to the horizon by a plumb-line, that the weight of the melted metal may press equably, and not more on one side of the mould than on another. It is not necessary that sand should be rammed round the mould, the box being strong, and its parts firmly bound together, so as to require no additional support. The mould is now in a position for the metal to flow into it through its open end, which is the extremity of the head.

Air furnace.

The pig-iron from which the gun is to be made is melted in a furnace, called an air-furnace in the iron foundries, and termed by some authors a reverberatory furnace. The flame of pit-coal is carried by a current of air so as to play upon the pig-iron. The stack of the chimney is 40 feet high. By the pressure of the unrarefied external air on the lower part of the rarefied column of air in the furnace and chimney, the current of air through the furnace is produced. The grate G is larger than any other transverse section of the furnace. (See figure next page.) The furnace has three openings; one, C, for introducing the coals; the second, P, which has a sliding brick door, with a counterpoise, serves for introducing the pig-iron. The third, I, is for the purpose of stirring the metal, and taking out the melted iron for small castings by iron ladles coated with clay, and made red hot. This third opening has a door of fire-brick; the joints between the door and the door-frame are luted. In the middle of the door is a hole, through which the state of the melted metal may be seen. There is likewise a smaller opening, T, for letting out the melted metal.

The furnace and stack are of brick. The interior of the furnace is a coating of fire-brick, nine inches thick, detached and separate from the outer coat and the other parts of the building, in order that the heat may not melt the common brick of which the outer parts are composed. The fire-brick is made of refractory clay, which, containing little iron, and little or no calcareous matter, burns white, and sustains a great heat without melting. These bricks are made of Stourbridge clay, or of a light-bluish gray stratified clay, found in the strata that accompany coal in some of the collieries in Scotland. The clay is first ground, the pieces of ironstone picked out, and then made into bricks. In making the interior coating of the furnace, the bricks must be built with moistened fire-clay, and not with lime-mortar. The quantity of metal put into the furnace should be equal to the weight of the solid unbored gun with its head, and something more in case of need. It requires a large air-furnace to contain metal enough for one large gun.

Quality of the iron.

The pig-iron for guns should be gray, that kind having most tenacity; white pig-iron is too brittle, and so hard that the head cannot be cut off, nor the gun bored.

Charging the furnace.

A bed of sand, N, is made in the furnace, on which the pig-iron is to be laid. The furnace is heated to a white heat, till the sand is vitrified, which is known to have taken place by touching the surface of the sand with an iron ringard. The brick door is then lifted up, and the pig-iron is

Cannon.

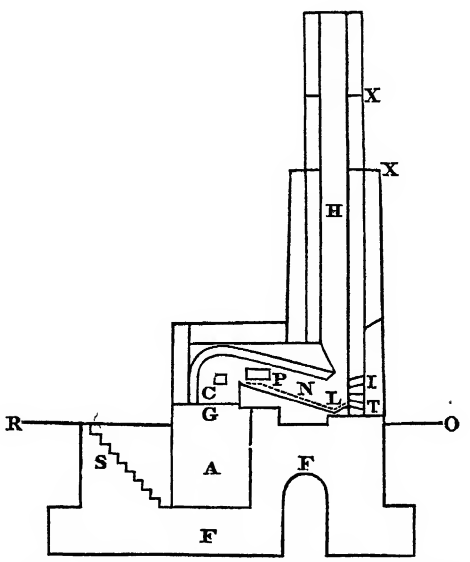
Fusion should be rapid.

laid on the bed of sand. The heat should be applied so as to produce a speedy fusion; for if the iron is long exposed to heat before melting, a portion of its carbonaceous matter is burnt, and it passes from the state of gray cast-iron to that of white. In situations where pit-coal cannot be had, wood may be used in the air-furnace; but the heat given by wood is not so great as that produced by pit-coal. To obtain the utmost heat that the wood is capable of affording, it should be well dried, cut into small logs, and the logs should be placed with their end upon the grate.

The pig-iron melted by the flame playing on it flows down into a cavity, L, which has a hole T, opening outwardly, and stopped with clay. When the hole is forced open by a workman, the metal issues and is conveyed by a gutter formed of sand to the gun-mould, into which the melted metal falls through the open end of the head. The sand forming the gutter should be in a proper state of moisture. If it is too dry, some pieces of it will be carried away by the metal. Across the gutter is a dam composed of an iron plate luted, and dipping a little below the surface of the metal to retain the scoriæ. This dam is driven down to stop the current of metal when the mould is full. The metal is also skimmed, as it passes along, by a skimmer, composed of a rod of iron terminated by a flat semi-elliptical piece luted and made red hot. It is sometimes the practice to plunge a piece of green wood for a short time into the head whilst liquid. This is with a view to prevent honeycombs, and its action may be to metallize any oxidated particles of the metal, and that the vapour from the green wood, rising to the surface of the metal, may carry with it small air bubbles, or other extraneous bodies that would, if they remained, occasion cavities in the metal.

Explanation of the figure.

The figure is a transverse section of the air-furnace. C is the opening through which the coals are introduced. P, the opening at which the pig-iron is thrown in. T, the hole through which the metal is let out. The metal flows into the casting-house. O, the floor of the casting-house. In this floor is the pit in which the moulds of large goods are sunk, that the metal may flow down into them. I, the door, with a hole in it, for seeing the state of the melted metal.



G, the grate. L, the lower part of the cavity of the furnace, into which the metal, as it is melted, flows. S, steps leading to A, the ash-pit. N, bottom of the furnace, lined with sand. H, chimney; the height of the stack is forty feet from the surface of the ground. The stack is strengthened in different places by iron bars, X. F is the mass of building which forms the foundation built below the surface of the ground to support the weight of the furnace and stack. R, the surface of the ground out of doors. C P N L H is the course that the flame takes.

Not cast from the blast furnaces.

The guns are not cast from the blast-furnace, where the ironstone is melted, as the quality of the metal would be uncertain, and might vary from one cast to another, by causes either unknown, or not under the control of the iron-master. On the other hand, in the air-furnace, pig-iron of a quality proper for making guns is put in, and the quality of the iron is not materially altered by the process of melting.

The head.

The head of the gun is like the jet (gate or geet of the workmen) of any other casting. Whilst the whole is liquid, the head is a column of liquid metal that acts by its height, exerting pressure on the metal that forms the body of the gun. The metal subjected to this pressure whilst liquid is less subject to porosity when cooled. The head also furnishes metal to fill up the cavities that occur in the piece by the contraction and crystallization of the metal whilst it is passing to the solid state. All the great contractions and crystallizations are thus transferred to the surface of the head, which is found to be composed of large cavities, sometimes containing cast-iron crystallized in a fern-leaf shape. The head also serves to receive any impurities that may have escaped the attention of those appointed to skim the iron as it flows along the gutter.

In 10 or 12 hours, the piece is sufficiently cool to be removed. It is then stripped of the mould, and taken to the boring-mill, to undergo the operations described under our article Boring of Cannon. Mortars, howitzers, and carronades, are moulded, cast, and bored in the same way as long guns.

Pit-coal cannot be employed entire in the blast-furnace; the bituminous part would be conglutinated by the heat, and the furnace would be choked, and the materials would no longer descend gradually as they ought to do. The coal is therefore burnt to drive off its bitumen, and it is then in a state of cinder, and called coke. It requires a larger mass of coke than of charcoal to smelt ironstone. Hence the coke blast-furnaces are large, and the machines employed to blow them are more powerful than the wooden spring bellows invented in Germany in 1620, and which continue to be employed in the charcoal iron-furnaces in Germany and France. Bellows connected by leather, and worked by water, were used to blow the blast-furnaces at Carron at the commencement of that establishment in 1760. Some time after, these bellows gave place to blowing machines, composed of pistons working in iron cylinders, constructed by the celebrated Smeaton, and described in his reports. The blowing machines of the blast-furnaces in Britain are now always composed of pistons moving in iron cylinders. The improvements in the steam-engine have rendered practicable the working of blast-furnaces in situations where there is no fall of water; and, on the other hand, the manufacture of the various parts of numerous steam-engines has called forth the abilities and ingenuity of the iron-founder.

In consequence of the advanced state of the English cast-iron manufacture, several foreign nations have been desirous of introducing the English method, and have procured English workmen for that purpose. In this way iron-works on the English plan were erected in Russia about 1780, in Silesia in 1790; and in France, at Creuzot, 12 miles south of Autun, there were three English coke blast-furnaces begun about 1790, under the direction of William Wilkinson.

Progress of the art of casting cannon.

The improvements in casting cannon, as in other arts, have been gradual. They are now always cast solid, experience having shown that guns cast solid are stronger, and less liable to burst than those cast hollow, and that the bore is freer from honeycombs, and more likely to have the same axis with the piece. The second of these qualities is still more certainly attained by the practice now in use of making the gun itself revolve whilst boring; in this way, as long as

the boring bar remains unmoved, the axis is right; but if the boring bar has a conical motion, then the point of the bit is out of the axis; when the boring bar was made to revolve, the bore might deviate greatly from the axis. The improvements in the casting of cannon have kept pace with the improvements in the manufacture of cast-iron.

The art of casting iron was known to the ancients, as appears from a small antique statue of Hercules of cast-iron, dug up at Rome. In China it appears to be practised with a dexterity visible in the Chinese specimens of many other arts. In modern Europe it has grown with the general advancement of society, and has now arrived at a high state of perfection. In the Prussian dominions small statues and other objects are cast in iron, and then bronzed; and from the great taste with which they are designed are highly ornamental; but in none of the other countries of Europe has so large a capital been embarked in the manufacture of cast-iron goods as in England, and their use, in some shape or other, is general throughout the British dominions. Pit-coal has been the main instrument in the development of this highly important manufacture, and Great Britain is indebted to its possession of such vast coal deposits for the extension and success of its iron-works. Pit-coal began to be used for smelting ironstone in 1619, the first operation having been performed in Worcestershire by Dudley, who describes the process in a book entitled *Metallum Martis.* The manufacture of cast-iron was not much advanced 100 years afterwards; for, in the first half of the eighteenth century cast-iron goods were imported from Holland, and the Dutch chimney backs, with the figure of a parrot, are yet to be seen in old country houses in Scotland. The minerals used are the hæmatites of Ulverstone, and the neighbourhood of Whitehaven, which, being very rich in iron, are carried by sea to smelting furnaces of other parts of Britain; and the argillaceous iron ore which is interstratified with the beds of coal of the great coal-fields, on which, therefore, the principal iron-works of Great Britain have been established.

Moulding in earth or prepared mould.

Bronze cannons are cast in earth or prepared mould, which is composed of clay, sand, cow-hair, and horse-dung. The clay, from its tenacity, the facility with which it can be moulded into any shape, and its property of hardening on drying, forms the basis of all moulding earths, whilst the defects it possesses of cracking and shrinking as it dries, are corrected by the addition of sand or silicious earth. Sands or earths containing much calcareous carbonate should be rejected, as the disengagement of carbonic acid upon contact with melted metal would produce air-bubbles; and ochreous earths should be also rejected, as the metallic oxides they contain may vitrify the first coats of the mould. The cow-hair adds to the tenacity of the earth, by binding its parts together, and diminishes the contraction or shrinking; and the horse-dung renders the paste more unctuous and cohesive, and more readily dried. All these substances undergo distinct preparative processes before they are mixed together, in order to free them from extraneous substances, and to make them fit for blending readily together; the earth being first mellowed by exposure in pits when moistened by a sufficient quantity of rain-water.

Three descriptions of moulding loam are used in the French foundries, viz., fine earth, putty, and common earth. The *fine earth* is a mixture of four parts of mellowed clay and one part of horse-dung, which is allowed to rest in the tubs for at least eight days, and is then used as a pulp, after having been passed through a very fine sieve. The putty consists of four parts of *fine earth* passed through a coarser sieve, or a perforated copper basin of three parts of silicious sand, and $\frac{1}{8}$th part of cow-hair. *Common earth* consists of two parts of mellowed clay, one of rather coarse silicious sand, one-half part of horse-dung, and one-half part of cow-hair. Each of these compounds is prepared separately on an oak table, and the various substances of which they consist are arranged in layers one upon the other, and then carefully triturated together with proper tools, so as to ensure a smooth and homogeneous mixture. The proportions vary in different foundries; but it is necessary to keep to moderate and fixed quantities of cow-hair and horse-dung, as these substances burn, and if in too great quantity may produce cavities in the coats of the mould into which the metal, when in fusion, would necessarily filter. In Spain the *common earth* is made by spreading on the table 584 lb. of prepared clay, and over that 36 lb. of horse-dung; and as a third layer $2\frac{1}{2}$ lb. of cow-hair; 69 lb. of water being then added, and left for $1\frac{1}{2}$ hours, so as to allow the whole mass to be penetrated by the water, when the operation of mixing commences, and is continued for about three-quarters of an hour, after which it is generally found that the three materials have been perfectly combined together.

Moulding in prepared mould or loam.

The operation of moulding is divisible into two parts, namely, the preparation of the model and the formation upon the model of the mould.

Model.

The model, as well as the mould, is formed of three distinct parts, namely, the models of the body of the gun, comprising part of the first and the second reinforces, the chase, and the muzzle; of the breech and cascable, and of the head metal. The model of the body of the gun is built up on a conical spindle of wood, either of pine or fir, which is supported horizontally, by its ends resting in the sockets of the vertical end-pieces of a frame firmly fixed to the ground. The large end of the spindle has a shoulder in the shape of a truncated cone, which, resting in a hollow or notch of the frame, prevents any longitudinal motion, and this shoulder is terminated by a square head pierced with lever holes, into which the handles are placed, by which the model and the mould in progress of formation may be turned as required. Each frame supports two spindles placed opposite each other, but in reverse positions, so that two models may be prepared at once. In well-arranged foundries the frames are constructed of cast-iron, and made moveable on trucks and rails, so that their position may be shifted; and as it is necessary to dry the model and mould in course of formation, the frames are placed over a brick pavement made slightly concave for the reception of the fuel. The external form of the model is regulated by a profile board, to one edge of which is attached throughout its length an iron plate cut so as to correspond exactly to the various rises, depressions, mouldings, &c. of the intended gun. This profile is fixed to the uprights of the frame, either horizontally at the level of the axis of the spindle, or vertically below the spindle; and as the spindle is turned round during the process of forming the model, every part of it is reduced to its true shape and size, or rather to a size somewhat greater, as the profile is so placed as to produce an increase in the diameter of the gun of about half an inch, which allows a sufficient thickness of metal for the operation of turning. The spindle and profile-board being properly placed, the first act of the moulder is to fix brackets, shaped to the swell of the muzzle, at regular intervals all round the smaller end of the spindle, and to fasten them on with long nails; he then covers the spindle with straw-rope, winding it round from the muzzle end backwards; and when the rope circles have sufficiently bound the brackets which define the swell of the muzzle, he withdraws the nails by which they had been at first secured in position, and continues the straw coating until there remains only an interval of one or two-tenths of an inch between it and the profile-board, which space is then filled up by a coat either of prepared clay, or plaster of Paris, the last layer being put on in a finely liquid state, so as to fill up all cracks, and efface any defects; the spindle being turned during the operation, so as to bring every point of the surface into contact with the profile-board, by which it is as it were turned into proper shape. The model of the

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body of the gun being thus finished, the models of the trunnions and dolphins (if any) are next attached to it. These models are made of plaster, cast in plaster moulds; and those of the trunnions are, from their bulk, cast hollow. The trunnions and dolphins having been carefully secured in their proper places by straps, and cemented on by liquid plaster the model is complete, and the workman then proceeds to form the mould upon it.

Formation of the mould.

The model is first brushed over with a wash either of finely comminuted and well-washed ashes, or with tan-ashes diffused in water, the object of this coating being to prevent adhesion between the model and the mould. The ash-coat being perfectly dry, the moulder applies three successive coats of putty loam, being in all about $\frac{6}{10}$ths of an inch thick, all being slowly dried in the air, with a mixture of putty and common loam. Several other coats are then added, gradually increasing in thickness, and dried by artificial heat so as to render them hard enough to resist the point of a knife; and these are followed by thicker layers of common moulding loam, until a thickness of about $2\frac{3}{4}$ inches in guns of large calibre, and $2\frac{1}{4}$ inches in those of lesser calibre has been attained. The surface is then carefully smoothed, and any irregularities having been removed by the application of a profile-board, the first armature is fixed, which consists of flat bands of iron of the length of the mould, secured by circular iron bands at fitting intervals, these hoops being well closed by iron wire. In guns of large calibre, such as the French 16-pounder and 24-pounder, 10 or 12 bands, and 16 or 20 hoops are used. The bands and hoops are 2 inches wide; the bands being $\frac{4}{10}$ths of an inch thick, and the hoops between $\frac{3}{10}$ths and $\frac{2}{10}$ths. Before putting on the bands some iron wire is wound round the mould at both ends and at each side of the trunnions, and by this wire the bands are tied down to the mould, and thus kept firmly in place until the hoops have been put on and closed. The armature being thus fixed, the moulder fills up all the spaces between the bands and hoops with common loam, and puts fragments of brick into any open spaces between the bands and hoops. He then applies over the whole surface a new coat of coarse loam, which he dries as before, and continues the operation, by successive coats, until the mould has acquired a total thickness of 5 inches for large calibre, and 4 inches for small; and as these dimensions have been found sufficient to insure stability in the mould, they should not be exceeded, as a greater thickness would only add to the difficulties of drying and baking. The moulder now smooths and trims this last coat, and having strengthened the region of the trunnions by hoops let into the substance of the loam, proceeds to attach the second armature of bands and hoops, which are somewhat stronger than the first, and terminated by hooked ends, by which they may be secured to the bands of the breeching and head-metal moulds; on this second armature one or two more coats of loam are spread, and the whole being smoothed by the hand, the mould is complete. The spindle and the straw bands are now withdrawn, and such portions of the plaster which do not come off with the straw being carefully extracted, as well as that which formed the moulds of the trunnions and dolphins, the mould is ready to be baked. The models and moulds of the breeching and head-metal are formed upon the same principles as that of the body of the cannon, except that in the model of the breeching, an iron axis is used instead of the wooden spindle; the axis and profile-board being sometimes horizontal for small calibres, and vertical in large calibres, in consequence of the greater thickness and heavier armature of the moulds. The moulding with a vertical axis is carried on over a small round furnace heated with wood, and surmounted by a cast-iron drum, which can be raised or depressed for either moulding or drying. The axis is in this case fixed, being firmly attached at its base to the platform of the furnace, and the profile-board is moveable, being fixed to an iron plate, which turns on a shoulder of the axis. The model being finished, the mould is formed upon it in the same manner as in that of the body of the gun; but the second armature is replaced by an envelope of iron or bronze, called the goblet mould, into which the mould is cemented either with plaster or loam, and from which it acquires strength to support the whole weight of the metal. The mould being completed is then dried by fire, and this is effected at Toulouse by a circular furnace with a central hearth sufficiently large to dry ten moulds at once; the ten stoves being arranged circularly round the hearth, and covered as required by a drum of sheet-iron. The model of the tail piece itself of the cascabel is made of bronze, and is used for all guns of the same calibre. The final hardening or baking of the moulds requires special precaution in respect to that of the body of the gun, on account of its length, and it is therefore effected in the casting-pits by suspending the mould over a small temporary brick furnace, which is removed after the operation. The three pieces which constitute the whole mould of a cannon being now ready, they are lowered into the pit and properly adjusted to the breech below and the dead-head above, each part being firmly secured to the other two by iron wire passed round the hooked ends of the iron bands of the armature, and the joints well plastered with moulding loam. The mould now forms one complete whole, and the moulds of all the cannons to be cast at the same time are carefully arranged in the pit, so that their summits should all be on the same level, and the top of the dead-head level with the lower discharging hole of the furnace. The whole pit is now filled up with slightly damp earth, put in by successive layers, gradually increasing in thickness from below upwards, and carefully rammed with an iron rammer. In the moulds of large guns, the breech and body of the gun are first connected together, and the dead-head mould fixed on when the pit has been filled up to the level of the muzzle. The ramming is a delicate operation, and much care is required to avoid a blow on the trunnion portion of the mould, an accident which in some foundries is guarded against by small stakes placed around the trunnions as a guide to the workman. When the filling has come up to about $1\frac{1}{4}$ inch of the discharge hole of the furnace, canals are formed in the earth of the pit for conveying the melted metal to the different moulds, the sides and bottoms being of bricks well cemented and plastered with moulding putty, and the pit is then filled up to its summit, when everything is ready for the casting. The system which has been here described is that adopted in the great cannon foundries in France, in which country even siege guns of the largest calibres are manufactured of bronze, and is, with some slight modification, that of our own arsenal.

Shell Moulding.—This description of moulding is also effected in loam, but far more expeditiously than the preceding. The model is either of wood or brass turned to the exact shape of the particular gun, with the addition of the dead-head; and serving, therefore, for all guns of that calibre. It is divided into two halves by a plane passing through the axis; and one half being placed on a horizontal plank, the model is covered by a coat of moulding loam sufficiently soft to be readily applied to the model by the simple pressure of the hand, and about $1\frac{1}{2}$ inches thick. Numerous holes are then made over the surface with the finger to the depth of about one-third of an inch, and the whole is dried with lighted charcoal placed in lumps upon it until it has begun to harden, when a thick coating of plaster is applied, which fills also the holes, and thus binds the two coats together. An armature is now applied consisting of strong iron bars, both longitudinal and transverse, fixed one to the other by rivetted bolts, and over this armature a second thick bed of plaster; so that the armature is as it were imbedded between the two coats. The one half

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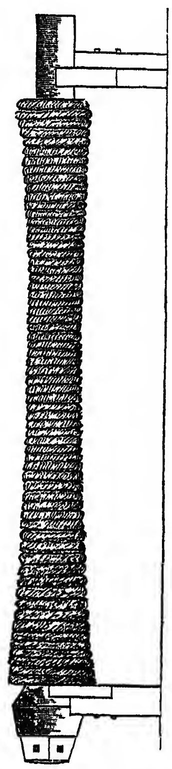
being finished, the mould is turned over, and the model having been taken out, the hollow is thoroughly dried by live coals, and the interior surface brushed over by a liquid paste of clay to fill up cracks or other defects, when an ash coat is applied as in ordinary moulding to prevent adherence. It should be observed that the models of the trunnions and dolphins are made separate, and are attached to the body of the model by long screws, being removed by unscrewing when the mould has been completed. The two halves are now carefully adjusted to each other, and secured by bolts passing through the transverse bars of the armature; after which the joints are plastered up and the mould is complete for lowering into the casting pit. Another mode of shell-casting is only a slight modification of the above: the model is laid with its longitudinal axis horizontal, and one-half immersed in a bed of sand. Upon that part of the model which projects above the sand successive coats of loam are applied, and dried one by one by fire, till the model is covered with a coat of loam four or five inches thick, when an iron carcass is applied, and over the carcass another coat of loam. The mould with the model in it is now turned, so that the half already covered with loam shall be lowermost. The plain surface of the loam which had been in contact with the sand is painted over with a coat of blacking, composed of finely-powdered charcoal mixed with clayed water; this prevents the adhesion of the flat surface with the loam that is to be laid on it in order to form the mould of the other half of the gun, now of course uppermost. The two halves are secured together in the manner before described; but this method has the advantage of securing precision in the structure of the two parts by forming one upon the other. Both these methods were in use in the French foundries towards the end of the last century, but have been abandoned, as it was found impossible to prevent an escape of the more liquid portions of the metal, surcharged with tin at the line of junction. Guns cast in this way exhibit along the lines of junction, even after turning, long white streaks, which are only so many spots of tin which has filtered through, and it was therefore found impossible to secure homogeneity in the mass by this system. The process of forming the model will be better understood by the accompanying woodcut, which represents the spindle at that stage of the work where the straw-rope is wound round it, the brackets fastened on towards the lesser end, giving an approximation to the form of the muzzle. The description will, it is believed, render the remaining portion of the process sufficiently intelligible.



The importance of casting with a dead-head is very great, as the weight of the column of fluid metal forces the lower portions into all the sinuosities of the mould, and insures a homogeneous structure with a proper density. The following table gives the result of French experience as regards the weight of the dead-head, as it is evident that an excess of weight would endanger the deterioration of the mould, whilst too little weight would lead to imperfections in the mass; hence it is very important to have some guide in determining the weight from such extended experience:—

Weight of French Cannon in their different States, and dimensions of their Dead-Heads, 1838, *in Kilogrammes, the Kilogramme equal to* $2\frac{1}{5}$ *lb. Avoirdupois.*

NATURE OF CANNON.	WEIGHT OF CANNON.						Weight of Dead-Head.			Length of Dead-Head in metres (1 metre = 3 281 feet).			Diameter of Dead Head in metres.		
	Rough, with Dead-Head.			Finished.											
	Douai.	Toulouse.	Strasbourg.	Douai.	Toulouse.	Strasbourg.	Douai.	Toulouse.	Strasbourg	Douai.	Toulouse.	Strasbourg.	Douai.	Toulouse.	Strasbourg.
Siege guns.... ....24-pr.	5400	5320	6028	2754	2764	2760	1554	1635	2196	1·84	1 38	1·52	0·400-0 395	0·450	0 540-0·400
... 16 ...	4070	3998	4817	2015	2033	2016	1217	1253	1984	1·95	1 40	1·68	0 339-0 332	0 390	0 475-0 350
Guns of position, 12 ...	3200	3323	3608	1568	1574	1583	981	1187	1387	1 91	1·47	1·44	0 304-0 295	0 360	0·430-0·370
Field guns......... 12 ...	1950	2233	1971	868	890	884	642	1018	689	1·45	1·35	1·40	0·289-0·283	0·350	0 280
.. 8 ...	1700	1620	1735	592	585	589	709	730	881	2 04	1·22	1 34	0·246-0·240	0 300	0·310-0·260
Howitzers, Siege 22 cent (centimetre = 0 39371 inches)	3474	2840	3468	1241	1231	1244	1686	1131	1229	1·38	1·12	1·65	0·411-0·404	0·400	0·442
Howitzers, Field, 16 cent.	2275	2265	2818	882	879	887	894	867	1407	1·77	1·18	1·66	0·305-0·290	0·350	0·390-0·320
Howitzers, Field, 15 cent.	1722	1489	1702	585	584	585	749	496	757	1·52	0·94	1·35	0·265-0·259	0·310	0 325-0·285
Howitzers, Mountain, 12 cent.......... ...	386	362	457	101	98	101	193	134	224	1·00	0·60	0 92	0 185-0 183	0 180	0 220-0·184
Mortars .... 32 cent.	3764	3708	3501	1284	1304	1291	1979	2081	1808	1·70	1·58	1·38	0 487-0·433	0·469	0·640-0·450
... 27 .	2960	2846	2687	908	930	915	1686	1634	1459	1·79	1 48	1·50	0 390-0·367	0 420	0·430-0·370
... 22 ...	1500	1121	1176	293	288	288	1015	600	697	1·35	1·05	1 00	0 318-0·311	0·300	0·376-0 340
... 15 ...	...	...	345	...	...	70	...	...	183	...	...	1·00	...	...	0·225-0·215

Remarks.—At Douai the dead-head is a truncated cone, the greater circle next the piece—both diameters given in the table. At Toulouse the dead-head is cylindrical, except the small piece merging in the mould of the body of the cannon, which is a truncated cone. At Strasbourg, in guns and howitzers, a truncated cone commencing at the swell of the muzzle, and then cylindrical; in mortars of 32 and 27 cent., partly cylindrical and partly a truncated cone; in mortars of 22 cent., two cylinders of different diameters. It appears from the data given, that the weight of the dead-head in a French 8-pounder, equivalent to an English 9-pounder, is to that of the whole mass to be cast, as 1 to $2\frac{1}{10}$ths, or about 1694 lb., and that its length is about $4\frac{1}{2}$ feet, this height of metal being necessary to ensure a sufficient pressure. (J. E. P.)

CANNONADE. See GUNNERY and WAR.

CANO, ALONZO, one of the most vigorous of the Spanish painters, and, like M. Angelo, also an architect and sculptor of great merit. He must have been very industrious, from the number of specimens of his genius which he has left in Spain, particularly at Seville, Malaga, Granada, and Madrid, where we have seen and admired the boldness of his design, the facility of his pencil, and the purity of his flesh-tints, with his knowledge of chiaro-oscuro. He was a contemporary of Velasquez and Pacheco, whom he rivalled without imitating; and though we regard him as one of the most original and spirited of the Spanish school, his name and merits are scarcely known beyond the Pyrenees. Alonzo was patronized by Philip IV., and obtained the church preferment of a canon; but he was a man of ungovernable temper; and at Granada demolished a saint he had sculptured for a niggardly magistrate with a blow of his hammer, a feat which before had condemned Torregiano to the stake, in the reign of Philip II. Alonzo was born at Granada in 1600, and died there in 1667.

CANOE, a sort of Indian boat formed of the trunk of a tree hollowed, and sometimes of several pieces of the bark put together. Canoes are of various sizes, according to the uses for which they are designed. The largest are made of the cotton tree; and some of them will carry from twenty to thirty hogsheads of sugar or molasses. Others are made to carry sail, and for this purpose are steeped in water till they become pliant, after which their sides are extended, and strong beams placed between them, on which a deck is laid. The smaller kinds rarely carry sail, unless when going before the wind; their sails are made of a sort of short silk grass or rushes. They are commonly rowed with paddles, which are worked in the water perpendicularly. The small canoes are very narrow, having only breadth enough for one person, and length for seven or eight. The Indians are very expert in managing their paddles, and adjusting their bodies so as to balance their canoes, which are extremely light, and liable to be overturned. The American Indians, when their progress is impeded by a waterfall or a shallow, or in crossing the land from one river to another, carry their canoes on their heads till they arrive at a place where they can launch them again. Some nations have small vessels under the name of canoes, which differ considerably from the above, as the inhabitants of Greenland, Hudson's Bay, Otaheite, and other places.

CANON, a person who possesses a prebend, or revenue allotted for the performance of divine service in a cathedral or collegiate church.

Canons are of no great antiquity. Paschier observes, that the name canon was not known before Charlemagne; at least the first we hear of are in Gregory de Tours, who mentions a college of canons instituted by Baldwin XVI., archbishop of that city, in the time of Clotharius I. The common opinion attributes the institution of this order to Chrodegangus, bishop of Metz, about the middle of the eighth century.

Originally canons were only priests, or inferior ecclesiastics, who lived in community, residing by the cathedral church to assist the bishop, depending entirely on his will, supported by the revenues of the bishopric, and living in the same house as his domestics or counsellors. They even inherited his moveables till the year 817, when this was prohibited by the council of Aix-la-Chapelle, and a new rule substituted in the place of that which had been appointed by Chrodegangus, and which was observed for the most part in the west till the twelfth century. By degrees these communities of priests, shaking off their dependence, formed separate bodies, of which the bishops, however, were still heads. In the tenth century there were communities or congregations of the same kind established even in cities where there were no bishops; and these were called collegiates, as they used the terms congregation and college indifferently; the name chapter, now given to these bodies, being much more modern. Under the second race of the French kings, the canonical or collegiate life had spread itself all over the country; and each cathedral had its chapter distinct from the rest of the clergy. They had the name canon from the Greek κανων, which signifies three different things—a rule, a pension or fixed revenue to live on, and a catalogue or matricula, all which are applicable to them.

In time, the canons freed themselves from their rules, the observance relaxed, and at length they ceased to live in community; yet they still formed bodies, pretending to other functions besides the celebration of the common office in the church, assuming the rights of the rest of the clergy, making themselves necessary as a council of the bishop, taking upon them the administration of a see during a vacancy, and the election of a bishop to supply it. There are even some chapters exempt from the jurisdiction of the bishop, and owning no head but their dean. From the example of cathedral chapters, collegiate ones also continued to form bodies after they had abandoned living in community.

Canons are of various kinds; as,

Cardinal Canons, who were those attached, and, as the Latins call it, *incardinati*, to a church, as a priest is to a parish.

Domicellary Canons, young canons, who, not being in orders, had no right in any particular chapters.

Expectative Canons, or such as, without having any revenue or prebend, had the title and dignities of canons, a voice in the chapter, and a place in the choir, till such time as a prebend should become vacant.

Foreign Canons, or such as did not officiate in the canonries to which they belonged. To these were opposed mansionary canons, or canons residentiary.

Lay or *Honorary Canons*, who are those among the laity who have been admitted, out of honour and respect, into some chapter of canons.

Regular Canons, who are canons that still live in community, and, like religious, have in process of time added the solemn profession of vows to the practice of their rules. They are called regulars, to distinguish them from those secular canons who abandon living in community, and at the same time the observance of the canons made as the rule of the clergy for the maintenance of the ancient discipline. The canons subsisted in their simplicity till the eleventh or twelfth century, when some of them, separating from the community, took with them the name of canons, or acephalous priests, because they declined to live in community with the bishop; and those who were left thenceforth acquired the denomination of canons regular, and adopted most of the professions of the rule of St Augustin. This order of regular canons of St Augustin was brought into England by Adelwald, confessor to Henry I., who erected a priory at Nostel in Yorkshire, and obtained for them the church of Carlisle as an episcopal see, with the privilege of choosing their own bishop. They were singularly protected and encouraged by Henry I., who gave them the priory of Dunstable in 1107; and by Queen Maud, who, in the following year, gave them the priory of the Holy Trinity in London. It appears that under the reign of Edward I. they had fifty-three priories.

Tertiary Canons, or those who had only the third part of the revenues of the canonicate.

CANON, in an ecclesiastical sense, is a law or rule, either of doctrine or discipline, enacted especially by a council, and confirmed by the authority of the sovereign.

Canons are properly decisions of matters of religion; or regulations of the policy and discipline of a church, made by

Canon. councils, either general, national, or provincial. Such are the canons of the councils of Nice, Trent, &c.

There have been various collections of the canons of the eastern councils; but there are four principal ones, each ampler than the preceding. The first, according to Usher, A.D. 380, containing only those of the first ecumenical council, and the first provincial ones; they were only 164 in number. To these, Dionysius Exiguus, in the year 520, added the fifty canons of the apostles, and those of the other general councils. The Greek canons in this second collection end with those of the council of Chalcedon; to which are subjoined those of the council of Sardica, and the African councils. The fourth and last collection comes down as low as the second council of Nice; and it is on this that Balsamon and Zonaras have commented.

Apostolical Canons are those which have been usually ascribed to St Clement. Bellarmin, Baronius, and others, will have them to be genuine canons of the apostles. Catelerius observes that they cannot be ascribed to the apostles or Clement, because they are not received with other books of Scripture, are not quoted by the writers of the first ages, and contain many things not agreeable to the apostolical times. Hincmar, de Marca, Beveridge, and others, believe them to have been framed by the bishops who were the apostles' disciples in the second or third century; S. Basnage is of opinion that they were collected by an anonymous writer in the fifth century, but Daille and others maintain them to have been forged by some heretic in the sixth century; and S. Basnage conjectures that some of them are ancient, and others not older than the seventh century. The Greek Church allows eighty-five of them, and the Latin only fifty; though there are eight-four in the edition given of them in the Corpus Juris Canonici.

CANON, signifying in *Scripture* a rule to walk by, or standard to judge by, was by the early Christians appropriated as a distinctive appellation of the inspired Scriptures, because they regarded them as the only rule of faith and practice. For the formation of the Canon, see BIBLE.

Paschal CANON, a table of the moveable feasts, showing the day of Easter, and the other feasts depending on it, for a cycle of nineteen years.

CANON, in monastic orders, a book in which the religious of every convent have a fair transcript of the rules of their order frequently read among them as their local statutes. This is also called *regula*, as containing the rule and institution of their order. The canon differs from the *missale*, *martyrologium*, and *necrologium*.

CANON, again, is used for the catalogue of saints acknowledged and canonized in the Romish Church.

CANON is also used, by way of excellence, in the Romish Church, for the secret words of the mass, from the preface to the *Pater;* in the middle of which the priest consecrates the host. The common opinion is, that the canon of the mass commences with *Te igitur*, &c.

CANON, in the ancient music, is a rule or mode of determining the intervals of notes. Ptolemy, rejecting the Aristoxenian way of measuring the intervals in music, by the magnitude of a tone, which was supposed to be formed by the difference between a diapente and a diatessaron, thought that musical intervals should be distinguished according to the ratios or proportions which the sounds terminating those intervals bear to one another, when considered according to their degree of acuteness or gravity, which, before Aristoxenus, was the old Pythagorean way. He therefore made the diapason consist in a double ratio, the diapente in a sesquialterate, the diatessaron in a sesquitertian, and the tone itself in a sesquioctave, and all the other intervals according to the proportion of the sounds that terminate them; wherefore taking the canon, as it is called, for a determinate line of any length, he shows how this canon is to be cut accordingly, so that it may represent the respective intervals; and this method answers exactly to experiment, in the different lengths of musical chords. From this canon Ptolemy and his followers have been called *Canonici*, as those of Aristoxenus were called *Musici*.

Canon Law. CANON LAW is a term used to denote the ecclesiastical law sanctioned by the church of Rome, and possessing more or less direct influence in all countries which acknowledge the authority of the pope. The word κανων signifies a rule, and this word was not at first considered as too feeble to express the claims of the church to the obedience of her children; but, in the progress of priestly usurpation, the successor of St Peter began to arrogate a more ample and definite jurisdiction, and to extend his regulations to many causes which are not strictly ecclesiastical. The stupendous fabric of papal dominion attained its full height in the eleventh century, under the auspices of Hildebrand, who was elected in the year 1073, and assumed the name of Gregory VII. It was one of his dictates, that the church of Rome has never erred, and, according to the testimony of Scripture, never shall err;[1] and after this maxim was fully admitted, nothing remained to obstruct the progress of spiritual arrogance. What had formerly been described as a *rule*, was now dignified with the name of *law;* and from this period, a period of the deepest ignorance and superstition, the canon law obtained great influence in most countries of Europe. After the foundation of those seminaries of learning which we denominate universities, it acquired a distinguished place among the other faculties; and a knowledge of the canon law became a common road to the highest honours. It is a maxim of the commentators, that a Doctor of the Canon Law is to be preferred to a Doctor of Divinity in such dioceses as do not contain many heretics.[2]

The canon law is derived from many different sources. The authority of the Scriptures cannot be entirely disregarded; but the writings of the fathers and doctors of the church, the decrees of councils, and the decretals of popes, are much better adapted to the general views of the canonists. The canon is to a great extent to be considered as the spurious offspring of the civil law: what is most valuable it has derived from the Roman jurisprudence; and its own peculiar maxims and rules have all the same general tendency towards the power and aggrandizement of churchmen.

The Greek church has bequeathed various reliques, which cannot be safely neglected by those who investigate the history of the canon law, as well as the general history of the church. Its *Codex Canonum*[3] is confirmed by the 131 Novel of Justinian, and is therefore considered as a portion of the civil law. From this collection the emperor borrowed those ecclesiastical constitutions which occur in the Code and Novels. We cannot however pursue this branch of enquiry, but shall merely direct the reader's attention to two very elaborate publications. The first of these is the "Bibliotheca Juris Canonici veteris: ex antiquis codicibus MSS. bibliothecæ Christophori Justelli, opera et studio Gulielmi Voelli et Henrici Justelli." Lu-

[1] Mastricht Historia Juris Ecclesiastici et Pontificii, p. 297. Amst. 1686, 8vo.
[2] Lancelotti Institutiones Juris Canonici. tom. i. p. 232. edit. Doujat. Paris. 1685, 2 tom. 12mo.
[3] Codex Canonum Ecclesiæ universæ, a Justiniano confirmatus. Christophorus Justellus, J. C. nunc primum restituit, ex Græcis codicibus editis et MSS. collegit et emendavit, Latinum fecit, et notis illustravit. Paris. 1610, 8vo.

tetiæ Paris. 1661, 2 tom. fol. For the other we are indebted to Dr Beveridge, the very learned bishop of St Asaph: " Συνοδικον, sive Pandectæ Canonum SS. Apostolorum, et Conciliorum ab Ecclesia Græca receptorum; nec non canonicarum SS. Patrum Epistolarum: una cum scholiis antiquorum singulis eorum annexis, et scriptis aliis huc spectantibus." Oxonii, 1672, 2 tom. fol. This publication was followed by his " Codex Canonum Ecclesiæ primitivæ vindicatus et illustratus." Lond. 1678, 4to. Nor must we here neglect to mention a very recent work by Professor Biener of Berlin: " De Collectionibus Canonum Ecclesiæ Græcæ Schediasma litterarium." Berolini, 1827, 8vo.

Of the rules or laws received by the Latin church, there were many ancient collections. Dionysius Exiguus, an abbot who flourished about the beginning of the sixth century, formed two different compilations, one of the canons of the church, another of the decretals of the bishop of Rome; and this was the earliest collection of decretals. These were followed by the collections of Fulgentius Ferrandus, who flourished soon afterwards; of Isidorus Hispalensis, who was bishop of Seville from 595 to 636; of Cresconius, who flourished about the year 690; of Isidorus Mercator, otherwise called Peccator, who wrote about the year 800, and is described as " impostor nequissimus;" and of various other compilers, whose labours we have not at present an opportunity of reviewing. Burchardus, who was bishop of Worms from 996 to 1025, formed a compilation of the canon law, described as " Magnum Decretorum Volumen," and divided into twenty books. Ivo Carnotensis, bishop of Chartres from 1092 to 1115, was the author of a similar compilation, which bears the title of *Decretum;* and to him is ascribed another work on the canon law, sometimes called *Pannomia,* and sometimes *Pannormia.* Both these works have been repeatedly printed.

Ivo was followed by Gratian, whose *Decretum* forms the first and most ample part of the *Corpus Juris Canonici.* He was a native of Clusium, or Chiusi, near Florence, and, according to a very improbable account, was the brother of Petrus Lombardus and Petrus Comestor. One of these three individuals was a native of Tuscany, another, as his name denotes, of Lombardy, and the third of France; but, in order to remove the difficulty which arises from this variety in the places of their nativity, some writers do their mother the honour of supposing that her three distinguished sons were the fruit of her unlawful intercourse with three different fathers, at different periods, and in different places. Gratian was a Benedictine monk of the monastery of St Felix and St Nabor at Bologna. His work has long been commonly known by the title of *Decretum,* but is more correctly described as " Decretorum Collectanea;" and it is remarked by the very learned archbishop of Tarragona, that the old manuscripts scarcely ever bear the former title, but generally that of " Concordia discordantium Canonum."[1] According to the usual account, it was compiled in the year 1151: this may indeed have been the period of its completion, but it evidently was not the labour of a single year. Cardinal Bellarmin has endeavoured to reconcile two conflicting authorities, by supposing that Gratian commenced his work in 1127, and completed it in 1151, thus allowing a period of twenty-four years for its composition.[2] The Decretum was presented to his holiness Eugenius III., who is said to have testified his approbation by conferring upon him the bishopric of Chiusi.[3] It never obtained the formal sanction of the pope; but although it is thus to be regarded as the work of a private individual, it speedily secured, and has ever since maintained, a degree of authority which makes a near approach to that which belongs to written law.[4] The principal sources from which his compilation is derived, are the sacred Scriptures, the spurious work described as the Apostolical Canons, the decisions of ecumenical and local councils, the decretal epistles, partly genuine and partly spurious, of seventy-eight Roman pontiffs, the works of the Greek and Latin fathers and other ecclesiastical writers, the Theodosian Code and the *Corpus Juris Civilis,* the capitularies of kings of France and the rescripts of emperors. It is divided into three parts; of which the first and third are subdivided into distinctions, and the second into causes and questions.[5] Gratian, who wrote in an unenlightened age, is chargeable with many errors of ignorance or inadvertence, which the canonists have not scrupled to detect and expose. Augustinus has composed a series of dialogues *De Emendatione Gratiani,* in which the reader will find much learned and curious disquisition; and many other writers, editors as well as commentators, have endeavoured to rectify errors and supply defects. " To the compilations of Isidore and Gratian," says a catholic lawyer, " one of the greatest misfortunes of the church, the claim of the popes to temporal power by divine right, may in some measure be attributed. That a claim so unfounded and so impious, so detrimental to religion, and so hostile to the peace of the world, should have been made, is strange—stranger yet is the success it met with."[6]

The second collection which appears in the body of the canon law is entitled *Decretalium D. Gregorii Papæ IX. Compilatio.* It was formed under the direction and authority of this pontiff, who filled the chair of St Peter from 1227 to 1241. He is himself commended for his skill in jurisprudence, and in the execution of this plan he employed Raymundus de Penyafort, a learned Spaniard, who was afterwards enrolled in the catalogue of saints.[7] The work is divided into five books, and each book into various titles. " Epistolæ decretales" are rescripts of the popes, in answer to prelates or other individuals by whom they have been consulted. They are sometimes called Decretalia, but commonly Decretales, the words Rescripta and Epistolæ being respectively understood. The work however is not strictly conformable to its title; for although the greater part of it is composed of decretals, the compiler has had recourse to various other authorities.

Gregory's decretals are followed by *Liber sextus Decretalium D. Bonifacii Papæ VIII:* which, notwithstanding the general title, is divided into five books. It was intended as supplementary to the other collection, and was compiled under the authority of Boniface, whose pontificate extended from 1294 to 1303. Besides the decretals of Boniface himself, and of preceding popes, ascending

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1 Augustinus de Emendatione Gratiani, p. 3. edit. Baluzii. Paris. 1672, 8vo.
2 Bellarminus de Scriptoribus Ecclesiasticis, p. 187. edit. Colon. 1684, 4to.
3 Pancirolus de claris Legum Interpretibus, p. 317. edit. Hoffmanni. Lipsiæ, 1721, 4to.
4 Mastricht, p 332. Doujat, Histoire du Droit Canonique, p. 92. Paris, 1677, 12mo. Doujat, Prænotionum Canonicarum libri quinque, p. 547. edit. Paris. 1687, 4to.
5 Of the usual method of quoting the Decretum and other portions of the canon law, the reader will find an account in Bishop Hallifax's *Analysis of the Roman Civil Law*, p. 2.
6 Butler's Horæ Juridicæ subsecivæ, p. 170.
7 Antonii Bibliotheca Hispana vetus, tom. ii. p. 67. edit. Bayerii.

to Gregory IX., it includes decrees of the two general councils held at Lyons in 1245 and 1274.

The next work in the series bears the title of *Constitutiones Clementis Papæ V. in Concilio Vienensi editæ,* and is likewise divided into five books. Clement, whose residence was at Avignon, presided in the council of Vienne in the year 1312; and in addition to the constitutions there enacted, his collection comprehends some other constitutions and decretals which he himself divulged before or after the holding of that council. After his death, these *Clementinæ* were promulgated in the year 1317 by his successor John the Twenty-first, otherwise called John the Twenty-second.

Of the same pope, who likewise resided at Avignon, there is a collection of twenty consitutions, which bear the name of *Extravagantes Joannis XXII.* They were so called, because for some time they wandered beyond the limits of the collection which contained the works already enumerated as belonging to the body of the canon law. The next work, which is entitled *Extravagantes Communes,* and is divided into five books, comprehends the constitutions of various popes, concluding with Sixtus IV. whose pontificate extended from 1471 to 1484.

These are all the different compilations which constitute what is denominated the body of the canon law. It may be proper to add that the best edition bears this title: "Corpus Juris Canonici, Gregorii XIII. Pont. Max. jussu editum: a Petro Pithœo et Francisco fratre, Jurisconsultis, ad veteres codices manuscriptos restitutum, et notis illustratum." Parisiis, 1687, 2 tom. fol. Of a more recent as well as more early date, there are many other editions which we cannot here enumerate; and we shall only mention another, which was published by a protestant professor: "Corpus Juris Canonici: Justus Henningius Boehmer, J. C. recensuit, cum codicibus veteribus manuscriptis aliisque editionibus contulit, variantes lectiones adjecit, notis illustravit." Halæ Magdeburg. 1747, 2 tom. 4to.

The Institutes of Jo. Paulus Lancelottus, divided into four books, are inserted in different editions of the Corpus; and this circumstance has led some individuals, superficially acquainted with the subject, to suppose that they form an essential part of the authorized collection. They are however the production of a private lawyer, and having never received the sanction of the pope, they possess no authority beyond that which belongs to the character of the author as an able interpreter of the canon law. This work was undertaken with the approbation of Paul IV.: fifteen years elapsed before its completion; and Lancelottus, having at length submitted it to the papal censors, and lingered two years in Rome, was compelled to abandon the hope of obtaining the sanction of his holiness Pius IV. The book was published in 1563, a few months before the dissolution of the council of Trent. The only favour which the author could obtain was that his Institutes might be added to the Corpus, but without any confirmation of their authority. They are sometimes inserted, and sometimes omitted; nor do they occur in that edition which we have already mentioned as the best. As they do not include the changes and modifications introduced by the council of Trent, they require the aid of a perpetual commentary. The Institutes of Lancelottus are closely modelled upon those of Justinian. His subject does not easily admit of any high degree of classical purity, but the work is at least written with much neatness and perspicuity. The notes of Doujat form a very important addition: they evidently proceed from a man of ability and learning, and are generally composed in a style of pregnant brevity.

The subsequent progress of the canon law, together with the more recent method of expounding it, must be learned from other writers. The most distinguished canonist of the last century was Dr Van Espen, professor of the canon law in the university of Louvain, whose works extend to five volumes in folio. His *Jus Ecclesiasticum universum* Mr Butler has described as "a work which, for depth and extent of research, clearness of method, and perspicuity of style, equals any work of jurisprudence which has issued from the press; but which, in some places, where the author's dreary Jansenism prevails, must be read with disgust."[1] The life of the learned and conscientious author, it may be proper to state, has been elaborately written by Bellegarde."[2] There are other two recent works on the canon law which we must recommend to the student's notice. "Caroli Sebastiani Berardi Commentaria in Jus Ecclesiasticum universum." Venetiis, 1789, 4 tom. 4to. "Joannis Devoti Institutionum Canonicarum libri IV." Florentiæ, 1816–7, 4 tom. 8vo. Neither of these is the earliest edition. Those who have any wish to ascertain how the canon law is now taught by the catholics of Germany, may consult the following works. "Mauri de Schenkl Institutiones Juris Ecclesiastici communis: editio emendata et valde adaucta a Josepho Scheill." Landishuti in Bavaria, 1830, 2 tom. 8vo. "Fundamenta Juris Ecclesiastici Catholicorum: in usus scholasticos conscripsit Jos. Anton. Sauter." Rotwilæ, 1825–6, 2 tom. 8vo. The canon law was ably illustrated by some of the German protestants, particularly by Ziegler, Thomasius, and Böhmer. Such was the reputation enjoyed by the last of these individuals, that difficult and intricate processes were frequently transmitted from Italy, to be decided by the law-faculty of the university of Halle, during the period when Bohmer was dean. Nor is this study neglected by the protestants of our own age. Dr Walter, professor of law in the university of Bonn, is the author of a work, published for the fourth time, under the title of "Lehrbuch des Kirchenrechts aller Christlichen Confessionen." Bonn, 1829, 8vo. And a similar work has more recently been published by Eichhorn of Göttingen, well known for his history of the German law.

While the papal power was yet in its meridian height, this system of jurisprudence could only claim the proper force of law within the papal dominions. It maintained a very powerful and direct influence in every other country which acknowledged the bishop of Rome's supremacy; but its dictates were controlled by the legislative authority, and modified by the practice of the courts, in each of the countries where it found admission. Thus the canon law of France differed in many respects from that of Spain, and the canon law of England from that of Austria. "All the strength," says Sir Matthew Hale, "that either the papal or imperial laws have obtained in this kingdom, is only because they have been received and admitted either by the consent of parliament, and so are part of the statute laws of the kingdom, or else by immemorial usage and custom in some particular cases in courts, and no otherwise, and therefore so far as such laws are received and allowed here, so far they obtain, and no further; and the authority and force they have here is not founded on, or derived from themselves; for so they bind no more with us than our laws bind in Rome or Italy."[3] These remarks, written in protestant times, were equally applicable during the times of popery.

[1] Butler's Horæ Juridicæ subsecivæ, p. 184.

[2] Vie de M. Van Espen, Docteur ès Droits, et Professeur des Saints Canons dans l'Université de Louvain; où l'on trouve des éclaircissemens historiques sur tous les Ecrits ci-devant imprimés de ce Docteur. Louvain, 1767, 8vo.

[3] Hale's Hist. of the Common Law of England, p. 27.

The influence of the canon law in countries which have long abjured the authority of the pope, renders it even there a study of occasional importance to lawyers. "So deep," says Lord Stair, "hath this canon law been rooted, that even where the pope's authority is rejected, yet consideration must be had to these laws, not only as those by which church benefices have been erected and ordered, but as likewise containing many equitable and profitable laws, which, because of their weighty matter, and their being once received, may more fitly be retained than rejected."[1] We cannot refrain from adding, that some knowledge of the canon law, at least of its history and external form, is of no small consequence to those who wish to understand the history and literature of the middle ages. This remark we shall endeavour to confirm by one or two examples. Winton, the venerable prior of Lochleven, after having mentioned the irregular manner in which Walter Danielstoun took possession of the see of St Andrews, subjoins this observation:

Yeit be this electioune
He dyd all ministratioune
In jurisdictioune spirituale,
And in all thingis temporale,
All that quhile, rycht as he
Had had lauchful autorite,
Pretendand ay for his resown
Nichil de electione.[2]

This passage, which to most readers must appear sufficiently obscure, the very accurate and intelligent editor, Macpherson, has left without explanation or conjecture. It bears an allusion to the *Decretales Gregorii IX.* lib. i. tit. vi. cap. xliv. § 2. *Nihil* is the first word of the chapter, and *de electione* denotes the subject of the title, or subdivision of the book. Danielstoun, whose election had not been confirmed by the pope, evidently relied on the authority of the subsequent passage: "Ita quod interim valde remoti, videlicet ultra Italiam constituti, si electi fuerint in concordia, dispensative propter necessitates ecclesiarum et utilitates, in spiritualibus et temporalibus administrent, sic tamen ut de rebus ecclesiasticis nihil penitus alienent."

Sir David Lindsay, another Scottish poet, makes the following allusion to the inordinate pretensions of the pope.

His style at lenth gif thow wald knaw,
Thow moste ga luke the cannon law:
Baith in the Sext and Clementene
His staitlie style thair may be sene.[3]

His editor, Mr George Chalmers, who was guilty of a radical error when he supposed himself to be a man of learning, has subjoined this curious annotation. "The allusion is to the works of Pomponius Sextus, the great jurist of the third century." It is first to be remarked that Pomponius did not flourish in the third, but in the second century;[4] but if this "great jurist," of whom he speaks so familiarly, had actually written in the third century, how could he have illustrated the temporal power and splendour of the pope before Christianity was established in the Roman empire? Manifestly the *Sext* to which Lindsay refers is the "Liber *sextus* Decretalium;" and the other authority the *Clementinæ*, or constitutions of Clement V. (D. I.)

CANONESS, in the Romish Church, a woman who enjoys a prebend, affixed by the foundation to maids without obliging them to renounce the world, or make any vows.

CANONICA, an appellation given by Epicurus to his doctrine of logic. It was called *canonica*, as consisting of a few canons or rules for directing the understanding in the pursuit and knowledge of truth. The *canonica* of Epicurus is represented as a very slight and insufficient logic by several of the ancients, who put a great value on his ethics and physics. Laertius even assures us that the Epicureans rejected logic as a superfluous science; and Plutarch complains that Epicurus made an unskilful and preposterous use of syllogisms. But these censures seem too severe. Epicurus was not averse to the study of logic, but even gave better rules in this art than those philosophers who aimed at no glory but that of being thought logicians. He only seems to have rejected the dialectics of the Stoics, as full of vain subtilties and deceits, and fitted rather for parade and disputation than real use. The stress of Epicurus's *canonica* consists in his doctrine of the criteria of truth. All questions in philosophy are either concerning words or things: concerning things, we seek their truth; concerning words, their signification: things are either natural or moral; and the former are either perceived by sense or by the understanding. Hence, according to Epicurus, arise three criteria of truth, namely, sense, anticipation or prænotion, and passion. The great canon or principle of Epicurus's logic is, that the senses are never deceived; and therefore, that every sensation or perception of an appearance is true.

CANONICAL, something that belongs to, or partakes of, the nature of a rule or canon.

Canonical *Hours* are certain stated times of the day, consigned, more especially by the Romish Church, to the offices of prayer and devotion. Such are *matins*, *lauds*, *sixth* and *ninth vespers*. In our country the canonical hours are from eight to twelve in the forenoon, before or after which marriage cannot be legally performed in any parish church.

Canonical *Obedience* is that submission which, by the ecclesiastical laws, the inferior clergy are bound to pay to their bishops, and other religious orders to their superiors.

Canonical *Sins*, in the ancient church, those which were deemed capital or mortal. Such especially were idolatry, murder, adultery, heresy, and schism.

Canonical *Punishments* are such as the church may inflict; as excommunication, degradation, and penance, &c.

Canonical *Life*, the method or rule of living prescribed by the ancient clergy who lived in community. It was a kind of medium between the monastic and the clerical. Originally the orders of monks and clerks were entirely distinct; but in process of time pious persons instituted colleges of priests and canons, where clerks brought up for the ministry, as well as others already engaged therein, might live under a fixed rule. This was called the *canonical life*, and those who embraced it *canons*. Authors are divided about the founder of the canonical life. Some maintain that it was founded by the apostles; others ascribe it to Pope Urban I. (about 1230), who is said to have ordered bishops to provide such of their clergy as were willing to live in community with necessaries out of the revenues of their churches. It is generally attributed to St Augustin, who instituted a monastery within the episcopal palace. According to Onuphrius Panvinus, Pope Gelasius I., about A.D. 495, placed the first regular canons of St Augustin in the Lateran church.

Canonical *Letters*, in the ancient church, were a sort of testimonials of the orthodox faith, which passed between the bishops and clergy, to keep up the Catholic communion, and distinguish orthodox Christians from Arians and other heretics.

CANONICUM, in the Greek church, a fee paid by the clergy to bishops, archbishops, and metropolitans, for degrees and promotions. Also a due of first fruits paid by the laity to their bishops or priests.

[1] Stair's *Institutions of the Law of Scotland*, b. i., tit. i., § 14.
[2] Wilton's *Cronykil of Scotland*, vol. ii., p. 398.
[3] Lindsay's Works, vol. iii., p. 89.
[4] *Guil. Grotii Vitæ Jurisconsultorum*, p. 150. *Bachii Hist. Jurisprudentiæ Romanæ*, p. 477.

CANONIST, a professor of canon law. Canonists and civilians are usually combined in the same persons; hence the title of *juris utriusque doctor*, or *legum doctor*, expressed in abbreviature, J.U.D. or LL.D.

CANONIZATION, a ceremony in the Romish Church, by which persons deceased are ranked in the catalogue of the saints. This act is preceded by beatification; and after the merits of the individual have been duly tested and approved, the pope decrees the canonization.

The term was not introduced till the twelfth century. The first person who availed himself of it was Udalric, bishop of Constance, in his letter to Pope Calixtus II. relative to the canonization of Bishop Conrad. The act, however, dates from a much more remote antiquity. The ceremony was originally only a commemoration of the martyrs, whose assistance was invoked in the name of the church militant to which they had belonged. Originally bishops decided whether or not the candidate had fairly vindicated his claim to the honour; but they only acted as the organ of public opinion. As soon as the power of Rome was once more upon the ascendant in Europe, the popes naturally appropriated to themselves the important privilege of canonization. None but martyrs were at first admitted into the category of saints, but in course of time the privilege was extended to some of those pious men who, without having sealed their testimony with their blood, had evinced the sincerity of their belief by the purity of their practice. In later times, however, the pope assumed the right of admitting into the sacred catalogue such potentates as had favoured his temporal interests. Notable instances of this are the names of Henry, Emperor of Germany, canonized by Eugene III., and Edward the Confessor, of England, canonized by Alexander III.

So long as the right of according the honours of canonization was vested in the bishops, there was no public guarantee that it had been exercised with rigour or discretion. But when it passed into the hands of the popes, means were taken to prevent any but really meritorious persons from being enrolled in the holy category. Even then, however, a very simple ordeal sufficed. A few pretended miracles happening at a tomb were enough to give its inmate a claim to have his name inscribed in the canon of the mass among the number of the happy. If the honour were conferred on any saint shortly after his death, it was commonly through family interest, or the intrigues of noble relatives. At a later period, when the ceremony was only performed after a considerable lapse of time, reasons were always hard to be found why the saintly candidate should be rejected. In modern times the court of Rome has shown itself extremely averse to promiscuous canonization; and since the days of Benedict XIV., the *advocatus diaboli*, or devil's advocate, has exercised extreme severity in sifting the claims of aspirants. It is further necessary that a period of a hundred years should elapse between the death of the saint and his admission into the calendar. But the more pious men of every country in Europe have of late evinced so little ambition to secure this posthumous compliment, that it may now be considered to have gone fairly out of fashion. Chemical science moreover has within the last century wrought so many miracles, that those of the church have fallen into neglect, if not absolute contempt.

On the day of canonization the pope and cardinals officiate in white; while St Peter's church is illuminated and hung with rich tapestry, upon which the arms of the pope, and of the prince or state requiring the canonization, are embroidered in gold and silver.

CANONRY, the benefice filled by a canon. It differs from a prebend, in that the prebend may subsist without the canonicate, whereas the canonicate is inseparable from the prebend; again, the right of suffrages, and other privileges, are annexed to the canonicate, and not to the prebend.

CANOPUS, a star of the first magnitude, in the rudder of the constellation Argo.

Canōpus, or *Canōbus*, a deity of the ancient Egyptians, and, according to some, the god of water. It is said that the Chaldeans, who worshipped fire, carried their idol through other countries to try its powers. It easily subdued the gods of wood, stone, brass, silver, and gold, and therefore its priests declared that all gods did it homage. But when the Chaldeans brought their god to contend with Canōpus, the priest took a large earthen jar, and bored in it several holes, which he stopped with wax; and then, after painting the vessel of various colours and filling it with water, he fitted the head of an idol to it. The Chaldeans then kindled their fire around the image; but it was speedily extinguished, for the wax melted and the water gushed out. Thus was the god of the Chaldeans vanquished by Canōpus. Jars similar to that we have just noticed are of frequent occurrence on the Egyptian monuments. They are generally ornamented with images and hieroglyphics, and surmounted by the head of some animal or by a human head. They are also found on coins. It is uncertain, however, whether a jar deity was really worshipped at Canōbus. These jars were probably merely symbolical representations of certain divinities, or perhaps of the god Serapis, who was the chief deity of Canōbus.

Canōpus, or *Canōbus*, the pilot of Menelaus, who, on his return from Troy, died in Egypt of the bite of a serpent. A temple was erected in his honour at Canōpus, which derived its name from him.

Canōpus, or *Canōbus*, in *Ancient Geography*, a town of Lower Egypt, on the Mediterranean, a hundred and twenty stadia, or fifteen miles, to the east of Alexandria.

CANOPY, in *Architecture*, a magnificent kind of decoration, serving as a hood or cover above an altar, throne, tribunal, pulpit, &c. The word is formed from κωνωπειον, *a net spread over a bed to keep off the gnats*, from κώνωψ, *a gnat*.

Canopies are also borne over the head in processions. The canopy of an altar is more peculiarly called *ciborium*.

CANOSA. See Canusium.

CANOVA, Antonio, one of the greatest sculptors of modern times, was born on the 1st of November 1757, at Passagno, an obscure village situated amid the recesses of the hills of Asolano, where these form the last undulations of the Venetian Alps, as they subside into the plains of Treviso. At three years of age Canova was deprived of both parents. Their loss, however, was compensated by the tender solicitude and care of his grandfather and grandmother, the latter of whom lived to experience in her turn the kindest personal attention from her grandson, who, when the efforts of successful genius had afforded him the means, gave her an asylum in his house at Rome. The father and grandfather of our artist followed the occupation of stone-cutters; and it is said that their family had for several ages supplied Passagno with members of that profession. As soon as Canova's hand could hold a pencil, he was initiated into the principles of drawing by his affectionate grandfather Pasino, who was acquainted with the subject. He also possessed some knowledge of architecture, designed well, and showed considerable taste in the execution of ornamental works. To his art he was attached with fond partiality; and upon his young charge he looked as one who was designed not only to perpetuate the family name, but also the family profession. The object of his hopes and instructions may be said to have done so; but his works were destined to be known far beyond the period of his life, or the circle of his native hills.

The early years of Canova were passed in study. The

bias of his mind was to sculpture, and the facilities afforded for the gratification of this predilection in the workshop of his grandfather were eagerly improved. In his ninth year he executed two small shrines of Carrara marble, which are still extant. Soon after this period he appears to have been constantly employed under his grandfather. Amongst those who patronized the old man was the patrician family Faliero of Venice, and by this means young Canova was first introduced to the senator of that name, who afterwards became his most zealous patron. Between the younger son, Giuseppe Faliero, and the artist, a friendship commenced, which terminated only with life. From the interest which was excited in this family for Canova, Signor Faliero was induced to receive him under his immediate protection. It has been related by an Italian writer, and since repeated by several biographers, that Canova was indebted to a fortuitous circumstance, the moulding of a lion in butter, for the warm interest which the senator took in his welfare. The anecdote may be true; but it does not appear to rest on authority sufficiently strong to warrant our stating it as authentic. By his kind patron Canova was placed under Bernardi, or, as he is generally called by filiation, Toretto, a sculptor of considerable eminence, who had taken up a temporary residence at Pagnano, a village in the vicinity of the senator's mansion. This took place whilst he was in his thirteenth year; and with Toretto he continued about two years, making in many respects considerable progress. This master returned to Venice, where he soon afterwards died; but by the high terms in which he spoke of his pupil to Faliero, the latter was induced to bring the young artist to Venice, where he accordingly went, and was placed under a nephew of Toretto. With this master he continued about a year, studying with the utmost assiduity. After the termination of this engagement he began to work on his own account, and received from his patron an order for a group on the subject of Orpheus and Eurydice. The first figure, which represents Eurydice in flames and smoke in the act of leaving the infernal realms, was completed towards the close of his sixteenth year. It was highly esteemed by his patron and friends, and the artist was now considered as qualified to appear before a public tribunal. The kindness of some monks supplied him with his first work-shop, which was the vacant cell of a monastery. Here for nearly four years he laboured with the greatest perseverance and industry. He was also regular in his attendance at the academy, where he carried off several prizes. But he did not confine himself to these exercises alone. He resolved to begin where the art itself began, in the study and imitation of nature. From his contemporaries he could learn nothing, for their style was vicious. From their works, therefore, he reverted to living models, as exhibited in every variety of situation. A large portion of his time was also devoted to anatomy, which science was regarded by him as " the secret of the art." He also frequented places of public amusement, where he carefully studied the expressions and attitudes of the performers. Not a day was allowed to pass without his making some visible advances in his profession. He formed a resolution, which was faithfully adhered to for several years, never to close his eyes without producing some design. Whatever was likely to forward his advancement in sculpture, he studied with ardour. On archaiological pursuits he bestowed considerable attention. With ancient and modern history he rendered himself well acquainted, and he also began to acquire several of the continental languages. When we view such industry, inspired and directed by such a genius as that of Canova, it scarcely appears matter of wonder that the result should be a new era in the art.

Three years had now elapsed without any production coming from his chisel. He began, therefore, to complete the group for his patron, and the Orpheus which followed evinced the great advances he had made in his profession. The work was universally applauded, and laid the foundation of his fame. Several groups succeeded this performance, amongst which was that of Dædalus and Icarus, the most celebrated work of his noviciate. The simplicity of style and the faithful imitation of nature which characterized them called forth the warmest admiration. But there was still wanting in his productions that elevation and ideal beauty which he afterwards attained to, and which rather carried nature to its highest perfection than went beyond it. His merits and reputation being now generally recognised, he began to turn his attention from the shores of the Adriatic to the more classic banks of the Tiber, for which he set out at the commencement of his twenty-third year.

Previous to his departure for Rome, his friends had applied to the Venetian senate for a pension, to enable him without embarrassment to pursue his studies. The application was ultimately successful. It amounted to three hundred ducats, about sixty pounds per annum, and was limited to three years. Our artist had obtained letters of introduction to the Venetian ambassador, the Cavaliere Zuliani, an enlightened and generous protector of the arts, and was received in the most gracious and hospitable manner. Canova's arrival in the " eternal city" marks a new era in his life. It was here he was to perfect himself, by a study of the most splendid relics of antiquity, and to put his talents to the severest test by a competition with the greatest living masters of the art. The result was equal to the highest hopes cherished either by himself or by his friends. The work which first established his fame at Rome was Theseus vanquishing the Minotaur. The figures are of the heroic size, that is, larger than life. The victorious Theseus is represented as seated on the lifeless body of the monster. The exhaustion which visibly pervades his whole frame proves the terrible nature of the conflict in which he had been engaged, while at the same time it evinces the genius of the sculptor. Simplicity and purity of natural expression had hitherto characterized his style; but with these were now united more exalted conceptions of grandeur and of truth. By those who were capable of appreciating the beauties of the Theseus, it was regarded with rapturous enthusiasm, as worthy of the best days of sculpture in a land where sculpture was unrivalled; and it formed a noble presage of future glory and yet more splendid achievements.

His next undertaking was a monument in honour of Clement XIV.; but before he proceeded with it, he deemed it necessary to request permission from the Venetian senate, whose servant he considered himself to be, in consideration of the pension. This he solicited in person, and it was granted in the most handsome manner. He returned immediately to Rome, and opened that studio in the Strada Babbuino, which was soon to be one of the proudest boasts of Italy, and to which the ardent devotees of the art from every nation of Europe were to perform pilgrimage. He spent about two years of unremitting toil in arranging the design and composing the models for the tomb of the pontiff. After these were completed, other two years were employed in finishing the monument, and it was finally opened to public inspection in 1787. Expectation had been highly excited, and never was it more amply gratified. The work, in the opinion of the best judges, stamped the author as the first artist of modern times. After five years of incessant labour, he completed another cenotaph to the memory of Clement XIII. of which it is sufficient praise to say, that it raised still higher the fame of

the author. Works came now so rapidly from his chisel, that it will be impossible to enumerate any but the most conspicuous. Amongst those which belong to the period in question is Psyche with a butterfly, which is placed on the left hand, and held by the wings with the right. This beautiful figure, which is intended as a personification of man's immaterial part, is considered as in almost every respect the most faultless and classical of Canova's works. In two different groups, and with opposite expression, the sculptor has represented Cupid with his bride; in the one they are standing, in the other recumbent, and both are of superlative excellence. These and other proofs of lofty genius raised his reputation so high, that the most flattering offers were sent him from the Russian court to induce him to remove to St Petersburg; but these were declined. "Italy," says he, in writing of the occurrence to a friend, "Italy is my country—is the country and native soil of the arts. I cannot leave it; my infancy was nurtured here, and if my poor talents can be useful in any other, they must be of some utility to this; and ought not hers to be preferred to all others?" Genius never appears so truly great as when it is united with a disinterested love of country. In this respect Canova will ever command admiration. The powers of his mind scarcely surpassed the virtues of his heart.

Numerous works were produced during the years 1795-6-7, of which several were repetitions of previous productions. It is only necessary to notice the celebrated group representing the parting of Venus and Adonis. The youth is gazing tenderly upon the goddess. With his left arm he encircles her waist, while his right grasps a hunting spear. She, on the other hand, by the most endearing yet chaste caresses, endeavours to avert his resolution of departing. This famous production was sent to Naples; and, out of respect to the artist, the king ordered every tax which attended its importation to be remitted. As a more substantial mark of approbation, he decorated the sculptor with the insignia of the order of the Two Sicilies. The French revolution was now extending its ravages over Italy; and the pure and peaceful spirit of Canova, shrinking from scenes of contention and blood, sought obscurity and repose in the bosom of his native Passagno. Thither he retired in 1798, and continued about a year, principally employed in the sister art of painting, in which also he was no ordinary proficient. One of his productions in this department of art is a picture representing the dead body of the Saviour just removed from the cross, surrounded by the three Marys, the beloved disciple, Joseph of Arimathea, and, somewhat in the back ground, Nicodemus. Above appears the personification of the Father, with the mystic dove in the centre of a glory, and surrounded by a circle of cherubs. This admirable composition, which was greatly applauded, he presented to the parochial church of his native place. Events in the political world having come to a temporary crisis, he returned to Rome; but his health, from arduous application, having been impaired, he took a journey through a part of Germany, in company with his friend Prince Rezzonica. He returned from his travels much improved, and again commenced his labours with renewed vigour and enthusiasm.

Canova's sculptures have been distributed under three heads: 1. Heroic compositions; 2. Compositions of grace and elegance; and 3. Sepulchral monuments and relievos. In noticing the works which fall under each of these divisions, it will be impossible to maintain a strict chronological order, but perhaps a better idea of his productions may thus be obtained. Their vast number, however, prevents their being all enumerated.

Soon after his return appeared his Perseus with the head of Medusa. The moment of representation is when the hero, flushed with conquest, displays the head of the "snaky Gorgon," whilst the right hand grasps a sword of singular device. By a public decree, this great triumph of art was placed in one of the *stanze* of the Vatican, hitherto reserved only for the most precious works of antiquity. In 1802, at the personal request of Napoleon, Canova repaired to Paris to model a bust of the first consul. The artist was entertained with munificence, and various honours were conferred upon him. The statue, which is colossal, was not finished till six years after. On the fall of the living original, the French king presented this statue to the British government, by whom it was afterwards given to the Duke of Wellington. Palamedes, Creugas, and Damoxenus, the combat of Theseus and the Centaur, and Hercules and Lychas, all displaying great and varied excellence, may close the class of heroic compositions, although the catalogue might be swelled by the enumeration of various others, such as Hector and Ajax, the statues of Washington, Ferdinand, and others. The group of Hercules and Lychas is considered as the most terrible conception of Canova's mind, and in its peculiar style as scarcely to be excelled.

Under the second head, namely, compositions of grace and elegance, the statue of Hebe takes the first place in point of time. Four times has the artist embodied in stone the goddess of youth, and each time with some variation. The only material improvement, however, is the substitution of a support more suitable to the simplicity of the art. The invention merits the title of originality, and the figure in each of the statues is, in all its details, in expression, attitude, elegance, and delicacy of finish, perfect in beauty. The Dancing Nymphs maintain a character similar to that of the Hebe. The Graces and the Venus are more elevated, as combining dignity with elegance. The Awakened Nymph is another work of extraordinary beauty, a term indeed which may be applied to all his productions indiscriminately. The mother of Napoleon, Maria Louisa, to model whom the author made a second journey to Paris in 1810, the Princess Esterhazy, and the muse Polyhymnia, take their place in this class; as do the ideal heads, comprising Corinna, Sappho, Laura, and Beatrice. In these the artist combined reality with fancy; all are representations of celebrated females, and he has endeavoured to realize the glowing descriptions of poesy, or the more veracious traits of history, according to his own refined conceptions of character. Living models supplied the contour and the features, but these were kindled up with the soul of passion and expression by the sculptor's hand. Belonging to this class of composition the most glowing portraiture of female loveliness is the Helen of Troy.

The cenotaphs and funeral monuments fall next to be noticed. Of these the most splendid is the monument to the Arch-Duchess Maria Christina of Austria, consisting of nine figures. It is considered as a *chef-d'œuvre* in this department of art. Besides the two for the Roman pontiffs, already mentioned, there is one for Alfieri, another for Emo, a Venetian admiral, and a small model of a cenotaph for Nelson, besides a great variety of monumental relievos.

The events which marked the life of the artist during the first fifteen years of the period in which he was engaged on the above-mentioned works, are of so little importance as scarcely to merit notice. His mind was entirely absorbed in the labours of his studio, and, with the exception of his two journeys to Paris, one to Vienna, and a few short intervals of absence in Florence and other parts of Italy, he never quitted Rome. In his own words, "his statues were the sole proofs of his civil existence." There was, however, another proof, which modesty forbade him

to mention, an ever active benevolence, especially towards artists. In 1815 he was commissioned by the Pope to superintend the transmission from Paris, of those works of art which had formerly been conveyed there under the direction of Napoleon. By his zeal and exertions, for there were many conflicting interests to reconcile, he adjusted the affair in a manner at once creditable to his judgment and fortunate for his country. In the autumn of this year he gratified a wish he had long entertained, of visiting the British metropolis, where he was graciously received by the prince regent, and honoured with the highest tokens of esteem. He returned to Rome in the beginning of 1816, with the ransomed spoils of his country's genius. Immediately after, he received several marks of distinction: by the hand of the pope himself his name was inscribed in "the golden volume of the capitol," and he received the title of Marquis of Ischia, with an annual pension of 3000 crowns, about L.625.

He now contemplated a great work, a colossal statue of Religion. The model filled Italy with admiration: the marble was procured, and the chisel of the sculptor ready to be applied to it, when the jealousy of churchmen as to the site, or some other cause, deprived the world of the projected work. The mind of Canova was inspired with the warmest sense of devotion, and though foiled in this instance, he resolved to consecrate a shrine to the cause, at once worthy of himself and of the religion to which he was devoted. In his native village he began to make preparations for erecting a temple, which was to contain not only the above statue, but other works of his own; and within its precincts also were to repose the ashes of the founder. Accordingly, in prosecution of this design, he repaired to Passagno in 1819. At a sumptuous entertainment which he gave to his workmen, there occurred an incident which it is impossible to overlook in any life of Canova, however circumscribed. When the festivities of the day had terminated, he requested the shepherdesses and peasant girls of the adjacent hamlets to pass in review before him, and to each he made a present, expending on the occasion about L.400. We need not therefore be surprised, that, a few years afterwards, when the remains of the donor came to be deposited in their last asylum, the grief which the surrounding peasantry evinced was in natural expression so intense and irrepressible, as totally to eclipse all the studied solemnity of more pompous mourning.

After the foundation stone of this edifice had been laid, Canova returned to Rome; but every succeeding autumn he continued to visit Passagno, in order to direct the workmen, and encourage them with pecuniary rewards and medals. In the mean time the vast expenditure exhausted his resources, and compelled him to labour with unceasing assiduity, when age and disease had set their seal upon his frame. During the period which intervened between commencing operations at Passagno, and his decease, he executed or finished some of his most splendid works. Amongst these were the group Mars and Venus, the colossal figure of Pius VI., the Pietà, the St John, the recumbent Magdalen, and others of scarcely inferior excellence. The last performance which issued from his hand was a colossal bust of his friend the Count Cicognava. In May 1822 he paid a visit to Naples, to superintend the construction of wax-moulds for an equestrian statue of Ferdinand. This journey materially injured his health, but he rallied again on his return to Rome. Towards the latter end of the year he paid his annual visit to the place of his birth, when he experienced a relapse. He proceeded to Venice, and expired there on the 13th of October 1822, at the age of sixty-five. The most distinguished funeral honours were paid to his remains, which were deposited in the temple at Passagno on the 25th of the same month.

Canova is allowed to rank above every other master, from the age of Nicholas of Pisa. He renovated the art in Italy, and brought it back to the standard from which it had declined. His style in youth displayed the utmost simplicity; but as he proceeded in his career, he evinced the true poetic feeling which spiritualizes and exalts nature into ideal beauty and grandeur—that power which gives to marble features an expression apparently resulting from the workings of an inherent and active intelligence; in a word, he stamped them with the impress of the soul. His finishing was excessively refined, and he had a method of giving a mellow and soft appearance to the marble, hitherto unattempted. He formed his models of the same size as the work he designed was intended to be, which was, undoubtedly, a great improvement in the art. Of his moral character, a generous and unwearied benevolence formed the most prominent feature. Of the vast fortune realized by his works, the greater part was distributed in acts of this description. To artists in particular, his hand was "open as day to melting charity." He established prizes for them, and endowed all the academies of Rome. The aged and unfortunate were also objects of his peculiar solicitude. His titles were numerous. He was enrolled amongst the nobility of several states, decorated with various orders of knighthood, and associated in the highest professional honours. (See the *Life of Canova* by Memes, one vol.; by Missinini, four vols.; also the *Biografia*, by the Count Cicognava.) (J. F. S.)

CANSO, or CANCEAU, an island, cape, and small fishing bank, on the N.E. coast of Nova Scotia, about forty leagues east by north of Halifax. The island is small, but has a good harbour. The Gut of Canso forms the passage from the Atlantic into the Gulf of St Lawrence, between Cape Breton Island and Nova Scotia. Lat. 45. 20. N. Long 61. W.

CANSTATT, CANSTADT, or KANSTATT, a town of Würtemburg on the Neckar, not far from Stuttgard, at a point where the high roads of the circle converge. Besides the mineral springs for which it is famous, it possesses a fine cathedral, a beautiful town-hall, an educational institute, considerable manufactures of cottons, woollens, and tobacco, and an important transit trade. The adjoining country is remarkably picturesque and fertile. Seelberg, a hill in the vicinity, is upwards of 600 feet in height, and is interesting as well for the numerous mineral springs which issue from it, as for the valuable fossils with which it abounds. The summer theatre, and the pleasure house, are much frequented by the people of Stuttgard, who repair thither in great numbers during the vacation. In the neighbourhood is the princely seat of Rosenstein, formerly known under the name of Kahlenstein. Pop. 5400.

CANT, a quaint, affected style of speaking, either as regards the utterance or the subject itself. The term has been said to be derived from the name of a Cameronian preacher in Scotland, Andrew Cant, who by practice had attained the faculty of preaching in such a tone and dialect as to be understood by none but his own congregation. Since his time, the word has been extended to all affected exclamations and whining unmusical tones, especially in praying and preaching. The more probable derivation of the word, however, is from the Latin *cantare*, to sing; in which sense cant would be synonymous with sing-song.

CANT is also applied to unusual words and phrases affected by particular persons or professions. The difference between *cant* and *technical*, as applied to terms, seems to be, that the former is restricted to those introduced out of folly, affectation, or imposture; and the latter is applied to such as are introduced for the sake of clearness and precision.

CANT also denotes a call for bidders at an auction. Some derive the word, in this sense, from *quantum*, how much; others, from *cantare*, to sing or cry aloud.

CANTABRIA, a district of Hispania Tarraconensis, lying on the south coast of the Bay of Biscay. By the more ancient geographers, the name was applied to the entire country now occupied by the provinces of Asturias, Santander, Biscay, and Guipuzcoa. After the conquest of Spain by the Romans, the name of Cantabria was restricted to what is now the province of Santander and the eastern portion of Asturias. The Cantabrians were the most warlike of all the native Spanish tribes that the Romans had to encounter, and were never finally subdued. Along with the Astures, they offered for many ages a successful resistance to the Roman arms, and were only at last compelled to acknowledge the supremacy of Rome by Augustus. They revolted a few years after, but were cut off nearly to a man by Agrippa, B.C. 19. When their numbers began once more to increase, they again revolted, and were only kept in check by the most vigorous exertions of the emperor Tiberius. Their indomitable spirit is frequently alluded to in the ancient classics; among others, Horace alludes to the "*Cantabrum indoctum juga ferre nostra.*" Cantabria under the Roman empire comprehended five principal tribes,—the Pleitauri, the Varduli, the Autrigones, the Conisci or Concani (who fed on the blood of their horses,—"*lætum equino sanguine Concanum*"), and the Tuisi. There were numerous towns and villages distributed throughout the country, of which the most important was Juliobriga.

CANTABRUM, a large banner used during the time of the Roman emperors, and borne in festive processions.

CANTACUZENUS, JOHANNES, emperor of the East, celebrated as a statesman, general, and historian, was born at Constantinople, of an ancient and opulent family; and, under the reign of the elder Andronicus, he held the high office of Great Domestic. In the disputes that ensued between that emperor and his grandson, Cantacuzenus espoused the cause of the latter; and when Andronicus II., on the abdication of his grandfather, ascended the throne (A.D. 1328), this able minister was intrusted with the supreme administration of affairs, in which capacity he displayed extraordinary vigour and ability. On the death of the emperor in 1341, Cantacuzenus was left regent, and guardian of his son John Palæologus, who was but nine years of age. This trust he continued to discharge with fidelity, till the intrigues of the empress-mother and her faction rendered Cantacuzenus alarmed for his personal safety. Declared a traitor, he had but one resource; and accordingly he assumed the imperial purple in the autumn of 1321. A civil war ensued, which lasted six years, when he admitted John Palæologus as his colleague in the empire; and this union was confirmed by the marriage of Palæologus with the daughter of Cantacuzenus. Suspicions and enmities, however, soon arising, the war broke out again, and continued till John took Constantinople in 1355. A few days after, Cantacuzenus, unwilling to continue the effusion of blood, abdicated his share of the empire, and retired to a monastery, where he assumed the habit of a monk, under the title of Joasophas Christodulus. His wife also retired to a nunnery, and changed her name of *Irene* for that of *Eugenia*. In this retirement he lived till 1411, when he must have been upwards of a hundred years of age. Here he wrote a history of his own life and times, which has been incorporated in the series of the Byzantine historians; and also an apology for the Christian religion against that of Mohammed, under the name of *Christodulus*.

CANTAL, a department in central France, lying between N. Lat. 44. 37. and 45. 26. and between E. Long. 2. 3. and 3. 18: bounded north by the department of Puy-de-Dôme; east by the Haute-Loire and Lozère; south by Aveyron; west by Corrèze and Lot. Area 1950 square miles.

It is formed of the ancient province of Upper Auvergne, and received its name from the Plomb-du-Cantal, the central peak of a bare and rugged chain which traverses the whole department. Near the Plomb, which attains a height of above 6000 feet, are the Col-de-Cabre, and other peaks belonging to the same system. They are evidently of volcanic origin; and volcanic agency may be traced in the strata of lava with which several valleys have been filled up, and which are exposed in the sides of the water courses. The slopes of the higher mountains are steep and bare, and the more elevated valleys thinly peopled. In summer they afford pasture for the flocks and herds which migrate thither from the low countries. Most of the streams of the department have their sources in this central ridge, and fall by a short and rapid course into the rivers which traverse the extensive valleys on either side. The Aragnon, which rises on the east, is a tributary of the Allier; the Celle and Truyère are tributaries of the Lot; the Cère and the Rue, into which the Santoire falls, are tributaries of the Dordogne. The climate of the department varies considerably in the different localities. In the alluvial plain between Murat and St Fleur, and in the S.W. in the arrondissement of Aurillac, the climate is generally mild and dry; but in the northern and central portions the winters are long and severe, and the hurricanes peculiarly violent. The internal resources of the department are considerable; but, from the difficulty of land-carriage over a rough and broken surface, they are prevented from being sufficiently developed. The hills and valleys are stocked with game, and the streams with fish. In the botanical kingdom it produces a vast variety of aromatic and medicinal plants; and its mineral products include coal, copper, lead, iron, antimony, granite, slate, &c.; but of these natural sources of wealth little advantage is taken by the inhabitants. The cold and damp of the climate are insuperable obstacles to the successful cultivation of corn, which has therefore to be imported from the neighbouring departments; but the extent and richness of the pastures render the rearing of cattle and horses for exportation a profitable source of remuneration. Butter and cheese are made in large quantities, and the wool of the district is of a very superior quality. The manufactures of Cantal are inconsiderable, consisting chiefly of coarse woollen and linen stuffs, paper, brazier's work, cooper's work, glass, and leather. The inhabitants are a rude and uncultivated race, accustomed to live on the scantiest fare, and plying the meanest handicrafts for a considerable part of the year in their migrations to Paris and through the provinces. The principal articles of food are rye, buckwheat, and chestnuts.

The department is comprised within the military division of Clermont-Ferrand, and the tribunals hold of the royal court of Riom. It forms the see of a bishop, who is suffragan to the archbishop of Bourges.

The divisions and population of the department are as follows:—

Arrondissements.	Cantons.	Communes.	Pop. (1851).
Aurillac	8	93	96,433
Mauriac	6	57	63,346
Murat	3	34	35,309
Saint Fleur	6	74	58,241
Total	23	258	253,329

CANTARINI, SIMONE, called *Simone da Pesaro*, a celebrated painter and engraver, born at Pesaro in 1612. He was a disciple of Guido, and a fellow student of Domenichino and Albano. The irritability of his temper was extreme; and it is said that his death, which took place at Verona in 1648, was occasioned by chagrin at his failure in a portrait of the Duke of Mantua. Others relate that he was poisoned by a Mantuan painter whom he had injured. His pictures, though masterly and spirited, are deficient in originality. Some of his works have even been mistaken for those of Guido.

CANTEMIR, DEMETRIUS, son of a prince of Moldavia, born in 1673; died in 1723. Disappointed in not succeed-

ing his father in that dignity, which was held under the Ottoman Porte, he went over with his army to the Czar Peter, against whom he had been sent by the Grand Signior. He signalized himself in the czar's service, and wrote in Latin a History of the Growth and Decay of the Ottoman Empire, which has been translated into almost every language in Europe. This once popular work is now known to be taken principally from an inaccurate abridgment and continuation of Saad-ed-deen's great Turkish history. (See *Journal Asiatique*, anno 1824, tom. iv.)

Cantemir, *Antiochus*, the father of Russian poetry, was the youngest son of the preceding, and was born in 1700. Under the ablest professors, whom the czar had invited to Petersburg, he studied mathematics, physics, history, moral philosophy, and polite literature. After completing his academic course, he published in the Russian language a Concordance to the Psalms, and was elected a member of the academy. When only twenty-four years of age he was nominated as minister to the court of Great Britain; and here, as well as in France, whither he went in 1738 as minister plenipotentiary, he was equally admired as a statesman and a man of letters. Subsequently he was ambassador-extraordinary at the courts of Britain and France successively. His wise and prudent conduct in relation to the different revolutions which agitated Russia during his absence, procured him the confidence and esteem of three successive princes. This accomplished man died at Paris in 1744, at the age of forty-four. Besides a Russian translation of Anacreon and the Epistles of Horace, he wrote original satires, odes, and fables, and translated Fontenelle's *Plurality of Worlds*, and Algarotti's *Dialogues on Light and Colours*. The Abbé Guasco has written his life in French, and translated his satires into that language.

CANTERBURY, a municipal and parliamentary borough in the county of Kent, 55 miles S.E. from London, or 81 miles by the South-Eastern railway. N. Lat. 51. 17., E. Long. 1. 4. It is situated on the river Stour, but its trade is carried on through the small port of Whitstable in Herne Bay, with which it communicates by rail. The municipal corporation consists of 6 aldermen, one of whom is mayor, and 18 councillors. By a very ancient statute, it is entitled to return two members to parliament. In a commercial point of view, Canterbury is a town of little importance. Its inhabitants are principally engaged in the corn, wool, and hop trades. The mills in the neighbourhood are driven by water-power derived from the river. The manufacture of silk was introduced here by the French refugees, to whom Queen Elizabeth granted the use of the cathedral crypt; but, as in other places of the empire, it became extinct with the original colony which had projected it. Recent improvements have rendered Canterbury a very desirable place of residence, and in the vicinity are several handsome villas and gentlemen's seats. Its principal modern public buildings are the corn-exchange, philosophical museum, and town-hall. It contains some mineral springs which are highly valuable for their medicinal properties. Pop. (1851) 18,398.

Ecclesiastical Antiquities.—The most famous is the cathedral, the foundation of which is said to have been laid in the time of Augustine, when that monk was sent by Gregory I. to convert the Angles, although the present building cannot be traced beyond the twelfth century. Since the date of its foundation it has suffered severely, at first from the fires of the Danish invaders, and at other times from accidental conflagrations; but from the zeal of its archbishops (amongst whom Lanfranc and Anselm are most conspicuous), and the treasures which it amassed from the crowds of pilgrims who resorted to it, it quickly recovered from its disasters. From the frequency of these repairs arises the motley character of its architecture. The cathedral is built in the form of a double cross, and has an extreme length of above 500 feet. The most remarkable objects are the great Bell Harry tower, and Becket's crown which forms the eastern part. The crypts, which are of immense size, contain the remains of several ancient paintings; and the monuments of Henry IV., Edward the Black Prince, &c., are of the most magnificent description. After the canonization of Thomas à Becket, who was assassinated beside the altar by the emissaries of Henry II., the shrine was visited, and the cathedral gifted with a small endowment by Louis VII. of France, and it was enriched by costly presents from the nobility and ecclesiastics of both nations. Mercery Lane, the name still given to the principal approach to the cathedral, shows that traffic was not forgotten by the pious visitors. The treasures of the cathedral were confiscated by Henry VIII., and fresh exactions were levied from it in the time of Edward VI. It was partly demolished during the parliamentary contests, and it is only in recent times that it has been thoroughly repaired.

Next to the cathedral in importance are the remains of the monastery of St Augustine, by whom it is said to have been founded. The greater part of it was destroyed by fire at the same time with the cathedral; and since the Reformation the remaining portion has been occupied successively as a royal palace, a private residence, and a public brewery. The old edifice has been recently restored and constituted by royal charter into a missionary college in connection with the establishment.

Of the churches of Canterbury the most ancient is that of St Martin in the suburbs. It is partly built of Roman and Norman remains, and has been carefully repaired. In the vaults of the Roper family, underneath St Dunstan's church, the head of Sir Thomas More was deposited after it had been exposed on Temple-Bar. The churches of Saint Mary Magdalen and St Mildred are also edifices of considerable antiquity. Of the numerous hospitals and alms-houses which once existed in the neighbourhood, scarcely any trace can be found.

Canterbury is a town of great antiquity, and held an important place both during the Roman occupation and under the Saxon heptarchy. Its Roman name was Durovernum, part of which is a corruption of the British *dwr*, and seems to refer to the Stour. It was the capital of Kent, and the residence of King Ethelbert, when Augustine landed on the island. Of its walls and gates the ruins have long since disappeared.

The archbishop of Canterbury is primate of all England and metropolitan. The jurisdiction of the ecclesiastical province comprehends the dioceses of Canterbury, Bangor, Bath and Wells, Bristol, Chichester, Ely, Exeter, Gloucester and Bristol, Hereford, Lichfield, Lincoln, Llandaff, London, Norwich, Oxford, Peterborough, Rochester, St Asaph, St David's, Salisbury, Winchester, and Worcester. Present value of income, L.15,000. The succession of archbishops has been as follows; the dates give the year of appointment.

A.D.		A.D.	
596.	St Augustine.	793.	Athelard.
611.	St Lawrence.	806.	Wilfred.
617.	St Miletus.	832.	Syred (died before consecration).
624.	St Justus.		Theologild.
655.	St Adeodatus.		Ceolnoth.
	Vacant four years.	871.	Athelred.
664.	Wigard (died before consecration).	889.	Plegmund.
	Adrian (declined).	915.	Athelm or Adelmus.
668.	Theodore.	934.	Wulfelm.
692.	Birthwald.	934.	Odo Severus.
732.	Tatwine.	959.	St Dunstan.
736.	Nothelmus.	988.	Ethelgarus.
742.	Cuthbert.	989.	Siricius.
759.	Bregwin.	993.	Alfric.
764.	Lambert or Jeambert.	1006.	St Elphege.

Canterus || Canticles.

A.D.	
1013.	Leovingus or Elstan.
1020.	Agelnoth.
1038.	St Eadsine.
1050.	Robert Gemeticensis.
1052.	Stigand, deposed for simony.
1070.	St Lanfranc.
	Vacant four years.
1093.	St Anselm.
	Vacant five years.
1114	Ralph or Rodolphus.
1122.	William Corbois.
	Vacant two years.
1138.	Theobald.
	Vacant two years.
1162.	St Thomas à Becket, assassinated.
1171.	Richard, prior of Dover.
1184.	Baldwin, died in the Crusades.
1191.	Reginald Fitz-Joceline.
	Vacant two years.
1193.	Hubert Walter.
	John Grey, set aside by the Pope.
1206.	Stephen Langton.
	Walter de Hempsham, set aside.
1229.	Richard Weathershed.
	Ralph Nevil and Richard Blundy, set aside.
1234.	Edmund.
1244.	Boniface of Savoy.
	William Chillenden, set aside.
1272.	Robert Kilwarby.
	Robert Burnel, set aside.
1278.	John Peckham.
1293.	Robert Winchesley.
	Thomas Cobham, not confirmed.
1313.	Walter Reynolds.
1327.	Simon Maphan.
1333.	John de Stratford.
1348.	John de Ufford.
1349.	Thomas Bredewardin.
	Simon Islip.

A.D.	
	William Edington, declined.
1366.	Simon Langham.
1369.	William Whittesley.
1375.	Simon de Sudbury, beheaded.
1381.	William Courtenay.
1396.	Thomas Fitz-Alan, fled when charged with treason, but restored.
1414.	Henry Chicheley.
1443.	John Stafford.
1452.	John Kemp.
1454.	Thomas Bourchier.
1486.	John Morton.
1501.	Thomas Langton.
	Henry Deane.
1504.	William Warham.
1553.	Thomas Cranmer, martyred.
1556.	Reginald Pole.
1559.	Matthew Parker.
1575.	Edmund Grindall.
1583.	John Whitgift.
1604.	Richard Bancroft.
1611.	George Abbot.
1633.	William Laud, beheaded.
	Vacant sixteen years.
1660.	William Juxon.
1663.	Gilbert Sheldon.
1678.	William Sancroft, deprived.
1691.	John Tillotson.
1694.	Thomas Tenison.
1716.	William Wake.
1737.	John Potter.
1747.	Thomas Herring.
1757.	Matthew Hutton.
1758.	Thomas Secker.
1768.	Hon. Frederick Cornwallis.
1783.	John Moore.
1805.	Charles Manners Sutton.
1828.	William Howley.
1848.	John Bird Sumner, the present archbishop.

(Haydyn's *Book of Dignities.*)

CANTERUS, William, an eminent linguist and philologer, born at Utrecht in 1541. He studied at Louvain and Paris under Valerius and Aratus, and, after visiting the German and Italian universities, retired to Louvain, where he died in 1575. He was familiar with Latin, Greek, Hebrew, French, Italian, and German literature, and published several works, which deserve notice as almost the earliest specimen of scientific criticism and philosophy. These are, *Novæ Lectiones*, 8vo, Basle, 1564; *Aristidis Orationes*, fol., Basle, 1566; *Nota, scholia, emendationes, et explicationes in Euripidem, Sophoclem, Æschylum, Ciceronem, &c.* (See his Life, in Melchior Adam's Collection.) His brother Theodore (born 1545, died 1617), was also a scholar and critic of some eminence. His critical works are published in Gruter's *Thesaurus Criticus*.

CANTHARIDES (κανθαρίς), or Spanish flies, are used as the common vesicatory or blistering-plaster. The largest are found in Italy, but the best come from Spain. See Entomology.

CANTICLES, or Song of Solomon, one of the books of the Old Testament, is placed in our modern collection immediately before the prophetical books, but generally stands fourth in the *Hagiography* of the Jews. There is no other inspired book concerning which (at least in modern times) so great diversity of opinion has existed; and the points of attack have been severally its canonicity, its authorship, its structure, and its interpretation. In regard to the first of these, the denial of its canonicity, this has been based more on æsthetical than on historico-critical considerations, although some writers (such as Whiston, and Dr Pye Smith) have attempted to show that, because it cannot hold a place in any of the groups into which the catalogue of Josephus is divided, it is therefore to be regarded with great suspicion. This is an opinion which has been generally abandoned by modern critics. It is utterly untenable when weighed against the fact of its existence in all the MSS., in all the detailed catalogues which have come down to us, in the Septuagint, and the versions of Symmachus and Aquila. The denial of its authorship by Solomon is a fundamental principle of that school of criticism which denies the unity, and consequently the single authorship, of all the great poems of antiquity. In this respect it has only shared the fate of the Iliad and Odyssey. With endless variety in the details, the critics of this class all agree in regarding it as a collection of songs by different authors, compiled and edited by a later hand. To what an extent this disintegrating criticism has been carried, may be seen from the scheme of Magnus (*Kritische Bearbeitung und Erklärung des Hohen Liedes*, 1842), who detects in Canticles no fewer than forty-four different parts, complete and fragmentary, early and late, glossarial and spurious. This is justly regarded by most later critics as inconsistent with the sameness that prevails throughout the whole collection. The sameness of the subject, of the recurring formulæ, of the Aramaic colouring and idiom, and of the personages introduced, all combine to mark the Song of Songs, like the holy of holies, as an individual *unity*. In regard to its author, the unvarying testimony of tradition is decisive in favour of Solomon, and there are many things in the style of the book to sanction this view. The wide circle of its imagery, drawn from the most remote localities, if not also the freshness and vigour of its style, point to an age anterior to the dismemberment of the kingdom; at the same time that the allusions to foreign equipages (i. 9), and the introduction of foreign words (iv. 13, iii. 9), strikingly coincide with Solomon's *penchant* for exotic grandeur. In regard to the structure of the book, critics have more widely differed. Bossuet regards it as a pastoral eclogue, divided into plots of seven days, commensurate with the celebration of a marriage-feast; Eichhorn divides it into a number of detached but systematized idyls; Ewald into a drama of four, Delitzsch of six, acts; while others split it into sections and subsections, on an endless variety of principles. The difficulty attaching to all the schemes is that they are too artificial. Any of them may, none of them must, be true; but the dramatic and semi-dramatic theories are inconsistent with the entire absence of any progress in the plot. With all the change of scenery there is no change of the relations subsisting between the parties who are introduced in each successive scene. The more probable solution appears to be, that it is entirely destitute of any plan, and that, as it aims simply at placing the love of the king and his bride in a variety of aspects, it is consistent with such abrupt transitions as may easily be mistaken for the commencement of separate acts.

The interpretation of the Canticles is the point at once the most important, and, within certain limits, the most keenly contested. Disregarding the questions that have been raised in regard to the origin of the poem, we may divide the various methods of interpretation into the three great classes of literal, typical, and allegorical. Those who interpret it literally, still regarding it as Solomon's, hold it to be an erotic poem, the heroine of which is either Pharaoh's daughter or a simple country maiden introduced into his court. Others, who regard it as a collection of detached songs or idyls, find in them the loving converse of a chaste pair, either before or after marriage. Of this class, some hold it to be utterly destitute of a moral at all; others recognise in it an ethical value, as commending monogamy, or as setting forth the beauty of conjugal fidelity in the faithfulness of Shulamith. On any of these hypotheses it seems impossible to account for or vindicate the placing of Canticles in the canon of

Scripture. Its language—which is, however, far more delicate in the Hebrew than in any European dress—might be used in the harem as well as at the hearth, and it is as void of any reference to the religious import and religious duties of marriage or monogamy as are the odes of Hafiz or Anacreon. The typical interpretation stands half-way between the literal and allegorical. It regards the primary aim of the Canticles as being a celebration of Solomon's marriage with his one favourite wife, at the same time that the parties described are raised to the rank of ideals or types of the marriage union, which has its antitype in the union of Christ and the church. This mode of interpretation, although—by investing the composition with a higher ethical meaning—it rises from the degradation of the literal, and approaches indefinitely near the higher spiritual signification, yet is unfortunate in having to bear the burdens of both without the advantages of either scheme. By those who have held the allegorical view various solutions have been given, most of them more remarkable for their ingenuity than their verisimilitude. One theory regards it as a delineation of the fortunes of Israel at various epochs of their history; another as marking the relation of the Jewish church to Christ, before and after his advent; and a third as illustrating the betrothal of Japhetic and Hametic heathendom to the Saviour.

But the interpretation which has been sanctioned by the concurrent testimony of Jewish and Christian antiquity is that which regards it as an allegory descriptive of the love of Jehovah to Israel, of Christ to his church. The arguments in favour of this view are derived from the inconsistencies that defy any literal interpretation; the intimations of collective plurality in that of which the bride is the representation (i. 4, i. 9, iii. 6, &c.); and the prominence given to the fundamental figure of the conjugal relation of Jehovah to the church in the Old, and in some passages of the New Testament. It remarkably corroborates this view, that the same idea is seen to colour the denunciations of all the posterior prophets, who freely borrow the language applicable to a violation of the seventh in order to designate a breach of the second commandment. This is the view which has prevailed almost universally in the synagogue and in the church till within a very recent period. It does not seem to have been challenged till the sixth century, when the literal interpretation formed a count in the condemnation of Theodore of Mopsuestia; and though Jerome approves of what seems to have been the Jewish rule in his day, which forbade all below thirty years of age to read it, this scrupulous jealousy was accompanied by no suspicions of the truth of its spiritual meaning. From Theodore in the sixth to Castellio in the sixteenth century, the literal interpretation had no advocate; and when first brought forward it was everywhere rejected as sacrilegious. From the period of the Reformation it again lay quiescent till revived in Germany by the Rationalists of last century, among whom it has since held undisputed sway. The most recent interpreters, however, in that country—Delitzsch, Hahn, and Hengstenberg—seem to be retracing their steps, through the typical and semi-allegorical, back to the ancient allegorical interpretation. (R. W—N.)

CANTILEVER, or Cantaliver, a support projecting from the front or the side of a building to sustain the eaves, mouldings, &c. The word is perhaps derived from *canterii labrum*, the lip of a rafter.

CANTIUM, in *Ancient Geography*, the name of a district in Britain, nearly corresponding with the county of Kent. The inhabitants, *Cantii*, were noted for being considerably in advance of the rest of the Britons in civilization.

CANTO (Italian *canto*, a song), a part or division of a poem, answering to what in prose is called a *book*.

CANTO-FERMO (literally *firm song*), in *Music*, the subject song. This term is applied by the Italians to every part that is the subject of counterpoint, whether plain or figured.

CANTON, a small district or portion of territory constituting a distinct state or government, as in Switzerland.

Canton, a large and populous commercial city of China, in the province of Quang-tong, situated on the eastern bank of the Pekiang river, which at Canton is somewhat broader than the Thames at London Bridge, and is navigable 300 miles farther into the interior. It has an additional course of 80 miles to the sea, near its junction with which it takes among foreigners the name of Bocca Tigris, or the mouth of the Tigris, from the appearance of one of the islands at its entrance. When viewed from the hills on the north, Canton appears to be little more than an expanse of reddish roofs relieved by a few large trees; two pagodas shooting up within the walls, and a five-storied tower near the northern gate, being the most conspicuous objects. These hills rise 1200 feet above the river. Little or no vegetation is seen on them; and their acclivities, covered for miles with graves and tombs, serve as the necropolis of this vast city. Three or four forts are built on the points nearest the northern walls. In the river opposite Canton is the suburb and island of Honam. The part of Canton inclosed by walls is about six miles in circumference, and has a partition wall, running east and west, and dividing the city into two unequal parts. The northern and larger division is called the old, and the southern the new city. Including the suburbs, the city has a circuit of nearly ten miles. The houses stretch along the river for four miles, and the banks are everywhere nearly concealed by boats and rafts. The walls of the city are of brick, on a foundation of sandstone, and are 20 feet thick, and from 25 to 40 feet high. There is an esplanade on the inside, with pathways leading to the rampart on three sides. The walls were formerly surrounded by a ditch, which is now dry on the northern side, but on the other three, and within the city, it and most of the canals are filled by the tide, and present a revolting mass of filth when the retiring waters expose the bottoms. There are twelve outer gates—four in the partition wall, and two water gates, through which boats pass from east to west across the new city. The gates are all shut at night, and a guard is constantly stationed at them to preserve order. The streets, amounting in all to upwards of 600, are long, straight, and very narrow, paved with little round stones, and flagged at the sides of the houses. They are not so dirty as those of some of the other cities in the empire; and considering the habits of the people and the inattention of government to these matters, it may be said to be a well-governed and comparatively cleanly city. The houses are in general small, seldom consisting of more than two stories, the lower story serving as a shop in which goods are exhibited for sale, and the rest of the house, with the court behind, being used as a warehouse. Particular streets are allotted for the supply of strangers; others to particular classes of artizans. The principal street appropriated to Europeans is denominated China Street. Here are to be found the productions of every quarter of the globe; and the merchants are in general extremely attentive and civil. The Chinese are remarkably expert men of business, and of the most assiduous habits. They are always to be seen sitting on their counters, and using every effort to attract the attention of the British seamen who are in the habit of frequenting this quarter of Canton. They have an English name painted on the outside of their shops, besides a number of advertisements composed for them by the sailors in their peculiar idiom. They contrive in this manner to draw the seamen into their shops, and occasionally to impose upon them by their specious manners and command of temper. The temples and public buildings of Canton are numerous; but none of them present features worthy of special remark

There are two pagodas near the west gate of the old city, and 124 temples, pavilions, halls, and other religious edifices within the city. One of the pagodas called the *Kwang-tah*, or plain pagoda, was erected by the Mohammedans about ten centuries ago, and rises in an angular tapering tower to the height of 160 feet. The other is an octagonal pagoda of 9 stories, 170 feet in height, and was first erected more than thirteen centuries ago. A Buddhist temple at Honam, opposite the foreign factories, and usually known as the Honam Josshouse, is one of the largest in Canton. Its grounds cover about seven acres, surrounded by a wall, and divided into courts, garden-spots, and a burial-ground, where are deposited the ashes of priests, whose bodies are burned. There are about 175 priests connected with this establishment, of whom only a small number can read. Besides the Honam temple, there are two others in the old city, belonging to the Buddhists, both of which are likewise well endowed. The number of priests and nuns in Canton is not exactly known, but they probably exceed 2000, nine-tenths of whom are Buddhists. The temples are gloomy-looking edifices. The areas in front of them are usually occupied by hucksters, beggars, and idlers, who are occasionally driven off to make room for the mat-sheds in which the theatrical performances got up by the priests are acted. The principal hall where the idol sits enshrined is lighted only in front, and the inner apartments are inhabited by a class of men almost as senseless as the idols they serve.

The residences of the high officers of government are all within the walls, some in the Old, and some in the New City. The residence of the governor-general is in the S.W. corner of the New City, and comprises a large number of buildings for the accommodation of himself and attendants. The collector of customs resides eastward of the governor-general. The residence of the commander-in-chief is in the Old City, and said to be one of the best houses in Canton. There are four prisons in the city, all large edifices. The factories of the different European powers trading here extend a considerable distance along the banks of the river, fronting the city at about a hundred yards from the water. They consist of large and handsome houses, on which are hoisted the respective flags of the different nations. By the Chinese these factories are called *hongs;* they resemble long courts without a thoroughfare, and generally contain four or five separate houses. They are built on a fine quay; and a broad parade extends along the river in front of the factories, whither the European merchants, and commanders and officers of ships, resort to enjoy the cool of the evening. The British factory far surpasses all others in elegance and extent. It has a large verandah, reaching nearly down to the water's edge, raised on handsome pillars, and paved with marble, and commanding an extensive view along the river banks. There are spacious warehouses in the neighbourhood for the reception of goods, as well as Chinese dwellings, which are let to merchants who visit Canton. For the space of four or five miles opposite Canton boats and vessels are ranged parallel to to each other in such close order that it resembles a floating city; and these marine dwellings are occupied by numerous families, who reside almost constantly on the water. In the middle of the river lie the Chinese junks, which trade to the eastern islands and Batavia, and which are moored head and stern, some of them of the burden of 600, and even of 1000 tons. The various guilds and associations among the people and the merchants from other provinces have each public halls for their own particular use. The number of these buildings is not less than 150. Canton was long the only, and is still the principal seat of the British trade with China. As a place of traffic, it labours under the great disadvantage that from the shallowness of the river most of the vessels cannot ascend farther than about eight miles from the city, and every British merchant-man is obliged to anchor at Whampoa, nine miles from the city; whereas at Shanghae ships can anchor close to the English wharfs. The trade of Canton is retrograding, while that of Shanghae is increasing; and indeed it is not unlikely that the latter will in time supplant Canton in the European trade, as it enjoys the additional advantage of being nearer the tea districts. Canton was no doubt fixed upon by the Chinese government for the European trade, as being the most distant from the capital Pekin.

Formerly only a limited number of merchants, called the hong or security merchants, were allowed to trade with foreigners. They were commonly men of large property, and were famed for integrity in their transactions. All foreign cargoes passed through the hands of these merchants, and by them also the return cargoes were furnished. They became security for the payment of duties, and it was treason for any other merchant to engage in the trade with foreigners. This severe law, however, has recently been abolished, and foreigners may now deal with any merchant they think fit to employ.

Accounts are kept in *tales, mace, candarines,* and *cash;*—ten cash being one candarine, ten candarines one mace, ten mace one tale, which last is converted into English money at 6s. 8d., though it is intrinsically worth only 6s. The coin called cash is of base metal, cast, not coined, and very brittle. It is of small value, and varies in the market from 750 to 1000 cash for a tale. Its chief use is in making small payments among the lower classes. Spanish and other silver coins are current, and are estimated by their weight; every merchant carrying scales and weights with him. All the dollars that pass through the hands of the hong merchants bear their stamp; and when they lose their weight in the course of circulation they are cut in pieces for small change. The duties are paid to government in sycee, or pure silver, which is taken by weight. In delivering a cargo, English weights and scales are used, which are afterwards reduced to Chinese catties and peculs. A pecul weighs 133⅓ pounds avoirdupois, and a catty 1⅓ pound. Gold and silver are also weighed by the tale and catty, 100 tales being reckoned equal to 120 ounces 16 pennyweights troy. All goods are sold by weight in China—even articles of food, such as fowls, hogs, and the like.

The foreign trade of Canton is very extensive; but the great article of export is tea, for which the demand in Europe has been increasing for upwards of a century. This article was formerly monopolized by the East India Company; and from their accounts it appears that they imported annually into this country about thirty millions of pounds. But this monopoly was abolished in 1834, and the commerce with China was thrown open to all classes of his majesty's subjects. The other exports are raw silk and silk manufactures, nankeen cloth, cassia, lignea, &c. The principal imports from the United Kingdom are cotton and woollen goods, earthenware, iron, steel, &c. In 1848, 176 British vessels of 73,975 tons, with goods of the value of 8,653,033 dollars left, and 171 of 72,315 tons, with goods to the value of 6,534,597 dollars, entered the port of Canton. The Americans, French, and Dutch, also carry on a considerable trade with Canton.

Although situated in the same parallel of latitude as Calcutta, the climate of Canton is much cooler, and is considered superior to that of most places situated between the tropics. The thermometer, during the months of July and August, averages from 80° to 88°; and in January and February from 50° to 60°. The highest recorded observation in 1831 was 94° in July, and the lowest 29° in January. In shallow vessels, ice sometimes forms at Canton a line or two in thickness. A fall of snow, nearly two inches deep, occurred at Canton in February 1835, and remained on the ground three hours,—a circumstance so unusual that the citizens hardly knew its proper name. Fogs are common during February

and March. Most of the rain falls during May and June, but it is nothing in comparison of a rainy season in Calcutta. July, August, and September, are the regular monsoon months, the wind coming from the S.W., with frequent showers, which allay the heat. In the succeeding months the northerly winds commence with some interruptions at first, but from October to January the temperature is agreeable, the sky clear, and the air invigorating. Few large cities are more healthy than Canton; no epidemics nor malaria prevail there, though much of the town is built upon piles.

Provisions and refreshments of all sorts are abundant at Canton, and in general are excellent in quality and moderate in price. It is a singular fact, that the Chinese make no use of milk, either in its natural state, or in the form of butter or cheese. Among the delicacies of a Chinese market are to be seen horse-flesh, dogs, cats, hawks, owls, and edible birds'-nests. The business at Canton is generally transacted in a jargon of broken English, the Chinese being extremely ready in acquiring such a smattering of English words as to render themselves intelligible; and the lower classes of them are frequently hired as servants by the Europeans.

The intercourse between China and Europe by the way of the Cape of Good Hope began in 1517, when Emanuel, king of Portugal, sent a fleet of eight ships, with an ambassador, who was conveyed to Pekin, and who obtained the sanction of the emperor to establish a trade at Canton. It was in 1596, in the reign of Queen Elizabeth, that the English first attempted with two ships to open an intercourse with China; but they were lost in the outward voyage. About 1634 several English ships visited Canton; but a misunderstanding having occurred with the Chinese authorities by the treachery of the Portuguese, a rupture and a battle took place, and it was with difficulty that this misunderstanding was rectified. China was again visited in 1673 by an English ship that was refused admission into Japan. In 1677 a factory was established at Amoy; but in 1680 the factory was destroyed by an irruption of the Tartars, and it was not till 1685 that the emperor permitted any trade with the Europeans. Upon the union of the two East India Companies in London, an imperial edict was issued, restricting the European commerce to the port of Canton. Tea was first imported about the year 1667. This is one of the five Chinese ports opened to Europeans by the treaty of 1842. See CHINA.

CANTON, *John*, an ingenious natural philosopher, born at Stroud in Gloucestershire, in 1718. Among those with whom he became acquainted in early life was Dr Henry Miles of Tooting, a member of the Royal Society, and of approved eminence in natural science and philosophy. This gentleman perceiving that Mr Canton possessed abilities too promising to be confined within the narrow limits of a country town, prevailed on his father to permit him to go to London. Accordingly he arrived at the metropolis in March 1737, and resided with Dr Miles at Tooting till the 6th of May following, when he articled himself for the term of five years as a clerk to Mr Samuel Watkins, master of the academy in Spital Square. In this situation, his ingenuity, diligence, and conduct were so conspicuous, that on the expiration of his clerkship in May 1742 he was taken into partnership with Mr Watkins for three years. He afterwards succeeded that gentleman in Spital Square, and there continued during the remainder of his life. In 1744 he married Penelope, the eldest daughter of Mr Thomas Colbrooke.

Towards the end of 1745, electricity, which seems early to have engaged Canton's notice, received a very important improvement by the discovery of the Leyden phial. This event turned the thoughts of most of the philosophers of Europe to that branch of natural philosophy; and Canton, who was one of the first to repeat and to pursue the experiment, found his assiduity and attention rewarded by many valuable discoveries. Towards the end of 1749 he was concerned with his friend Benjamin Robins in making experiments in order to determine to what height rockets may be made to ascend, and at what distance their light may be seen. In 1750 was read at the Royal Society Canton's "Method of making Artificial Magnets, without the use of, and yet far superior to, any natural ones." This paper procured him the honour of being elected a member of the society, and the award of their gold medal. The same year he was complimented with the degree of M. A. by the University of Aberdeen; and in 1751 was chosen one of the council of the Royal Society.

In 1752 Canton was so fortunate as to be the first person in England who, by attracting the electric fire from the clouds during a thunder-storm, verified Dr Franklin's hypothesis of the identity of lightning and electricity. Next year his paper entitled "Electrical Experiments, with an attempt to account for their several phenomena," was read at the Royal Society. In the same paper he mentioned his having discovered, by a great number of experiments, that some clouds were in a positive, and some in a negative, state of electricity. Dr Franklin, much about the same time, made a similar discovery in America. This circumstance, together with Canton's constant defence of the doctor's hypothesis, induced that philosopher immediately on his arrival in England to pay him a visit, and gave rise to a friendship which ever afterwards continued without interruption. In the Lady's Diary for 1756, Canton answered the prize question that had been proposed in the preceding year. The question was, "How can what we call the shooting of stars be best accounted for; what is the substance of this phenomenon; and in what state of the atmosphere doth it most frequently show itself?" and the solution, though anonymous, proved so satisfactory to his friend Mr Thomas Simpson, who then conducted that work, that he sent Canton the prize, accompanied with a note, in which he said he was sure that he was not mistaken in the author of it, as no one besides, that he knew of, could have answered the question. Canton's next communication to the public was a letter in the *Gentleman's Magazine* for September 1759, on the electrical properties of the tourmalin, in which the peculiarities of that stone are stated in a very concise and elegant manner. On the 13th December, in the same year, was read at the Royal Society a paper of his entitled "An attempt to account for the regular diurnal variation of the Horizontal Magnetic Needle; and also for its irregular variation at the time of an Aurora Borealis." A complete year's observations of the diurnal variations of the needle are annexed to this paper. On the 5th November 1761, he communicated to the Royal Society an account of the Transit of Venus, 6th June 1761, observed in Spital Square. His next communication to the Society was a letter addressed to Dr Franklin, and read in February 1762, containing some remarks on Mr Delaval's electrical experiments. On the 16th December in the same year he published a paper entitled "Experiments to prove that water is not incompressible." These experiments are a complete refutation of the famous Florentine experiments, which so many philosophers have mentioned as a proof of the incompressibility of water. On St Andrew's day 1763, he was for the third time elected one of the council of the Royal Society; and on the 8th November in the following year were read before that learned body his further "Experiments and observations on the compressibility of water and some other fluids." The establishment of this fact, in opposition to the received opinion, formed on the hasty decision of the Florentine Academy, was thought to be deserving of the society's gold medal. It was accordingly moved for in the council of 1764; and after several invidious delays, which terminated much to his honour, it was presented to him on the 30th November 1766.

His next communication to the Royal Society was made in December 1768, entitled "An easy method of making a phosphorus that will imbibe and emit light like the Bolognian stone; with experiments and observations." The dean and chapter of St Paul's having, in a letter to the president, dated 5th March 1769, requested the opinions of the Royal Society relative to the best and most effectual method of fixing electrical conductors to preserve that cathedral from damage by lightning, Canton was one of the committee appointed to take the letter into consideration, and to report upon it. The gentlemen joined with him in this business were Dr Watson, Dr Franklin, Mr Delaval, and Mr Wilson. Their report was made on the 8th of June following, and the method recommended by them was carried into execution. The last paper of Canton's which was read before the Royal Society was on the 21st December 1769, contained "Experiments to prove that the Luminousness of the Sea arises from the putrefaction of its animal substances." Besides these, he wrote a number of papers both in earlier and in later life, which appeared in several publications, and particularly in the *Gentleman's Magazine*.

The close and sedentary life of Canton, arising from an unremitted attention to the duties of his profession, and to the prosecution of his philosophical inquiries and experiments, probably contributed to shorten his days. He died of a dropsy in the chest, on the 22d of March 1772.

CANTONI, Simone, a Milanese architect, who after studying at Rome settled in his own country, where he erected several palaces, and the halls of the Lyceo and Seminario, in a good Italian style of architecture. His principal work is the council-hall in the ducal palace at Genoa, where his father had formerly been employed. He died in 1818.

CANTONING, in the military art, the allotting separate quarters to each regiment.

CANTON'S PHOSPHORUS, is made by mixing three parts of calcined oyster-shells with one of flowers of sulphur, and exposing the mixture to a strong heat in a covered crucible for an hour. If exposed to the sun's light for a few seconds, it will shine in a dark room for some minutes afterwards. It must be kept in a well-stopped bottle.

CANTRED, or Cantreth, a hundred villages. It is a British word, compounded of the adjective *cant*, hundred, and *tref*, a town or village. In Wales some of the counties are divided into cantreds, as in England into hundreds.

CANTYRE, a peninsula of Scotland, forming the most southern part of the county of Argyll. The *Mull of Cantyre* is its most southern point, and has a lighthouse with a fixed light, seen 22 miles off.

CANUS, or Cano, Melchior (1523–1560), a learned Spanish bishop and theologian, who succeeded Vittoria as professor of theology at Salamanca. From his violent opposition to the establishment of the Jesuits in his native country, he was summoned by Paul III. to the council of Trent, and appointed bishop of the Canaries. By his influence with Philip II., Canus succeeded in frustrating the schemes of his enemies and procuring his recal to Castile, where he became provincial of the Dominican order. His principal works are entitled *Prælectiones de Pœnitentia; de Sacramentis;* and *Locorum Theologicorum, libri* xii. Two 8vo editions of his works were published at Cologne in 1605 and 1678; and a 4to edition at Venice in 1759.

CANUSIUM, now Canosa, an old and celebrated town of Apulia, on the right bank of the Aufidus, 15 miles from the mouth of that river, and 6 miles from the ancient Cannæ. Like very many of the more important cities in this part of Italy, it is said to have been founded by the Grecian hero Diomed: the origin of the city, however, can be traced with tolerable certainty to the Pelasgi. Canusium is first mentioned in history as assisting the Samnites in their wars against the Romans, by whom it was subdued for the first time B.C. 318. In the second Punic war the inhabitants gave a strong proof of their patriotism by sheltering within their walls the relics of the Roman army, which retreated thither after the rout at Cannæ. In the second year of the social war, in which Canusium joined the revolted allies, it was besieged unsuccessfully by the Romans. In the civil wars it suffered severely, but always contrived to secure its municipal privileges, and was never colonized from Rome till the days of Marcus Aurelius. Canusium is repeatedly mentioned in the Latin classics. In the *Iter ad Brundusium* of Horace, its bread is described as gritty, and its water is extremely scanty. This last defect was remedied by Herodes Atticus, who constructed an aqueduct, of which the remains are still visible. In the tenth satire of the first book of Horace, the inhabitants are called *bilingues*, either from their duplicity, or, as is more generally believed, from their speaking Latin or Greek indifferently. The modern Canosa is built on the site of the ancient citadel of Canusium, and contains about 6000 inhabitants. Many interesting remains of antiquity are from time to time discovered in the neighbourhood.

CANUTE, or Knut, king of England, was the son of Sweyn, king of Denmark, whom he succeeded A.D. 1014, and, by the conquest of England, was the first monarch that united in his own person the undivided sovereignty of the two kingdoms, after the assassination of Edmund Ironside by Edric the brother-in-law of Canute, in 1017. He married Emma, widow of King Ethelred, and put to death or banished several persons whose legitimate claims to the throne he had reason to dread. Having thus confirmed his power in England, he crossed over to Denmark, in order to resist the attacks of the king of Sweden; and he carried along with him a great body of English under the command of Earl Godwin. This nobleman had there an opportunity of performing a service by which he both reconciled the king's mind to the English nation, and gained to himself the friendship of his sovereign. He was stationed next to the Swedish camp; and observing a favourable opportunity, he suddenly attacked the enemy in the night, drove them from their trenches, threw them into disorder, and obtained a decisive victory. Next morning, when Canute saw the English camp entirely abandoned, he imagined that the troops had deserted to the enemy; but was agreeably surprised to learn that they were then engaged in pursuit of the discomfited Swedes. He was so pleased with this success, and the manner of obtaining it, that he bestowed his daughter in marriage upon Godwin.

In another visit to Denmark, Canute attacked Norway, and expelled the just but unwarlike Olaus from his kingdom, of which he took possession. Canute, who was become one of the greatest sovereigns in Europe, now began to feel the unsatisfactory nature of worldly greatness; and, weary of the glory and turmoils of this life, he began to turn his thoughts upon that which is to come. Unfortunately the spirit which prevailed in that age gave a wrong direction to his devotion; and, instead of making atonement to those whom he had formerly injured by his acts of violence, he devoted himself to those exercises of piety which monkish superstition represented as most meritorious. He built churches, endowed monasteries, enriched ecclesiastics, and bestowed revenues for the support of chantries at Assington and other places, where he appointed prayers to be said for the souls of those who had there fallen in battle against him. He even undertook a pilgrimage to Rome, where he sojourned a considerable time; and, besides obtaining from the pope some privileges for the English school erected there, he engaged all the princes through whose dominions he passed to desist from those heavy impositions and tolls which they were accustomed to exact from English pilgrims. By this spirit of devotion, no less than by his equitable and politic administration, he gained the affections of his subjects.

A well-known and beautiful story shows that he had learned to bear his honours meekly. Some of his courtiers, desirous of serving their own interests by flattering their royal master, extolled his greatness as if nothing were now too great for him to resist or overcome. The monarch, it is said, caused his chair to be placed at the sea-side when the tide was flowing; and when the waves approached his feet, he, with a feigned assumption of that power which his obsequious attendants declared his own, commanded the rising waters to respect the voice of him who was lord of the ocean, and retire. The result was a practical rebuke to those sycophants, and, on the part of Canute, a humble ascription of omnipotence to God alone. From that time, it is said, he never would wear a crown. He died at Shaftesbury, A.D. 1036, in the twentieth year of his reign, and was buried in the monastery at Winchester.

CANVAS (French *canevas;* Greek *καννaβις*, hemp); a strong kind of cloth made of hemp or flax, and used for tents, sails, &c. Also a clear unbleached cloth, woven regularly in little squares used for working tapestry with the needle.

Canvas, among painters, denotes the prepared cloth on which pictures are drawn.

Canevas, among the French, signifies also the rough draught of the words to which an air or piece of music is composed, and which serves merely to indicate the measure and style of writing required of the poet who is to complete the work.

CANY, a town in the department of the Lower Seine, in France, with 240 houses and 1650 inhabitants.

CAOUTCHOUC, sometimes called *Gum-elastic*, or more commonly, from its use in removing pencil-marks from paper, *India-rubber*, is a substance *sui generis*, found in the milky juice of a great variety of tropical trees; the most prolific in this remarkable product being *Siphonia Cahuchu* or *Hevea guianensis*, *Urceola elastica*, and *Ficus elastica*. The first of these trees, which affords the best commercial caoutchouc, extends over a vast district in central America; the second is abundant in the islands of the Indian Archipelago; and the *Ficus elastica* abounds in Assam, and is plentifully distributed over some other parts of India. This substance is contained also in small quantity in the milky juices of some European plants.

Though caoutchouc was introduced into Europe early in the last century, its origin was unknown till 1736, when M. de la Condamine communicated to the French academy the discovery that it was the inspissated juice of a Brazilian tree, known by the native name of *Hhevé*. The best caoutchouc is still imported from Para, where it is called *borracha* and *seringa;* but the native name is *cahuchu*—and thence the word caoutchouc is derived. It is procured by piercing the tree, or by making a series of incisions around the trunk and main branches, whence the juice exudes abundantly as a creamy-looking fluid, which gradually becomes firmer and darker by exposure to the air. It is usually collected in clay cups, or in leaves folded in that form, and attached to the tree in the line of incision. It is also spread in successive layers on moulds of clay, which are crushed and shaken out when the process of drying is completed. In this manner the India-rubber bottles and figures of animals are produced. The trees are most prolific during the rainy season. The caoutchouc proper may be separated from the thinner portion of the juice by the application of heat, which coagulates it; and the same result is obtained by means of acids and with alcohol. The Indians have long been acquainted with the fact that cloth imbued with this juice is rendered impervious to water. They also form it into boots; and for this purpose they employ wooden lasts coated with clay, which are dipped from time to time in the fluid caoutchouc until they have received a coating of the thickness desired. To accelerate the process, the caoutchouc is usually dried over wood fires, and thus is blackened by the smoke. While still soft, it is frequently ornamented by indenting patterns on its surface, which its want of elasticity in that state enables it to retain very readily.

Caoutchouc is occasionally imported in its fluid state; but in spite of the utmost care to exclude it from the atmosphere it gradually tends to solidification. Fluid caoutchouc has the consistence and colour of cream, and a specific gravity of 1·012. In some recent experiments on caoutchouc juice, Dr Ure found one sample, with a specific gravity of 1·04125, to yield 20 per cent. of solid caoutchouc; while another of a thicker consistence, and a specific gravity of only 1·0175, yielded no less than 37 per cent. of white, solid, and very elastic caoutchouc. The ordinary commercial caoutchouc is in the form of bottles, solid balls, and crude masses, and varies considerably in quality according to the species of tree from which it is obtained, independently of adulteration by the admixture of earthy and other matters. Previous to being used for manufacturing purposes, the caoutchouc is freed from from its impurities by washing in warm water. Sometimes the masses contain a viscid tarry-looking matter (the result apparently of putrefactive fermentation), which renders them worthless.

Pure caoutchouc is insipid, with little if any perceptible odour, and has a specific gravity of 0·925. Unlike most solid vegetable products, it contains no oxygen. Its constituents, according to Professor Faraday, are carbon 87·2, hydrogen 12·8; while Dr Ure gives the result of his experiments as carbon 90, hydrogen 10, or three atoms of the former to two of the latter. Caoutchouc is insoluble in water, alcohol, and acids; but it dissolves more or less readily in ether, naphtha, coal-tar naphtha, bisulphuret of carbon, and some essential oils, as oil of cassafras, lavender, and turpentine. By certain processes it may be dissolved in the fixed oils; but these solutions when spread as varnishes remain in a glutinous state. One of the most perfect solvents for manufacturing purposes is a mixture of 100 parts of sulphuret of carbon and 6 or 8 parts of anhydrous alcohol. Caoutchouc is but slightly affected by the acids at the ordinary temperature; nor will the strongest caustic potash ley, even at a boiling temperature, dissolve it. Sulphuric acid, especially with the aid of heat, decomposes it; and so will nitric acid, if concentrated. Azotic acid changes it into a yellow insoluble substance, with the disengagement of a minute quantity of oxalic acid. From its quality of resisting the action of the most corrosive gases, tubes of this substances are much employed in the chemical laboratory; and it also forms, when fused, a very adhesive and efficient lute. When boiled in water it swells; and in this state it is more readily soluble in its several menstrua. Boiling water also renders it somewhat adhesive; so that a slip coiled about a cylinder, and held in position by a thread, may be formed into a tube. Its solutions in coal-tar naphtha and ether, when dried up, leave the caoutchouc unaltered in its properties. When treated with the first it soon swells to many times its original bulk; and the process of solution may be accelerated by trituration. This solution is much employed for rendering textile fabrics impervious to air and water, and formed the subject of Macintosh's well-known patent. For such purposes the manufacturers usually employ the coarse inelastic lumps and parings, which may be dissolved either in petroleum (coal-tar), naphtha, or oil of turpentine. The solution is effected in a close cast-iron vessel, by the aid of triturating cylinders; the heat generated during the process being alone sufficient to favour the solution Thirteen cwts. of caoutchouc may thus be prepared at one time in a vessel measuring 4 feet by 4; three days being required to complete the process. The quantity of caoutchouc much exceeds that of the solvent, so as to produce a varnish of considerable consistence. This

Caoutchouc.

solution is spread in one or more coats over the surface of the cloth; and in order to ensure its uniform thickness, the varnished cloth is drawn along under an edge or bar, which is placed horizontally to its surface, and almost in contact with it. When it is partially dry, another piece of cloth, similarly prepared, is applied carefully to the varnished surface of the first, and the two are then united firmly together by pressure between rollers. The cloth thus prepared is suspended in a well-ventilated stove-room, where it speedily dries, and loses in a great measure its offensive smell. When required for the purposes of the bookbinder, or any nice operation, this varnish should be well smoothed by rubbing, and then strained. The latter precaution, indeed, should be observed in the preparation of all caoutchouc varnishes, in order to remove the aloetic or other extraneous matter which usually occurs in the caoutchouc of commerce. To obtain the ethereal solution it is necessary that the ether be previously washed with water three or four times; and this purification may be simply effected by agitation with twice its bulk of water in a narrow-necked bottle, which is then to be inverted and allowed to remain in that position until the ether has separated and risen to the surface—when the water is to be drawn off. In this state the ether will completely dissolve it in the course of a few days. The caoutchouc should previously be cut into shreds, and boiled in water for two hours. For nice purposes this solution is particularly well adapted, as when spread it dries very speedily, leaving a coating of caoutchouc unaltered in its properties, and free from any disagreeable smell. It remains somewhat clammy for a while; but this defect may at once be removed by dusting its surface with sulphur or with French chalk. A varnish suitable for aerostatic machines may be obtained by digesting one part of caoutchouc, cut into shreds, in thirty-two parts of rectified oil of turpentine, and then straining the solution through muslin. A good transparent cement, too, for uniting small pieces of glass, &c., is said to be obtained by dissolving from fifteen to twenty grains of caoutchouc in two ounces of chloroform, and afterwards adding half an ounce of mastic; the whole to be allowed to macerate for a week, when it will be ready for use, and may be applied cold with a brush.

The most remarkable property of caoutchouc is its elasticity, which exceeds that of any other known substance. Cold and quiescence render it hard and rigid, but warmth speedily restores its elasticity. If a slip of this substance be softened by immersion in hot water, it may be extended to seven or eight times its length, and will contract very nearly to its original dimensions. Its expansive power may be strikingly exhibited in a very simple manner. If an India-rubber bottle be steeped in well-washed sulphuric ether till it has become quite flaccid, it may be expanded by means of a condensing syringe to a globe five or six feet in diameter. If suffered to dry in this state, its tractile power will be destroyed.

The great variety of purposes to which its elasticity and imperviousness to water and to air have occasioned its application, are too numerous and familiar to be particularized in this place. The extent of its employment in Britain in the several branches of manufacture is shown by the quantity of caoutchouc imported, which for the year ended January 5, 1854 amounted to 17,326 cwt. The total quantity exported from Para alone in 1852 was 32,860 cwt., and 116,465 pairs of shoes. The filature of caoutchouc, for the manufacture of elastic fabrics, such as cloth, cord, tape, braces, &c., is an important and increasing branch of our national industry. This operation has been made the subject of various patents, all modifications more or less perfect of one general principle, namely that of reducing it to threads by means of steel edges acting either on the bottle caoutchouc compressed in a mould, on the solid cake, or by cutting it when stretched on a mandrel of wood which is set in rapid revolution. In this operation water is allowed to trickle over the cutting blades in order to prevent the cohesion that would otherwise impede their progress. In this manner, thread of 5000 yards to a pound weight is produced. Previous to its employment in the manufacture of textile fabrics, it is necessary to render the thread inelastic; which is effected by winding it tightly on reels, and allowing it to remain in that condition until nearly deprived of its elasticity—which is afterwards restored by exposing it to the action of a heated smoothing-iron. Sheets are sometimes cut from the solid cake; and may likewise be obtained of any size, and of extreme tenuity, by spreading a solution in naphtha upon cloth previously sized, stripping it off when dry. The use of rollers, with a piece of cloth similarly prepared and superimposed on the varnished surface of the first, may also be employed in this operation.

Caoutchouc ‖ Cap.

An ingenious application of the elastic force of caoutchouc has been used to raise weights by what are called power purchases; and it has also been used as torsion springs for roller-blinds, for door-springs, as a projectile force, and a great variety of other purposes.

Caoutchouc when impregnated with sulphur—a process technically called *vulcanizing*—undergoes a very important change. Thus prepared, it becomes more uniformly elastic, always recovering its form after being stretched, and remaining unaffected by climatic temperatures. Various methods for effecting its sulphuration in the most effectual way have been proposed and patented. This may be done, either by adding sulphur to the naphtha or turpentine in which the caoutchouc is to be dissolved; by kneading in by means of a roller-press the flowers of sulphur, in the proportion of ten pounds of sulphur to sixty pounds of caoutchouc; or by impregnating it with the fumes of sulphur or its compounds. Sheets and tubes are well vulcanized by immersion for a few minutes in a mixture of 100 parts of sulphuret of carbon and 2½ parts of protochloride of sulphur, and then rinsing them in water. Other methods also are practised.

Caoutchouc burns with a bright flame, emitting much smoke, and an odour that is scarcely disagreeable. At a temperature of 248° Fahr. it fuses, and remains very long in a glutinous state. When exposed to about 600°, it resolves itself into a vapour which is condensable into a powerfully odorous and extremely volatile amber-coloured oil, which has received the name of *caoutchoucine*. Caoutchoucine is a powerful chemical solvent; and as when mixed with alcohol it dissolves copal and other resins without the aid of artificial heat, it is peculiarly useful in the preparation of varnishes. It is also a solvent of caoutchouc. By repeated rectification, this dark-coloured fluid becomes bright and transparent; and it may be deprived of its peculiar odour by being mixed and shaken up with nitromuriatic acid, or with chlorine. Though the lightest of known fluids, its vapour is so ponderous that it may be poured like water from one vessel to another. This interesting fluid is the discovery of Mr William Henry Barnard of Greenwich, who obtained a patent for it in 1833.

It is worthy of remark, that in the operation of grinding or kneading the crude masses of caoutchouc for the purpose of reducing the separate fragments into a homogeneous whole, the alternate expansion and contraction of the mass occasions so great an evolution of caloric that the water employed in the process, though cold as it trickles into the drum, is quickly raised to a boiling temperature.

For some very interesting details of the several processes connected with the manufacture of caoutchouc, the reader is referred to the article Caoutchouc in Ure's *Dictionary of Arts and Manufactures*, from which the leading facts here noticed are derived. (T. S. T—L.)

CAP, a cover for the head. Caps and hats were not in general use before the year 1449, the fashion having been introduced, it is said, at the entry of Charles VII. into

Rouen; from which time they began to take the place of the hoods or chaperons, which had till then been used. When the cap was of velvet it was called *mortier;* when of wool, simply *bonnet.* None but kings, princes, and knights, were allowed the use of the mortier. The cap was the head-dress of the clergy and graduates. Pasquier says that it was a part of the hood anciently worn by persons of the robe, from which the skirts were cut off as an encumbrance, leaving the round cap a convenient cover for the head; and when the round cap was afterwards assumed by the people, those of the gown changed it for a square one, first invented by a Frenchman named Patrouillet. He adds, that the giving of the cap to students in the universities denoted that they had acquired full liberty, and were no longer subject to the control of their superiors; in imitation of the ancient Romans, who gave a *pileus* or cap to their slaves, in the ceremony of making them free; and hence the proverb, *Vocare servos ad pileum.* Hence, also, on medals, the cap is the symbol of liberty.

The Romans for many ages had no regular covering for the head. As a defence against the rain or sun, the lappet of the gown was thrown over the head. The same usage obtained among the Greeks, at least during the heroic age; yet hats or bonnets appear in the Panathenaic procession.

The French clergy wear a shallow kind of cap called *calotte*, which only covers the top of the head, and is made of leather, satin, worsted, or other stuff. The red cap is a mark of dignity, allowed only to cardinals. The secular clergy are distinguished by black leathern caps; the regulars, by knit and worsted ones.

Churchmen, and the members of most universities, students in law, physic, and others, as well as graduates, wear square caps. In many universities doctors are distinguished by peculiar caps, which are given them on assuming their degree. Wickliff calls the canons of his time *bifurcati*, from their caps. Pasquier observes that in his day the caps worn by churchmen and others were called square caps, though in fact they were round yellow caps.

The cap is sometimes used as a mark of infamy. In Italy generally the Jews are distinguished by a yellow cap, but at Lucca by an orange one. Formerly in France, bankrupts were obliged to wear a green cap, that others might be warned against trusting them. By several arrêts in 1584, 1622, 1628, and 1688, it was decreed, that if such person were found without his green cap, his protection should be null, and his creditors might cast him into prison.

CAP *of Maintenance*, one of the regalia, or ornaments of state, carried before the sovereigns of England at their coronation and other great solemnities. Caps of maintenance are also carried before the mayors of some cities, and likewise appear in heraldic bearings.

CAPACITY, the power of containing or holding; extent of room or space. It is also applied to the extent or comprehensiveness of the intellectual faculties; and it likewise denotes state, condition, character, profession, occupation, &c. In geometry it signifies the solid contents of any body: in chemistry, that state, quality, or constitution of bodies by which they absorb and contain, or render latent, any fluid.

CAPALUAN, one of the Philippine Islands, fourteen miles in length by five in breadth. It lies about four miles south of the island of Luzon. E. Long. 121.48., N. Lat. 13. 50.

CAPARASON, or CAPARISON, the cloth or covering laid over a horse, especially a sumpter horse, or horse of state. The word is Spanish, *caparazon*, probably an augmentative of *capa*, a cloak. The ancient caparason was defensive armour with which horses were protected in battle.

CAPE, a high land running out with a point into the sea; as Cape Nord, Cape Horn, the Cape of Good Hope, &c.

CAPE-BRETON, an island of British America, to the north of Nova Scotia, from which it is separated by the Strait of Canso. It lies between 45. 27, and 47. 5. N. Lat. and between 59. 40. and 61. 40. W. Long. It has an area of about 2,500,000 acres, of which about one-third consists of swamps and barren wastes. It is deeply indented in all directions by arms of the sea, the largest of which, the great Bras d'Or, nearly divides the island in two, and being deep enough for the largest vessels, affords the greatest facilities for commerce. It was discovered by Cabot, but was first occupied by the French, in whose possession it remained till 1758, when it fell into the hands of the English. By them it was annexed to Nova Scotia and erected into a county, returning two members to the assembly. It was afterwards constituted a distinct government; but in 1820 it was re-annexed to Nova Scotia, to whose laws it has since remained subject. It now returns two members to the assembly. Population of the united county of Cape Breton and Victoria in 1851, 27,580. The climate of Cape Breton is very variable. In winter the thermometer sometimes falls to 32° and generally to 20° below zero; while in summer it rises to 96° in the shade. The mean summer heat may be estimated at 80°. The commercial resources of the island consist chiefly in its timber, its agricultural productions, its minerals, and fisheries. In the timber trade it joins with the mainland of North America in the shipment of pine, birch, ash, &c., to the United Kingdom. The agricultural produce consists chiefly of grain crops: the most extensively cultivated are oats (1,384,437 bushels), wheat (297,157 bushels), and barley (196,097 bushels), in 1851. On the pasture grounds horses and cattle are reared, and cheese and butter are made. The only minerals wrought in the island are coal, limestone, and gypsum; although iron ore and slate might be made available for commercial purposes. The coal mines are wrought in the neighbourhood of Sydney, and in 1851 yielded 53,000 chaldrons. In the same year the consumpt of limestone was 4421 casks. Gypsum is exported, although in very small quantity, to the United States. The fisheries, which employ nearly 1300 men, consist chiefly of salmon, cod, mackerels, herrings, shad, and white fish, of which large quantities are cured and exported. The rest of the population are engaged at the saw-mills, grist-mills, and tanneries, and in the manufacture of coarse cloth, flannel, and soap. The number of schools in the island in 1851 was 70, with an attendance of 2179 scholars. The number of churches in the same year was 47. The principal religious sects are, Roman Catholics 11,493; Free Church, 8968; Church of Scotland, 3452; Church of England, 2156; the rest consist of Methodists, Congregationalists, Baptists, &c. There is still a remnant of the native Indian population.

CAPE Clear. See CORK COUNTY.

CAPE Coast Castle. See COAST.

CAPE Fear River. See CAROLINA, NORTH.

CAPE of Good Hope. See GOOD HOPE.

CAPE Haytien, a seaport-town of the island of Hayti, on its northern coast, 90 miles north of Port-au-Prince, in N. Lat. 19. 46. W. Long. 72. 14. Pop. probably from 12,000 to 16,000. This town was formerly the capital of the island, and previous to the Haytian revolution was noted for its elegance and beauty, but is now remarkable for little more than the ruins of its former grandeur. It has a secure harbour protected on the north by a projecting tongue of land, but the entrance is rather difficult. It carries on a considerable trade, principally with the United States.

CAPE Horn. See HORN.

CAPE Verd. See VERD.

CAPEL, LORD ARTHUR, was the son of Sir Henry Capel. In 1640 he was chosen to represent the county of Hertford, and sat as a member of the Long Parliament, which was convened that year. He was elevated to the peerage by Charles I.; and on the breaking out of the revolution he

raised and maintained a troop in the royal interest till the final triumph of the Parliamentarians compelled him to make peace with them. He then retired to his private residence at Hadham. On reassembling his troop, in order to effect the rescue of Charles, he was forced to surrender at Colchester to General Fairfax, and was condemned by the Commons to be banished; but on the authority of some of the parliamentary leaders he was immediately committed to the Tower. He contrived to effect his escape from prison, but was apprehended at Lambeth, and again committed to stand his trial at Westminster for treason. He was condemned to death, and executed on the 9th of March 1649, exhibiting on the scaffold the greatest calmness and dignity. While in the Tower he wrote several stanzas, which were afterwards published. He was the author of *Daily Observations or Meditations, divine, moral, and political, written by a person of honour and piety; to which are added, Certain Letters written to several persons*, a posthumous publication, which was afterwards reprinted under a different title, with an account of his life.

CAPELL, Edward, the well-known critic and annotator of Shakspeare, was born at Troston in Suffolk in 1713. Through the influence of the Duke of Grafton, he was early appointed to the office of deputy-inspector of plays, with a salary of L.200 per annum. Shocked at the inaccuracies which had crept into Sir Thomas Hanmer's edition ot Shakspeare, he projected an entirely new edition, to be carefully collated with the original copies. After spending three years in collecting and comparing a vast number of scarce folio and quarto editions, he published his own edition in 10 vols. 8vo, with an introduction, which was written in a style of extraordinary and romantic quaintness, and which was afterwards appended to the prolegomena of Johnson's and Steevens's editions. The work was published at the expense of the principal booksellers of London, who gave him L.300 for his labour. Three other volumes of *Notes and various readings of Shakspeare*, which he had announced in his introduction, under the title of *The School of Shakspeare*, were published under the editorial superintendence of Mr Collins, in 1783, two years after Capell's death. They contain the results of his unremitting labour for thirty years in collating the ancient MSS., and throw considerable light on the history of the times of Shakspeare, as well as on the sources from which he derived his plots. Besides the works already specified, he published a volume of ancient poems called *Prolusions*, and an edition of *Antony and Cleopatra* adapted for the stage.

CAPELLA, Martianus Mineus Felix, a celebrated writer, who lived somewhere about the close of the fifth century A.D. From his familiar name of *Afer Carthaginiensis*, he appears to have been born at Carthage; but of his life nothing is known with certainty. He is the author of a voluminous allegorical work entitled *Satyra de Nuptiis Philologiæ et Mercurii*, in nine books, which attained a wide celebrity during the middle ages. It is a medley in prose and verse, composed in the bizarre style of Varro's *Satyra Menippea*, and Petronius's *Satyricon*, and probably furnished the model of Boethius' *Consolatio Philosophiæ*. The first two books give an account of the nuptials of Mercury with Philology, mentioned in the title, and the remaining seven are devoted to an exposition of the seven liberal sciences, grammar, dialectics, metaphysics and logic, rhetoric, geometry, arithmetic, astronomy, and poetry. In the eighth book he makes the remarkable assertion that the earth is not the centre of all the planets, but that Venus and Mercury revolve in common round the sun; and it seems probable that Copernicus, who quotes Capella (*De revolutionibus orbium cœlestium*, lib. i., cap. 10), derived from this the first hint of his system. The whole work is one which displays immense learning, and, independently of its African idioms, probably owes much of its barbarous appearance to the frequent erroneous transcriptions which were made by the monks for the use of the mediæval schools. The best editions are those of Hugo Grotius, 8vo, Leyden, 1599, and U. F. Kopp, 4to, Frankf., 1836.

Capella, a bright fixed star in the left shoulder of the constellation Auriga.

CAPELLUS or CAPPELLUS, Ludovicus, a celebrated Protestant theologian, born at Sédan in France, abou the year 1579. After prosecuting his studies at Sédan, Oxford, and Saumur, he was appointed Professor of Divinity and Oriental languages in the University of Saumur, and wrote several learned critical and exegetical works. He is chiefly known from his controversy with the younger Buxtorf, in regard to the antiquity of the Masoretic pointing, which had been first called in question by Jacob Perez of Valencia, in his Commentary on the Psalms. His book *Arcanum punctationis revelatum* was written in reference to a passage in the *Tiberias* (viii. 8.) of the elder Buxtorf, and was answered in the *De punctorum origine, &c.* of the younger, in reply to which Capellus again published his *Vindiciæ arcani punctationis revelati*. The arguments which Capellus advanced from the existence of unpointed MSS., of unpointed alphabets, and unpointed quotations in Origen, Jerome, and the translators generally, have been confirmed by the researches of modern Hebraists, who have shown that the present elaborate system of pointing cannot be traced beyond the eleventh century. Capellus died about the year 1658. His brother James was also distinguished as a theologian and an astrologer.

CAPERCAILZIE, the Scotch name for the capercail or wood-grouse, which had ceased to hold a place in the British fauna, until lately re-introduced with success by Lord Breadalbane. It is the *Tetrao Urogallus* of Linnæus.

CAPERNAUM (Καπερναούμ), a city on the northwestern side of the Lake of Gennesareth, and on the border of the tribes of Zebulun and Naphtali. The infidelity and impenitence of the inhabitants, after the evidence given to them by our Saviour himself of the truth of his mission, brought upon them this heavy denunciation:—"And thou, Capernaum, which art exalted unto heaven, shalt be brought down to hell," &c. (Matt. xi. 23.) This seems to have been more than any other place the residence of Christ after he commenced his mission; and hence the force of the denunciation, which has been so completely accomplished, that even the site of Capernaum is quite uncertain. Dr Robinson regards its site as marked by a mound of ruins, called by the Arabs Khan Minyeh, situated in the fertile plain on the western border of the Lake of Gennesareth. In this plain Josephus places a fountain called Capharnaum: he says nothing of the town; but, as the town of Capernaum was in this same plain, it may be safely concluded that the fountain was not far from the town, and took its name therefrom. In this plain there are now two fountains, one called 'Ain el Madauwarah, the "Round Fountain," rising immediately at the foot of the western line of hills; the other, called 'Ain et-Tin, near the northern extremity of the plain, and not far from the lake. This latter fountain Dr Robinson inclines to regard as that which Josephus mentions under the name of Capharnaum. Near it is a low mound of ruins occupying a considerable circumference, which are most probably the remains of the doomed city: and if these be all its remains, it has, according to that doom, been brought low indeed. It is important to add, that Quaresmius expressly states, that in his day, the place called by the Arabs Minyeh, was regarded as marking the site of Capernaum.

CAPEROLANS, a congregation of the minor order of Observants, in Italy, so called from Peter Caperole their founder, in the fifteenth century.

During the Milanese and Venetian war, the superiors in the province of Milan, whose jurisdiction extended as far as Venice, behaved so haughtily to the Venetians, that the

monks of Brescia resolved to shake off their yoke. The superiors, informed of this, drove out of the province those whom they considered as the authors of the plot, the principal of whom were Peter Caperole, Matthew de Tharvillo, Gabriel Maluezzi, and Bonaventure of Brescia. Peter Caperole, with a view to separate the convents of Brescia, Bergamo, and Cremona, from the province of Milan, instituted a law-suit against the vicar-general, which was determined in his favour; and the convents, in 1475, by the authority of Pope Sixtus IV., were erected into a distinct vicarate. Soon after, by the interposition of the doge of Venice, this vicarate was erected into a congregation, which from him was called *Caperolans.* On the death of Caperole, they were incorporated with the Observantine order, but retained a separate jurisdiction, under the title of the Province of Brescia. They consist of about twenty-four convents in Brescia, Bergamo, Cremona, and other places.

CAPERS, the pickled buds or unexpanded flowers of *Capparis spinosa*, which grows in the warm parts of Europe.

CAPH, a Jewish measure of capacity for things, estimated by Arbuthnot at the sixteenth part of the hin, or five-eighths of an English pint.

CAPIAS, in *English Law*, is a name given to certain executive writs. It is derived, according to a common practice, from the initial words in the order or instruction. This writ is of two sorts; one before judgment in an action, and the other after. That before judgment is called *capias ad respondendum*, and may issue, at any time before final judgment, on the application of a plaintiff having a cause of action to the amount of L.20 or upwards (1st and 2d Vict., c. 110) against a defendant who it is suspected is about to quit the country. Under this writ, the defendant is arrested, and cannot obtain his discharge until he gives bail, or deposits the amount of the debt, together with L.10 for costs. That after judgment is of divers kinds; as,

Capias ad Satisfaciendum, abbreviated into *ca. sa.*, is a writ authorizing execution by imprisonment, and its use has of course been much restrained by recent legislation. It issues on a judgment obtained, and lies where any person recovers in a personal action, as for debt, damages, and the like, exceeding L.20, exclusive of costs (7th and 8th Vict., c. 96).

Capias pro Fine was anciently a writ lying where a person was fined to the king for some offence committed against a statute, and who did not discharge the fine according to the judgment. So early as the 5th and 6th Will. and Mary, c. 12, it was abolished in cases of trespass, ejectment, assault, and false imprisonment.

Capias ut Lagatum, is a writ which lies against any one outlawed in any action, by which the sheriff is ordered to apprehend the party outlawed, for not appearing on the exigent, and keep him in safe custody till the day of return, when he is ordered to present him to the court, to be there further dealt with for his contempt.

Capias in Withernam, generally employed against a party endeavouring to evade distress or execution against moveables, is said to lie for goods *in withernam;* that is, where the distress is carried out of the county, or concealed, so that the sheriff cannot make deliverance upon a replevin. The writ requires the sheriff to take other goods of the distreinor, in lieu of the distress formerly taken, and withheld. The term *withernam*, in the old northern languages, is used as equivalent to *reprisals*. Under the new County Courts Act, 9th and 10th Vict., c. 95, the law on the subject of the replevin of goods taken in withernam is materially altered.

The process for treason or felony is also in general by writ of capias, 25th Edw. III., c. 14; and it may also issue on indictments for misdemeanour; but the more usual mode is by a bench warrant, signed by a judge or by two justices, under the 48th Geo. III., c. 58, sec. 1, and the 11th and 12th Vict., c. 42, sec. 3.

CAPIDJI, in Turkish, signifies literally a doorkeeper. The term, however, is applied not only to the porters of the seraglio, but also to those functionaries who are sent into the provinces to administer justice, and who frequently, under the pretence of being the bearers of presents and similar marks of the imperial favour to the pachas and other great personages, are commissioned to put them to death.

CAPILLARY (from *Capillus*, hair) resembling a hair, fine, minute, small in diameter though long.

CAPILLARY ACTION.

1. When a solid body is partially plunged in a fluid, the level surface near it is disturbed, and the fluid is observed either to ascend or descend, so as to form a ring round the part immersed. If a tube of glass be inserted in a vessel containing water, the liquid will rise in a concave ring, both on the outside and the inside; and if the tube be small enough, the cylinder of water within it will be elevated above the general level, and the elevation will be greater nearly in the same proportion that the bore is less. On the other hand, if the tube be plunged in mercury, the fluid in contact with the glass will be depressed, forming a hollow ring with the convexity upward; and when the diameter is very small, the cylinder of mercury in the inside will sink below the level on the outside. In all these appearances the physical cause is the same, and it has received the name of Capillary Action, because its effects are most remarkable in the case of tubes with extremely minute diameters.

No part of natural philosophy has been the subject of a greater variety of researches than capillary action. It has been viewed in almost every possible light, and it would be difficult to suggest a new principle that has not been proposed by some philosopher in order to account for the observed appearances. One advantage has resulted from repeated discussion; for by this means the true cause of the phenomena is no longer doubtful, although there is still considerable difference of opinion with regard to the manner in which the effects are produced. It is now universally allowed, that the suspension of fluids in capillary tubes is to be ascribed to the attraction observed to take place between the elementary particles of which bodies are composed. We shall not stop to detail the different experiments which prove the reality of this attractive force, and we shall at once assume that the two following facts, which are the fundamental principles of this theory, are fully established; namely, that glass and other solid bodies attract the particles of fluids with which they are in contact, and that the particles of fluids attract one another. Admitting these two kinds of attraction, it remains to investigate the consequences that flow from them.

2. Corpuscular attraction acts with great intensity in contact, or at the nearest distances, but it decreases very rapidly as the distance increases, and, on the whole, is confined within a very small range. Clairaut supposed that the sides of a capillary tube extend their action to the central parts of the contained cylinder of fluid. But in this opinion he is singular. All other philosophers confine the sphere of attraction within much narrower limits. They suppose that the corpuscular force has produced its full effect, and has become evanescent, at a distance so small that it cannot be appreciated by the senses. But

Law of corpuscular attraction.

from this we are not to conclude that a particle attracts those only which are quite contiguous to it; its action, although confined within a sphere of a very small radius, nevertheless extends to some distance, and reaches to the particles beyond the nearest.

As corpuscular attraction extends its influence to a distance, it must vary, within the sphere of its action, according to some law, which is unknown, and in all probability will never be discovered. But a knowledge of this law is not necessary to explain the capillary phenomena; for these are caused by the accumulated action of the force in its whole range, and are independent of the intermediate variations of intensity which it may undergo. In this respect capillary action resembles the attraction by which transparent bodies refract the rays of light. In both cases, what we observe is the total effect of the attractive energy, which may remain the same, although the intermediate degrees of intensity be infinitely varied.

3. Conceive a fluid mass (Plate CLVII. fig. 1), the particles of which attract one another, but which is subjected to the action of no other forces, not even to that of gravity; and let an imaginary surface be traced through the fluid, having at every part a depth equal to the utmost range of the corpuscular force. Then a particle placed within the imaginary surface may be considered as occupying the centre of a sphere of the fluid, described with a radius equal to the greatest distance to which attraction reaches; whence it is manifest that the particle will be urged with equal forces in all opposite directions. If the particle be placed between the boundaries of the superficial stratum or film, the sphere of which it is the centre will extend above the fluid's surface; and, on account of the defect of matter, the particle will be less attracted outward than inward. Let N be a particle so situated, and suppose that *n* is another particle as much elevated above the fluid's surface as N is immersed below it; and trace the surface PQ in the fluid as far below N as that particle itself is below the outer boundary of the fluid mass. Then the particle N will be in equilibrium with regard to the attraction of all the fluid above PQ; but it will be urged inward by the force with which it is attracted by the fluid below PQ; and as the particles at N and *n* are similarly situated with regard to the whole fluid mass, and the part of it below the surface PQ, it is manifest that the attraction of the whole mass upon the particle at *n* is equal to the force which urges the particle at N inward. From this it follows, that all particles placed in a stratum which is everywhere at the same depth below the fluid's surface, are drawn inward with the same force, equal to that with which the whole mass attracts a particle placed at an equal height above the fluid's surface.

If now we conceive a canal passing through the interior of the fluid, and terminating both ways in the surface, it follows, from what has been said, that the attraction of the whole mass upon the superficial drops placed at the two orifices will propagate equal pressures in opposite directions through the canal. In order to estimate the force of compression, we may denote by K the pressure inward, caused by the attraction of the whole fluid upon a square inch of the superficial film; then a portion of the fluid within the canal will be compressed by the equal forces, K, acting in opposite directions. This is true of all portions of the fluid within the superficial stratum; between the boundaries of that stratum the compressive force is less, being always of the same intensity at the same depth, but decreasing rapidly in approaching the surface, where it is evanescent.

We may now conceive a fluid mass, whatever be its figure, to consist of a central part, surrounded by an indefinite number of thin beds or strata, placed at equal depths below the surface; and it will follow, from what has been proved, that the compression is constant in all the central part; and likewise that it is uniformly of the same intensity throughout every superficial stratum, varying from one stratum to another, and decreasing very rapidly near the surface. Such a body of fluid will therefore be in equilibrium whatever be its figure; in other words, the corpuscular attraction will oppose no resistance to a change of figure in the fluid, nor obstruct, in any degree, the perfect mobility of the particles among one another.

It must be observed, however, that the conclusion just obtained is exact only when we confine our attention to the direct action of the attractive forces, as is done in the theory of the figure of the earth. But there is another effect caused by the direct attraction of the particles of a fluid, to be afterwards considered, which takes place only at the surface, and from which this consequence results, that a body of fluid subjected to no forces but the attraction of its own particles will no longer be indifferent to any figure, but will arrange itself in a perfect sphere.

Effect of temperature.

A change in the temperature of a fluid mass will produce an alteration in the cohesive force; but it appears very difficult, if not impossible, to estimate, in any satisfactory manner, the effect arising from this cause.

A variation of temperature will affect the attraction of the particles of a fluid by the change of density which it induces. When two portions of a fluid attract one another, if we conceive one of them to have its density changed, while that of the other remains unaltered, it is evident that their cohesion will be proportional to the number of particles of the first portion placed within the sphere of action of the second; that is, it will vary in the direct proportion of the density. Again, if we now suppose the density of the second portion to vary, the attractive force will on this account also suffer a proportional change. Wherefore, when both portions undergo an equal change of temperature, their cohesion will vary as the square of the density.

Again, the variations in the mutual distances of the particles of a fluid, caused by changes of temperature, must bear a finite proportion to the range of the corpuscular force; and, on this account, a change in the fluid's cohesion will take place, depending upon the law that attraction follows in regard to the distance. At a given temperature, and under a given pressure, the particles are separated from one another to a certain distance, at which there is an equilibrium between the attractive force which impels them to one another, and the repulsive power attending the action of heat. In these circumstances, the actual cohesion is due to that part only of the whole corpuscular force which is exerted upon the particles placed beyond the limit of approach allowed by the given degree of temperature. The cohesion, too, is diminished not only by the decreased intensity of the attractive force, but also by the increased repulsion of heat. Our ignorance of the laws that regulate the action of these forces makes it impossible to subject to calculation the effect of a change of temperature; but, when we consider that corpuscular attraction decreases very rapidly as the distance increases, it is extremely probable that the cohesion of a fluid undergoes much greater changes from this cause than from the variations of density.

But capillary action arises from the cohesion between the particles of a fluid, and the attraction that takes place between them and the solid bodies with which they are brought into contact. Experiments show that these forces continue to act so long as the state of fluidity endures; their action is constant under the same temperature; and they are affected in degree only by the variations of heat. In the further prosecution of this inquiry we shall there-

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fore throw out of view the effect of temperature, and shall confine our attention to develope the consequences of corpuscular attraction.

Attraction between a solid body and a fluid.

4. The attraction of a solid body on every particle of a fluid within the sphere of its action, is a force perpendicular to the surface of the solid. This is manifest from the homogeneity of the solid when its surface is a plane; for, on account of the uniform arrangement of the parts, there is no reason why the attractive force should decline from the perpendicular to one side rather than to another. And when the solid is bounded by a curve of any kind, we may still consider the extremely small part of the surface which acts on a particle, as coinciding with the tangent plane; whence we may conclude that, in all cases, the attraction on every particle is perpendicular to the surface of the attracting body. The same thing is true in the action of transparent bodies on light; for, if the motion of a ray be decomposed into two parts, one parallel to the refracting surface, and the other perpendicular to it, the observed law of refraction implies that the velocity of the first part will remain unchanged, while the velocity of the other part will be increased or diminished by the refracting force.

If a smooth plate of glass be laid horizontally upon the surface of water, it is found that the glass will adhere to the water. The adhesion is not produced by the pressure of the atmosphere, for the fact is equally true in the vacuum of an air-pump. There is, therefore, evidently an attraction between the glass and the water, acting perpendicularly to the plate, and causing it to adhere to the water.

If the plate, instead of being laid horizontally upon the water, be immersed vertically in it, the part below the surface will exert the same attractions as it did in the former position. Every particle of the fluid within the sphere of action of the glass will be drawn perpendicularly towards it, and a thin coating of the fluid will attach itself to all the immersed surface of the plate.

Secondary or lateral force.

5. Although the attractive force exerted by a solid body on a fluid is confined to insensible distances, it must still be considered as penetrating in some degree into the fluid mass. The thin film on which it acts retains possession of all the properties of a fluid. The particles of water in contact with the glass press upon its surface; the particles farther off press upon those nearer; and the whole film is in a state of compression. But it is a distinguishing property of a fluid, arising from the perfect mobility of its particles, that a pressure in one direction will cause an equal pressure in all directions; and hence we must infer that the thin film of water, at the same time that it is compressed by the direct attraction of the glass, will likewise press laterally, or will make an effort to spread itself towards every side on the surface of the plate. If the film, instead of being attracted by the plate, were pressed against its surface by a weight, the lateral pressure, estimated on a given superficial space, would be the same with the direct pressure. But as the strata at different distances from the plate are attracted in unequal degrees, the whole lateral force can be found only by summing up the lateral pressures arising from the attraction upon each stratum.

Let AB (fig. 2) be a plate of glass on which there stands an upright vessel or tube, containing water; and let GH be a thin section or elementary part of the water within the tube, parallel to the glass, and so near it as to be attracted by it. Suppose that w denotes the area of the section, a its distance from the plate, and da its thickness; and let $\Psi(a)$ represent the attraction of the whole matter of the plate upon a single particle of water placed at the distance a. Then the density being constant and equal to unit, the attractive force of the plate upon the thin elementary section will be equal to

$$\Psi(a) \times w da;$$

and hence the attraction of the plate upon all the water in the tube will be equal to the integral

$$w \times \int \Psi(a) \cdot da,$$

generated while a increases from 0 to be infinitely great. The expression $\int \Psi(a) \cdot da$, which we may denote by K′, is therefore the force with which the attraction of the glass causes the fluid to press upon a square inch of the plate, or it is the measure of that force. If the particles of the fluid were attracted by the matter of the plate with an intensity equal to their own cohesive force, then K′ would be equal to K, that is, it would be equal to the force with which an indefinite mass of the fluid causes the superficial stratum to press inward.

In the inside periphery of the tube, assume any determinate length ab, equal to λ, and let the lines ac, bd, be drawn in the interior surface at right angles to ab. The area of the space $abdc$ is equal to $\lambda \times a$; and because fluids press equally in all directions, the attraction which urges the elementary section towards the plate AB will cause the fluid below the section to press upon the space $abdc$ with a force which is to the attractive force urging the section downward, as $\lambda \times a$ to the area of the section. Hence the pressure on the space $abdc$, caused by the attraction of the glass on the elementary section GH, is equal to

$$\lambda \times \Psi(a) \cdot a da.$$

This expression would evidently denote the pressure upon the surface $abdc$, if the fluid below the section were impelled towards the plate by a piston exactly fitted to the orifice of the tube. But there is no difference between the action of such a piston and that of the thin elementary section when urged by attraction with equal force in the same direction. The total force acting laterally in the length λ, is therefore equal to the fluent

$$\lambda \times \int \Psi(a) \cdot a da,$$

generated while a increases from 0 to be infinitely great. Hence, if we put $H' = \int \Psi(a) \cdot a da$; then H′ will be the measure of the lateral force in the length equal to unit.

It is obvious that the direct attraction between two portions of a fluid, as well as that between a solid and a fluid, is attended with a lateral pressure. If we denote by H what H′ becomes when the matter of the plate attracts the fluid with the same intensity that the fluid attracts its own particles, then H will be the measure of the lateral force arising from the direct attraction of the fluid, and it will have the same relation to K that H′ has to K′.

The lateral force is always very small when compared with the direct pressure. For the function $\Psi(a)$ has a conceivable value only when a is so small as to be imperceptible to the senses; in such circumstances the product $\Psi(a) \times a$ is very small when compared with $\Psi(a)$; and, consequently, $H' = \int \Psi(a) a da$ is considerable in respect of $K' = \int \Psi(a) \cdot da$.

The smallness of the lateral in comparison of the direct pressure arises from this, that every elementary part of the latter is estimated on the same finite area, while the simultaneous element of the former is confined to a space incomparably less. These two pressures resemble the power in the hydrostatic paradox, and the effect which it produces. In both cases we have a small pressure applied

to a surface extremely minute, in equilibrium with a great pressure distributed over a comparatively large area.

When a piece of glass is partially plunged in water in a vertical direction, the thin film which is attracted by the immersed surface endeavours to spread itself on the glass with an effort more or less in proportion to the compressive force. Below the surface of the water the lateral actions of the parts in contact mutually counteract one another; but at the surface the expansive force meets with no opposition. The film will therefore be pushed above the general level; and as it acts by cohesion on the contiguous fluid, it will draw up a portion of it, and form a ring surrounding the immersed part of the glass. The small fluid mass on which the glass exerts its attraction performs the office of a machine, which changes a horizontal force into one having a vertical direction. In the mechanical properties of a fluid we thus have a principle adequate to account for what we observe in capillary action. But although the general view here given of the cause of the capillary phenomena is so far satisfactory, a great deal of discussion is still necessary, in order to deduce from it a clear explanation of the laws observed in the appearances that take place in different circumstances.

The idea of accounting for capillary action by means of the lateral force produced by the direct attraction of a solid body upon a fluid, is due to Professor Leslie, a philosopher to whom physical science is indebted for more than one discovery. It is developed and applied, to explain some of the principal phenomena, in a short dissertation published in 1802 in the *Philosophical Magazine*. This dissertation is written with the same ability that characterizes all the productions of the author; and nothing more was necessary than to pursue the observation he had made, in order to obtain a complete theory of this branch of natural philosophy. It happens that, in this instance, the views of the philosopher are confirmed by the most abstruse and refined mathematical investigation. The formula found by Laplace for the attractive force of a fluid bounded by a curve surface, consists of two parts, one of which is the same for all surfaces, and the other varies with the curvature in each particular case. The first of these terms is the attractive force of an indefinite mass of the fluid bounded by a plane. The other term, which depends upon the curvature, is composed of a constant quantity multiplied into half the sum of the reciprocals of the radii of the circles, which have the same curvature with any two sections of the curve surface made by planes, perpendicular to one another and to the curve surface; and, on examination, this constant quantity will be found to coincide with the measure of the lateral tendency of the fluid caused by the direct action of the first force. Thus it appears that the two quantities which enter into the formula of Laplace are no other than the measures of the two kinds of force which we have been considering; the one denoting the direct pressure caused by the attraction of a fluid mass bounded by a plane, and the other signifying the derivative force acting laterally, which is a necessary consequence of the direct pressure. In a subsequent part of this article, what has now been advanced will be proved, by deducing the formula of Laplace in a direct and satisfactory manner from the two kinds of force, with the consideration of which we have been occupied.

Manner in which the immersion of a solid body disturbs the equilibrium of a fluid.

6. Imagine a large vessel DGHF (fig. 3), which contains a fluid subjected to no forces but gravity and the attraction of its own particles, and consequently having its surface DF horizontal; let AB represent a rectangular plate partially plunged in the fluid which it attracts; and supposing the surface of the fluid to remain level, let it be proposed to investigate the force with which the attraction of the plate tends to disturb the equilibrium of the fluid.

Suppose a horizontal plane, *df*, to be traced in the fluid, at a depth equal to the range of the corpuscular force; then this plane will separate all the superficial strata, in which the pressure is variable, from the rest of the mass. Below the plane *df*, the fluid particles cohere with the same force in every part, and they are likewise attracted with equal intensity by all the points of the plate with which they are in contact; above the same plane the attractive force of the plate remains unchanged, but the pressure of the fluid in the different strata is variable, gradually becoming less and less as we approach the surface. It will therefore be proper, first to examine what tendency the part of the plate below the plane *d f* has to disturb the equilibrium; and, secondly, to consider the effect of the plate's attraction upon the superficial film or stratum.

If the matter of the plate have the same attraction for the particles of the fluid that they have for one another, we may consider the plate as a body of the fluid that has congealed without any other change; in which case it is evident that, below the superficial stratum, the cohesive force of the fluid particles will be equal to their adhesion to the plate, and the action of the solid matter will nowise disturb the equilibrium of the fluid in the vessel.

If the plate be supposed to have no attraction for the fluid, a canal having one end in the surface of the fluid, and the other end on the plate, will be similar to a canal terminating both ways in the fluid's surface. It will be in equilibrium by the mutual attractions of the particles within it, and will exert no pressure whatever upon the plate.

If the solid matter attract the particles of the fluid, but with less intensity than they attract one another, there will be an adhesion of the fluid to the plate in proportion to the attractive force. In this case we may distinguish the attraction between the fluid particles into two parts, one of which is equal to and in equilibrium with the attraction of solid matter; while the other part, which is over and above what balances the attraction of the solid matter, is in equilibrium by the mutual action of the particles upon one another.

The solid matter acts immediately upon a thin portion of the fluid in contact with it; that portion attracts another contiguous portion; and in this manner the attraction of the plate reaches to any distance in the fluid mass. But from this it is manifest that the whole of a force greater than the mutual attraction of the particles cannot be propagated to a distance. Part of it must remain confined to the sphere of immediate action. Hence, if the plate attract the particles of the fluid with greater intensity than they attract one another, a part only of the attraction of the solid matter will balance the whole attraction of the fluid; and the remaining part will not penetrate beyond the range of the corpuscular force, but will act only upon a thin film of the fluid in contact with the plate. In this case, therefore, the plate's attraction produces a force which is not absorbed by the fluid. As this force compresses the thin film on which it acts upon the plate's surface, it will be attended with a lateral pressure, or an effort of the film to spread itself on all sides; and it may at first be thought that this lateral tendency, by acting upon the superficial stratum, will disturb the equilibrium. But it will immediately occur, that the effort which the edge of the film adhering to the plate below the plane *df* makes to raise up the superficial stratum, is counteracted by the opposite effort of the fluid situated immediately above the plane *df*. Thus, in every relation that can subsist between the attractive powers of the plate and the

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fluid, that part of the solid which is immersed below the superficial stratum has no tendency to disturb the equilibrium of the fluid in the vessel.

Insufficiency of Laplace's second theory of capillary action

Some philosophers account for capillary action by means of attractions between the plate and the fluid, which are supposed to take place, partly at the surface of the fluid, and partly at the bottom of the plate. Laplace, in particular, has grounded his second or more popular theory entirely on such attractions. He observes, that the part of the plate's vertical plane immersed in the water attracts the fluid in contact with it as much upward as downward, and therefore has no effect in causing either an elevation or a depression; but the part above the water attracts a thin film in contact with the plate upward; and the whole vertical side of the plate likewise attracts in the same direction the fluid below it, and situated in its prolongation. According to Laplace, it is the united effect of these two attractions which supports the suspended ring. The whole of this reasoning appears to us gratuitous. No part of the fluid is attracted by the solid matter in a vertical direction, but in a direction perpendicular to the plate's surface. The immersed part of the solid presents a continuous surface to the fluid, attracting it with the same intensity at every point; whereas Laplace neglects the action of the plate's horizontal boundary, and seems to suppose that the attractive energy of the solid matter resides only in the vertical sides. We have endeavoured to prove that the thin film or coating of fluid which covers the part of the solid immersed below the superficial stratum, is everywhere in a state of equilibrium and of equal compression by the attractions which act upon it. There is, therefore, no force produced at the bottom of the plate by the attraction between the solid matter and the particles of the fluid which can contribute to support the weight of the ring raised above the level.

We proceed now to consider the action of the plate upon the superficial stratum. Trace a canal at right angles to the plate, of the same depth with the superficial film, and having its horizontal width equal to unity, and continue the canal till it terminate in a vertical plane PS, parallel to the plate. Let n be the small portion of the canal within the sphere of the plate's attraction, and suppose the canal to be divided in its whole length into the parallelopipeds m, m, m, &c., each equal to n. It is plain that the attractions of the fluid below the canal, and on the two sides of it, have no tendency to impel it in any direction, nor to impede the motion of the fluid along it. The canal is also in equilibrium with regard to gravity, since by the hypothesis it is horizontal. The rectangular wedge of fluid beyond the plane PS will attract the small parallelopiped contiguous to it with a force proportional to $\frac{1}{2}$K, because K denotes the attractive force of two rectangular wedges, sect. 5; and the same parallelopiped will also be attracted with an equal force in the opposite direction by the one next to it. In like manner, every parallelopiped in the canal is attracted with equal forces by those contiguous to it on opposite sides, except the one in contact with the plate, which is attracted in the direction of the canal with the force $\frac{1}{2}$K, and towards the plate with the force K′, depending upon the intensity of the plate's attraction for the fluid.

Now, if K′ be just equal to $\frac{1}{2}$K, which will happen when the intensity of the plate's attraction is half that of the fluid, the parallelopiped n will be situated, with regard to the forces that act upon it, similarly to the others in the canal; in this case, therefore, the insertion of the plate will not disturb the equilibrium of the fluid, the surface of which will remain horizontal.

If K′ be greater than $\frac{1}{2}$K, it may be resolved into two parts, $\frac{1}{2}\text{K} + (\text{K}' - \frac{1}{2}\text{K})$, of which one will counterbalance the opposite force, and reduce the canal to equilibrium; and the other part, $\text{K}' = \frac{1}{2}\text{K}$, will act only upon the parallelopiped n, and will compress it upon the surface of the plate. The compression will produce a lateral force proportional to $\text{H}' - \frac{1}{2}\text{H}$, which urges the small fluid mass to spread itself towards every side; and as this force is unopposed vertically upward, the equilibrium of the fluid will be disturbed; the superficial film will ascend all round the plate, and, by means of the force of cohesion, will carry with it a portion of the fluid till the suspended weight is sufficient to counterbalance the force acting upward.

When K′ is less than $\frac{1}{2}$K, the parallelopiped in contact with the plate will be more attracted in the direction of the canal than towards the plate. When this happens the fluid is depressed below the level by capillary action; but we shall leave this case to be afterwards considered, and at present confine our attention to the former case, when the fluid is elevated above the level.

Ring upon the surface of a solid body plunged in a fluid.

7. When the immersion of the plate causes an elevation, the fluid will assume the form of a concave ring, as KLM (fig. 4). If we suppose a superficial canal divided into parallelopipeds as before, we may prove by like reasoning that the attraction of the solid matter has no tendency to disturb the equilibrium of the fluid except by the lateral force which it communicates to the small parallelopiped in contact with it. And since the attractive force of the plate upon the particles of the fluid depends only upon their perpendicular distance from its surface, it readily follows that the lateral force will undergo no variation, but will remain constantly equal to $\text{H}' - \frac{1}{2}\text{H}$, both during the rising of the ring, and when it has attained the greatest elevation. The reciprocal attraction of all the fluid in the vessel likewise produces pressures that are propagated inward from the surface of the fluid, and from the sides and bottom of the vessel, sect. 3; but these forces cannot be in equilibrium with the ring and the disturbing force arising from the plate's attraction. For the former forces have no tendency to move the centre of gravity of the whole mass, whereas the latter tend to produce motion in that point, each in its own direction. In the case of equilibrium, therefore, the vertical force arising from the plate's attraction must be equal to the weight of the suspended ring; or, which is the same thing, $\text{H}' - \frac{1}{2}\text{H}$ will express the weight of a portion of the ring in every unit of the horizontal extent.

The vertical force produced by the attraction of the solid matter begins to act the instant the fluid comes into contact with the solid; it first causes the ring to rise, and then keeps it suspended.

If m^2 denote the area of a section of the ring made by a vertical plane perpendicular to the surface of the plate, then m^2, or $m^2 \times 1$, will be the volume of a portion of the fluid equal in weight to $\text{H}' - \frac{1}{2}\text{H}$.

Elevation of a fluid between two parallel plates.

If two parallel plates, AB and CD (fig. 5), very near one another, have their lower ends immersed in a fluid, it is observed that the fluid will rise between them above the natural level. Conceive a superficial canal extending between the plates in a direction at right angles to their surfaces, having its depth equal to the greatest range of the corpuscular force, and its horizontal width equal to unit; then all the fluid below the canal will be in equilibrium with respect to the attractive forces that act upon it, and therefore the suspended weight must be supported by the action of the two plates upon the canal. Of the forces which act upon the canal, we may neglect the attraction of the fluid below it, which causes the particles in the inside to press perpendicularly on the bottom. At each end it is attracted by the plates with a force equal to K′, or $\frac{1}{2}\text{K} + (\text{K}' - \frac{1}{2}\text{K})$, and, at the vertical sides between the

plates, by the fluid on the outside with a force equal $\frac{1}{2}$K. Wherefore, when the canal is reduced to equilibrium by equalizing the pressure upon its sides, there will remain at each end an excess of force equal to K′—$\frac{1}{2}$K, which compresses the fluid upon the plates; and the compressive force is necessarily accompanied with a lateral pressure equal to H′—$\frac{1}{2}$H, which tends upwards and supports the weight of the fluid suspended below the canal.

Hence the weight elevated between the plates, in the horizontal length λ, is equal to $2(H'-\frac{1}{2}H) \times \lambda$; and, since $m^2 \times 1$ is the volume corresponding to the weight $(H'-\frac{1}{2}H) \times 1$, the volume corresponding to the weight $2(H'-\frac{1}{2}H) \times \lambda$ will be equal to $2m^2 \times \lambda$. Let D denote the distance of the plates, and Q the least height of the curve surface between them above the natural level; then, if we conceive a horizontal plane touching the curve surface at its lowest point, the whole fluids between the plates in the length λ will be composed of a small curved portion in the shape of a meniscus, and a parallelopiped equal in volume to $\lambda \times D \times Q$. Now, when the plates are very near one another, and the elevation is considerable in comparison of their distance, the meniscus will be so small that the parallelopiped alone may be reckoned equal to the whole volume of the fluid. Hence, if we equate the two expressions of the same bulk, we shall get

$$D \times Q = 2m^2;$$

which proves that the elevations of a fluid between plates of the same matter are reciprocally proportional to the distances of the plates; and this agrees with observation.

Elevation of a capillary tube. When a capillary tube, or one with a bore less than one tenth of an inch, is partly plunged in a fluid, the fluid will rise within the tube above the level on the outside. Let AB and CD (fig. 5) represent the sides of such a tube, MHN the curve surface of the elevated column, having below it an imaginary surface at a depth equal to the range of the corpuscular force, and conceive two planes intersecting one another in the axis of the tube at any angle, then all the fluid below the superficial stratum will be in equilibrium with regard to the attractions to which it is subjected; and the triangular portion of that stratum, bounded by the inside of the tube, and the two planes intersecting in the axis, would likewise be in equilibrium, if the pressures upon all its vertical sides were equal. But the side in contact with the tube is attracted with a force equal to K′, or $\frac{1}{2}K + (K' - \frac{1}{2}K)$; and each of the other two sides is attracted with a force equal to $\frac{1}{2}$K; therefore, when the equilibrium of the attracting forces is provided for, there will remain an unbalanced pressure, proportional to K′—$\frac{1}{2}$K, upon the inside of the tube; and this direct compressive force is accompanied with a lateral tendency, proportional to H′—$\frac{1}{2}$H, which is directed upward, and sustains the elevated fluid between the two intersecting planes.

If π denote the circumference of a circle that has its radius equal to unit, and r the radius of the capillary tube, then $(H' - \frac{1}{2}H) \times r\,\pi$ will be the weight of the elevated column of fluid within the tube, and $m^2 \times r\,\pi$ will be its bulk. Conceive a plane which touches the curve surface of the column at its lowest point, and let q be the height of that point above the level on the outside of the tube, then the elevated column will consist of a cylinder equal to $\frac{1}{2}\,r^2\,\pi\,q$, and a small meniscus above the cylinder; so that, in very small tubes, the cylinder may be taken for the whole bulk of the column; wherefore, by equating the two expressions of the same bulk, we get

$$\tfrac{1}{2}\,r \times q = m^2;$$

which proves that, in small tubes of the same matter, the elevations are reciprocally proportional to the radii or diameters of the tubes.

And because m^2 is the same in all cases, when plates and tubes of the same matter act on the same fluid, if we equate the values of it taken from the last expression, and from the expression formerly obtained for two plates, we shall get

$$H \times Q = r \times q;$$

and this shows that a fluid will rise between two plates, to the same height it would do in a tube of the same matter having its radius equal to the distance of the plates.

Theory of Dr Jurin. The deductions that have now been drawn from the principle of a corpuscular attraction evanescent at all sensible distances, are equivalent to the account of capillary action founded on the hypothesis of Dr Jurin. Whatever may be thought of the physical principle advanced by this philosopher, it must be allowed that his theory agrees well with observation; and it cannot be denied that he has, with great sagacity, inferred from his experiments the true place in which the capillary force resides. But it is impossible to accede to his opinion, that, when a capillary tube of glass is immersed in water, the water within the tube is attracted upward by a narrow ring of glass immediately above the surface of the liquid. If the glass attract the water, the attraction must be perpendicular to the surface of the glass; the force acting on the fluid cannot be vertical, it must be horizontal; and if we would reason strictly, the proper inference must be, that an attraction between the glass and the water is alone insufficient to account for capillary action. In order to explain the phenomena, it is necessary to attend to the remark of Professor Leslie, founded on the properties essential to fluidity, namely, that a fluid cannot be attracted horizontally by a solid body, without having a vertical force communicated to it. It is certainly not a little surprising, that an observation made in 1802, so well calculated to remove all the difficulties of the theory, should have passed entirely unnoticed, although, since that period, the subject has engaged the attention of the first philosophers of the age.

In what goes before, it has been shown that, in many cases, the height to which a fluid will rise may be found with considerable exactness, by comparing the bulk as determined by the magnitude of the capillary force with the same bulk deduced from the figure which the displaced fluid is constrained to assume; but a rigorous investigation of all the circumstances attending the capillary phenomena requires further, that we know the nature of the curve assumed by that part of the fluid's surface which is free to obey the impulse of all the forces that act upon it; and it is to this branch of the subject that we are now to proceed.

8. Resuming the first and simplest case of a single plate immersed in a fluid, which rises upon its surface in a concave ring, let a vertical plane PL (fig. 4), parallel to the plate, and at a distance from its surface greater than the range of the corpuscular force, be drawn to intersect the curve; then the part of the ring cut off, being without the sphere of the plate's attraction, must be supported by the force with which it is attracted by the fluid between the plate and the plane. Now, all the fluid below the superficial stratum is in equilibrium with regard to the corpuscular forces to which it is subjected; and hence it is the attraction of the fluid between the plate and the plane upon the superficial stratum which supports the part of the ring below the plane, in the same manner that the attraction of the plate upon the same stratum supports the whole ring. All the fluid in the vessel being supposed in equilibrium, we may conceive that the portion of it between the plate and the plane is converted into a solid without any other change of its properties; then if we consider that part of the superficial canal which lies between the vertical plane and the level surface of the fluid,

the upper end of it will be pressed against the imaginary solid by the attraction of an obtuse-angled wedge of the fluid, while the pressure upon all the other vertical sides is only equal to the attraction of a right-angled wedge; and the difference of these forces remaining unbalanced, generates the force which tends upward, and supports the weight of the part of the ring situated below the point of its action.

It is now necessary to determine the attractive force of a portion of a fluid, in the shape of a wedge, contained in any proposed angle. Suppose that a fluid mass bounded by the plane AB (fig. 6) is divided by the plane PQ; and let it be required to find the force with which the attraction of the particles contained in each of the wedges APQ and BPQ will cause a small drop placed at P to press upon the plane AB. Draw PN and PG to bisect the angles APQ, BPQ; let the line PH, perpendicular to the plane AB, represent the force K, or the pressure of the drop caused by the attraction of all the fluid below the plane, sect. 3; and draw HN and HG perpendicular to PN and PG. It is manifest that the attraction of all the particles in the wedge APQ is a force in the direction PN; and, in like manner, the attraction of the particles in the wedge BPQ is a force in the direction PG. Wherefore, since PH, the united effect of both attractions, is resolved into the forces PN and PG, it follows that PN will represent the attraction of the obtuse-angled wedge upon the drop, and PG that of the acute-angled wedge. Draw NO and GL perpendicular to PH; then PO is the part of the force PN acting at right angles to the plane AB, and PL is the like part of the force PG. Draw NG, and let φ denote the angle HPQ, or the difference of each of the angles APQ and BPQ from a right angle. Then NG and PH are equal and bisect one another. Also, the angle PHG = BPG, each being the complement of HPG. Wherefore GCP = 2PHG = 2BPG = BPQ; and, taking the complements of the equal angles, CGL = CNO = HPQ = φ. Now GC = $\frac{1}{2}$PH = $\frac{1}{2}$K; hence CL=CO = $\frac{1}{2}$K sin. φ; therefore PO = $\frac{1}{2}$K + $\frac{1}{2}$K sin. φ, and PL = $\frac{1}{2}$K — $\frac{1}{2}$K sin. φ. Thus the pressure of the drop upon the plane AB, caused by the attraction of the obtuse-angled wedge, is equal to $\frac{1}{2}$K + $\frac{1}{2}$K sin. φ; and that caused by the attraction of the acute-angled wedge is equal to $\frac{1}{2}$K — $\frac{1}{2}$K sin. φ.

Curve formed upon the surface of a solid.

Returning now to the canal below the vertical plane PL (fig. 4), and the level surface of the fluid, let θ denote the inclination of the curve at L to the horizon; the canal would be in equilibrium with respect to the corpuscular forces that act upon it, if the attractions upon all its vertical sides were equal. But, according to what has just been investigated, the upper end is attracted by the fluid beyond the vertical plane PL, with a force equal to $\frac{1}{2}$K + $\frac{1}{2}$K sin. θ; and the attraction upon each of the remaining sides is only equal to $\frac{1}{2}$K; wherefore there is an excess of attraction equal to $\frac{1}{2}$K sin. θ, which causes the drop of liquid at the upper end of the canal to press upon the fluid above it, and which will be attended with a lateral force, equal to $\frac{1}{2}$H sin. θ, acting upward and sustaining the part of the ring cut off by the vertical plane.

Let $\beta^2 \times 1$ denote the volume of a portion of the fluid equal in weight to $\frac{1}{2}$H. Then $\frac{1}{2}$H sin. θ will be the weight, and β^2 sin. θ the bulk, of the partial ring cut off by the plane PL in the horizontal extent equal to unit. Let y denote the vertical ordinate of a point in the curve, formed by the intersection of the ring, with a vertical plane perpendicular to the plate; and let x be the corresponding horizontal ordinate, or the distance of y from the plate. Then the area of the curve below the point L is equal to $\int ydx$, the fluent vanishing with y; and the volume of partial ring in the horizontal extent equal to unit, is equal to $1 \times \int ydx$. Hence if we put $z = \sin.\theta$, and equate the two expressions of the same bulk, we shall get these equations, which are sufficient to determine the nature of the curve, viz.

$$\beta^2 z = -\int ydx$$

$$-\frac{dy}{dx} = \frac{z}{\sqrt{1-z^2}}:$$

the negative signs must be used, because z and y both decrease when x increases.

From the first of these equations we get

$$-ydx = \beta^2 dz;$$

and, if this be multiplied into the second equation, there will result

$$ydy = \frac{\beta^2 zdz}{\sqrt{1-z^2}};$$

that is, since $z = \sin.\theta$, $ydy = \beta^2 d\theta \sin.\theta$; whence $y^2 = 2\beta^2 (1 - \cos.\theta) = 4\beta^2 \sin.^2 \frac{1}{2}\theta$; and

$$y = 2\beta \sin.\tfrac{1}{2}\theta.$$

Again, $dz = d\theta \cos.\theta = d\theta(1 - 2\sin.^2\frac{1}{2}\theta)$; therefore

$$-dx = \frac{\beta^2 dz}{y} = \beta \cdot \left\{\frac{\frac{1}{2}d\theta}{\sin \frac{1}{2}\theta} - 2\cdot\tfrac{1}{2}d\theta \sin.\tfrac{1}{2}\theta\right\};$$ and hence

$$-x + \beta \log.\tan.\tfrac{1}{4}t - 4\beta \sin.^2\tfrac{1}{4}t = \beta \log.\tan.\tfrac{1}{4}\theta - 4\beta \sin.^2\tfrac{1}{4}\theta,$$

t being the value of θ when $x=0$. Therefore

$$x = \beta \times \log.\frac{\tan.\frac{1}{4}t}{\tan.\frac{1}{4}\theta} - 4\beta\left\{\sin.^2\tfrac{1}{4}t - \sin.^2\tfrac{1}{4}\theta\right\}$$

The value of the ordinate shows that x increases without limit as y decreases; whence it follows that the curve has an asymptote in the level surface of the fluid.

Curve between two parallel plates.

In like manner, we may investigate the curve formed by the intersection of the fluid between two parallel plates and a vertical plane perpendicular to the plates. Let y denote the height above the natural level of a point in the curve, and x the distance of y from the middle of the plates, or from the point where y is least. Suppose two vertical planes, PO and QR (fig. 5), parallel to the plates and at equal distances from them; then, as before, the fluid on the outside of the planes PO and QR will attract the ends of the superficial canal between them with a force equal to $\frac{1}{2}$K + $\frac{1}{2}$K sin. θ; and, as the part $\frac{1}{2}$K is alone sufficient for the equilibrium of the canal, it follows that the other part $\frac{1}{2}$K sin. θ will compress the fluid in contact with the two planes, producing thereby a lateral pressure that tends upward and sustains the weight of the suspended fluid. Hence the weight of the fluid suspended between the planes PO and QR, in every unit of the horizontal length, is equal to $2 \times \frac{1}{2}$H sin. θ; and its bulk is equal to $2\beta^2$ sin. θ. But the same bulk is also equal to $2 \times \int ydx$, the fluent vanishing with x. Wherefore, by putting $z = \sin.\theta$, and equating the two expressions of the same bulk, we get the equations

$$\int ydx = \beta^2 z,$$

$$\frac{dy}{dz} = \frac{z}{\sqrt{1-z^2}},$$

which determine the nature of the curve.

By combining the two equations, we get $ydy = \frac{\beta^2 zdz}{\sqrt{1-z^2}}$: now let $u = \sin.\frac{1}{2}\theta$; then $z = \sin.\theta = 2u\sqrt{1-u^2}$, and $\frac{dz}{\sqrt{1-z^2}} = \frac{2du}{\sqrt{1-u^2}}$: hence $ydy = 4\beta^2 udu$, and

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$$y = 2\beta\sqrt{q^2 + u^2},$$

$2\beta q$ being the height of the lowest point of the curve above the level.

Again, $dx = \frac{\beta^2 dz}{y} = \beta \cdot \frac{du(1-2u^2)}{\sqrt{(1-u^2)(q^2+u^2)}}$; therefore,

$$x = \beta \cdot \int \frac{du(1-2u^2)}{\sqrt{(1-u^2)(q^2+u^2)}};$$

and x will be obtained by the rectification of the conic sections.

Curve surface in a capillary tube.

In the case of a capillary tube, conceive an imaginary tube, of which the sides are PO and QR (fig. 5), within the real one, and let θ denote the inclination of the curve surface to the horizon at the points P and Q. The elevated column within the imaginary tube is supported by the attraction of the fluid between the two tubes, in the same manner that the whole capillary column is supported by the attraction of the solid matter of the real tube. The fluid in contact with the imaginary tube on the outside having the shape of a wedge contained in the obtuse angle $90° + \theta$, will attract the fluid in the inside in a horizontal direction with a force equal to $\frac{1}{2}K + \frac{1}{2}K \sin. \theta$; and of this force, the part $\frac{1}{2}K \sin. \theta$ will compress the fluid ring on which it acts, producing, by this means, a lateral tendency upward, proportional to $\frac{1}{2}H \sin. \theta$, which supports the weight of the suspended column. If r denote the radius of the imaginary tube, then $\frac{1}{2}H \sin. \theta \times r\pi$ will be equal to the weight, and $\beta^2 \sin. \theta \times r\pi$ to the bulk of the elevated column within that tube; and if y be the vertical ordinate of a point in the curve surface, or the height above the natural level, and r the horizontal distance of y from the axis of the tube, the bulk of the same column will be equal to $\pi\int yrdr$, the fluent vanishing with r. Wherefore, by equating the equivalent expressions, we shall get the following equations, which determine the nature of the curve surface, viz.

$$\beta^2 rz = \int yrdr,$$

$$\frac{dy}{dr} = \frac{z}{\sqrt{1-z^2}}.$$

If these equations be combined so as to exterminate y, a differential equation between r and z will be obtained, viz.

$$\frac{d.\left(\frac{d.rz}{rdr}\right)}{dr} = \frac{1}{\beta^2} \times \frac{z}{\sqrt{1-z^2}}.$$

Curve when a fluid is depressed below the level.

9. Having explained the most remarkable instances of elevation by capillary action, we must now turn our attention to the cases where a fluid is depressed below the level by the same cause. It has been shown that an elevation will always take place when K′ and H′ are greater than $\frac{1}{2}K$ and $\frac{1}{2}H$, and that the fluid will remain level when the same quantities are equal. It follows, therefore, that the fluid will sink below the level when the former quantities are less than the latter; or otherwise there could not be an equilibrium. The shortest and most perspicuous manner of explaining the cases when a fluid is depressed is to compare them with the similar cases of an elevation. Suppose that AB and *ab* (fig. 7 and 8) are two plates of different kinds of matter immersed in the same fluid, which they attract with intensities equally above and below the mean quantity $\frac{1}{2}K$, we shall prove that the same curve which is formed above the level on the surface of the one, will be in equilibrium by the action of the other when placed upon its surface in a reversed position below the level.

Conceive the two curves to be intersected at intervals equal to the range of the corpuscular force by an indefinite number of planes parallel to the plates; and let the curves at L and l have the same inclination, θ, to the horizon. In the curve above the level (fig. 7), it has been shown that the force which tends upward, and supports the part of the ring below L, is equal to $\frac{1}{2}H \sin. \theta \cdot$ and, in like manner, the force which supports the part of the ring below the point O, indefinitely near L, is equal to $\frac{1}{2}H.(\sin. \theta + d \sin. \theta)$. Therefore the difference of these forces, or $\frac{1}{2}H \cdot d \sin. \theta$, which may be considered as a force urging the curvilineal element OL upward, is equal to the weight of the fluid elevated between the planes passing through O and L. In effect, if we put y and x to denote the vertical and horizontal ordinates of the point L, and equate the two expressions of the bulk of the small portion of fluid above mentioned, we shall get

$$\beta^2 d \sin. \theta = \beta^2 dz = ydx,$$

which is no other than the differential of the equation formerly obtained (sect. 7). We may therefore conceive that every element of the curve is urged upward with a force equal to the weight of the elevated fluid below it, the attraction of the plate supplying the force necessary to sustain the accumulated weight of all the suspended fluid.

In the curve below the level (fig. 8), the fluid on the same side of the plane *tl* with the plate *ab*, attracts the particles on the other side of that plane; and as the attracting fluid forms an acute-angled wedge contained in the angle $klt = 90° - \theta$, the horizontal attraction will be equal to $\frac{1}{2}K - \frac{1}{2}K \sin. \theta$; and the lateral force thence arising, and acting vertically, to $\frac{1}{2}H - \frac{1}{2}H \sin. \theta$. The point l of the curve is therefore urged upward by the attraction of the fluid between it and the plate *ab*, with a force equal to $\frac{1}{2}H - \frac{1}{2}H \sin. \theta$; and in like manner, the point o indefinitely near l, tends upwards with the force $\frac{1}{2}H - \frac{1}{2}H \cdot (\sin. \theta + d \sin. \theta)$. The difference of these forces, which may be considered as a force applied to the curvilineal element *ol*, is equal to $-\frac{1}{2}Hd \sin. \theta$; and it is the same in quantity as in the other curve, but has an opposite direction. The difference in the directions of the two forces acting upon the elements of the two curves arises from this, that, in the curve above the level, the force acting upward continually increases from the level surface to the plate, whereas, in the curve below the level, it continually decreases. Again, because OL and *ol* are placed at equal distances above and below the general level of the fluid, the weight drawing the element OL downward will be just equal to the vertical pressure caused by the superincumbent fluid, and urging the element *ol* upward. It thus appears that the forces which act upon the like elements of the two curves are the same in quantity, but that they have their directions reversed; which proves that, because the one curve is in equilibrium, the other will be so too; at least this will be the case if the attraction of the plate *ab* be sufficient to maintain the lowest point of the convex curve in its place.

The parts of the curves between the level surface of the fluid and the planes TL and *tl* are kept in their places by the horizontal attraction of the fluid on the other side of the same planes. These attractions are respectively equal to $\frac{1}{2}K + \frac{1}{2}K \sin. \theta$, and $\frac{1}{2}K - \frac{1}{2}K \sin. \theta$; and the one as much exceeds the mean quantity $\frac{1}{2}K$ as the other falls short of it. Now, in place of the attractions of the fluid particles contained in the wedges KLT and *klt*, we may substitute the attractions of two solid plates that act upon the fluid with equal forces; and these plates will come under the condition we have supposed with respect to the attractions of the plates AB and *ab*. It follows, therefore, that, because the attraction of the plate AB main-

tains the concave curve in its place, the attraction of the plate ab will be sufficient to maintain the convex curve in its place.

It is evident that the same reasoning which has been applied to two solid plates will apply equally in all other cases, and we may lay down this general proposition, viz. If two solid bodies, perfectly equal and similar, but composed of different kinds of matter, be immersed in a fluid which they attract with intensities equally different from the mean quantity $\frac{1}{2}$K, the fluid will be raised above the level by the action of the one, and depressed below the level by the action of the other, and the convex curve below the level will differ from the concave curve above the level in no respect, except that it will have a reversed position.

Limit to the elevation and depression of a fluid.

As no bounds can be set to the attractive force which a solid body exerts upon the particles of a fluid, it may be asked, will the weight displaced by capillary action increase in proportion to the attraction of the solid? or, are there any conditions that confine the effect within a certain limit, however great may be the attraction of the solid? In answer to this, it must be observed, that the action of the solid matter is confined to a thin film of the fluid in contact with it; and that it is this film alone which acts on the particles beyond it, and keeps them suspended by means of the force of cohesion. Hence the weight maintained above the level can never exceed what this last force is able to support. The elevation of the fluid will there be regulated by the attractive force of the solid matter, only so long as that force is less than the mutual attraction of the fluid particles; and the fluid will always rise to the same height when the attraction of the solid matter is either equal to or greater than the fluid's cohesion. In all these cases, the solid is wetted by the fluid, and we may conceive that it becomes covered with a coating of sufficient thickness to shield the particles on the outside from the attraction of the solid matter, a new body being thus formed, which attracts the fluid with a force equal to its own cohesive power.

From the relation that has been shown to take place between the cases of equal elevation and depression, it follows that the greatest depression will take place when a solid has no attraction for the particles of a fluid. If we go beyond this limit, and suppose that the solid matter repels the fluid, the capillary effect will not be heightened; for the repulsive force will be confined to the particles within the range of its action; beyond this insensible distance the repelling power will produce no effect, and the fluid will be left to assume the same figure it would do if no such power existed.

10. In the several cases that have been considered, the weight of the fluid suspended below that point of the curve surface which is inclined to the horizon in the angle θ, has been found to be equal to $\frac{1}{2}$H sin. θ; wherefore, if ε denote the angle of contact, or the angle in which the surface of the fluid intersects the solid, then $90°-\varepsilon$ will be the limit of θ, or what θ becomes at the surface of the solid; and consequently the weight of the whole fluid suspended by capillary action will be equal to $\frac{1}{2}$H cos. ε; but, as has likewise been proved (sect. 7), the same weight is also equal to $H'-\frac{1}{2}H$; and hence, by equating the equivalent quantities, we get

$$H' = H \cos.^2 \tfrac{1}{2}\varepsilon.$$

This expression is possible only when H′ is not greater than H; but we must not infer that the theory leads to any contradiction in the case where a solid body attracts the particles of a fluid with an intensity greater than their own mutual action upon one another. The equation is a consequence of the equality that takes place between the vertical force $H'-\frac{1}{2}H$ derived from the attraction of the solid, and the weight of the displaced fluid deduced from the figure which the attraction of its own particles causes it to assume. It is, therefore, only the effective part of the force $H'-\frac{1}{2}H$, or that which is really employed in displacing the fluid, that can enter into the equation; and when a part of the same force has no effect in elevating or depressing the fluid, that part must be neglected. Now it has been proved that, however great the force $H'-\frac{1}{2}H$ may be, the capillary effect can never exceed that produced by the force $H'-\frac{1}{2}H$ (sect. 9); and hence it appears, from the principle on which the investigation proceeds, that, in the equation, H′ must be limited not to exceed H, which must be taken for its value in all cases when the solid matter acts upon the fluid particles with an intensity either equal to or greater than their own mutual attraction.

From this equation it follows that the angle of contact is always the same when different solids of the same attractive powers are immersed in the same fluid, a property that was first noticed by Dr Young.

The weight of the displaced fluid being equal to $\frac{1}{2}$H cos. ε, is in every case proportional to the cosine of the angle of contact.

Investigation of Laplace's formula for the attraction of a fluid mass bounded by a curve surface.

11. In order still farther to illustrate and confirm the principles of the theory we have been explaining, we shall conclude this article with applying them to demonstrate the formula found by Laplace for the attraction of a fluid mass bounded by a curve surface.

Conceive a fluid mass bounded by a curve surface concave outward, and let the plane MAN (fig. 9) be a tangent, and the straight line AO a normal, to the curve surface at any point A; through AO draw any two planes perpendicular to one another, which cut the surface of the fluid in the curve lines BA and CA, and let DC and DB be two other sections of the fluid's surface made by planes parallel to the first planes, and indefinitely near them. Put ds and ds' for the small curve lines AB and AC; and $d\theta$ and $d\theta'$ for the measures of the small angles which the tangents drawn to the curve lines from the points B and C make with the tangent plane MAN. The four planes intersecting the fluid contain within them a rectangular prism, standing upon the base ABDC, and extending into the interior of the fluid mass at right angles to the curve surface; it is required to find the force which urges the prism outward above the tangent plane.

Conceive a surface intersecting the prism at a depth below its base equal to the range of the corpuscular force; then all the fluid of the prism below this imaginary surface being an equilibrium with regard to the attractions to which it is subjected, we have only to examine the forces that act upon the superficial stratum. It is attracted by the particles below the imaginary surface, and by the fluid on the outside of the force bounding planes. The attraction of the particles below the imaginary surface is at every point perpendicular to that surface; and therefore the stratum would be in equilibrium, if the attractions upon its four sides were equal. The fluid on the outside of each of the two planes AB and AC is a rectangular wedge; and consequently the attractions upon the particles within the stratum causing them to press perpendicularly upon these planes, are each proportional to $\frac{1}{2}$K. On the outside of the plane DC, the fluid is a wedge contained in the obtuse angle $90°+d\theta'$; and on the outside of the plane BD, it is a wedge contained in the obtuse angle $90°+d\theta$; the attraction is therefore proportional to $\frac{1}{2}K+\frac{1}{2}K d\theta'$ in the first case, and to $\frac{1}{2}K+\frac{1}{2}K d\theta$ in the other case. Hence, after the attractions upon the sides of the stratum are equalized, there is an excess of force perpendicular to each of the planes CD and DB,

amounting respectively to $\frac{1}{2}\mathrm{K}d\theta'$ and $\frac{1}{2}\mathrm{K}d\theta$. These direct forces produce the corresponding lateral pressures $\frac{1}{2}\mathrm{H}d\theta'$ and $\frac{1}{2}\mathrm{H}d\theta$; of which the first is the force in the length equal to unit, urging the fluid in contact with the plane CD to ascend above the tangent plane, and the second is the like force acting upon the fluid in contact with the plane BD. Therefore the actual forces which, in the lengths DC and DB, impel the superficial stratum, and consequently the prism attached to it by cohesion, above the tangent plane, are respectively equal to $\frac{1}{2}\mathrm{H}d\theta' ds$ and $\frac{1}{2}\mathrm{H}d\theta ds'$. It must be observed that these forces, like the curvatures from which they arise, are independent of one another; and that any alteration in the intensity of one will in no degree affect the action of the other. We may therefore conceive them to be applied to the prism one after the other; in which case the centre of gravity of the prism will have the same motion communicated to it as it would have if it were acted upon by the sum of both, or by the single force,

$$\tfrac{1}{2}\mathrm{H}d\theta' ds+\tfrac{1}{2}\mathrm{H}d\theta ds';$$

and this must therefore be considered as the effective force which pushes the prism above the tangent plane.

Let R and R′ be the radii of the circles that have the same curvature with the sections BA and CA, at the point A; then the small arcs AB and AC will subtend angles at the centres of the circles respectively, equal to $d\theta$ and $d\theta'$; consequently $ds=\mathrm{R}d\theta$, and $ds'=\mathrm{R}'d\theta'$; $d\theta=\frac{ds}{\mathrm{R}}$, and $d\theta'=\frac{ds'}{\mathrm{R}'}$; and if these values be substituted in the expression of the force, it will become

$$\tfrac{1}{2}\mathrm{H}\cdot\left\{\frac{1}{\mathrm{R}}+\frac{1}{\mathrm{R}'}\right\}\cdot dsds'.$$

Since ds and ds' are entirely arbitrary, we may suppose that $dsds'$, the base of the prism, is constant or equal to unit; then the measure of the attractive force arising from the curvature of the surface, and lifting the prism above the tangent plane, will be equal to

$$\tfrac{1}{2}\mathrm{H}\cdot\left\{\frac{1}{\mathrm{R}}+\frac{1}{\mathrm{R}'}\right\}.$$

This expression would not be a proper measure of the attractive force, unless $\frac{1}{\mathrm{R}}+\frac{1}{\mathrm{R}'}$ have the same value at the same point of the curve surface, for any two planes perpendicular to one another and to the curve surface; but this is a well-known property belonging to all curve surfaces.

If the surface of the fluid be convex outward, the preceding expression will become negative, and the force will change its direction and draw the prism inward, below the tangent plane.

The force arising from the curvature of the surface is independent of the direct attraction of the fluid mass upon the prism. This last force is proportional to K; it is the same whatever be the figure of the fluid, and it is always directed inward. (Sect. 3.) The whole force which draws inward a column upon a given base is, therefore, proportional to

$$\mathrm{K}-\tfrac{1}{2}\mathrm{H}\cdot\left\{\frac{1}{\mathrm{R}}+\frac{1}{\mathrm{R}'}\right\}.$$

This is the formula of Laplace; and the manner in which we have attained it proves clearly that the symbol which makes its appearance in the analytical operations of the illustrious geometer, is, in reality, the measure of the lateral pressure necessarily attending the direct attraction of the particles of a fluid.

In a fluid mass, which is subjected to no forces but the attractions of its own particles, and which is in equilibrium, if we conceive a slender canal passing through the interior and forming a communication between any two points of the surface, the canal will be in equilibrium taken separately (fig. 1). Of the forces in action at the ends, those which arise from the direct attraction of the whole mass, being equal and opposite, counteract one another in all positions of the canal; but the other forces, which depend on the curvature, and which in reality are nothing more than the lateral tendencies outward, produced by the direct attraction of the particles surrounding the two orifices, cannot be equal to one another in all positions of the canal, unless the function

$$\frac{1}{\mathrm{R}}+\frac{1}{\mathrm{R}'}$$

have the same value at all points of the curve surface, which is the case in no solid figure except a sphere. Such a body of fluid, therefore, cannot be in equilibrium, unless its form be perfectly spherical.

The formula of Laplace must be considered as a great step made in this branch of natural philosophy, not only because it ascertains the connection between the pressure and the curvature, in which it agrees with the hypothesis of Segner and Dr Young; but also because it brings into view the forces K and H, and draws the attention to the relation they have to one another, and to the primitive attraction of the particles. The labours of philosophers have discovered the facts of capillary action, which have been verified by innumerable experiments; but if the truth is to be told, it may be affirmed, that, reckoning back from the present time to the speculations of the Florentine academicians, the formula of Laplace, and the remark of Professor Leslie relating to the lateral force, are the only approaches that have been made to a sound physical account of the phenomena.

Method of computing the Depression of the Mercury in the Tubes of Barometers.

It is a problem of no small difficulty to determine the vertical ordinates of the curve surface in a capillary tube from the differential equations that have been investigated. The research possesses considerable interest, as it applies to the correction of the observed heights of the mercury in a barometer, by enabling us to compute the depression arising from capillary action. It is more particularly with a view to this application that the problem is here very briefly considered.

Resuming the equations of the curve surface in a tube, found in sect. 8, we get

$$y=\beta^2\left\{\frac{dz}{dr}+\frac{z}{r}\right\}$$

$$\frac{d\cdot\left(\frac{d\cdot zr}{rdr}\right)}{dr}=\frac{1}{\beta^2}\cdot\frac{z}{\sqrt{1-z^2}};$$

and if we put $x=\frac{r}{\beta}$, these equations will become

$$\frac{y}{\beta}=\frac{dz}{dx}+\frac{z}{x}$$

$$\frac{d\cdot\left(\frac{d\cdot zx}{xdx}\right)}{dx}=\frac{z}{\sqrt{1-z^2}}\quad\ldots\ldots(1).$$

In these equations, when $x=0$, we have $\frac{dz}{dx}=\frac{z}{x}$: and

hence, if q denote the elevation or depression, or the least value of y, then $\frac{q}{\beta} = 2\frac{z}{x}$, when $x = 0$.

When z is small, the equation (1) will coincide very nearly with the more simple equation

$$\frac{d\cdot\left(\frac{d\cdot wx}{xdx}\right)}{dx} = w \quad \ldots\ldots (2).$$

And if, in this last equation, we put $w=\lambda x$, $x^2=4t$, we shall get

$$\frac{dd\cdot\lambda t}{dt^2} = \lambda:$$

hence,

$$\lambda = 1 + \tfrac{1}{2}t + \frac{1}{1^2 2^2 3}t^2 + \frac{1}{1^2 2^2 3^2 4}t^3 + \&c.$$

Again, if we put $\lambda = c^{\frac{1}{2}\int vdt}$, c being the base of the hyperbolic logarithms, we shall get by substitution,

$$\tfrac{1}{2}\frac{dv}{dt}t + \frac{v^2}{4}t + v = 1;$$

and hence,

$$v = 1 - \frac{1}{6}t + \frac{1}{24}t^2 - \frac{1}{90}t^3 + \frac{13}{4320}t^4 - \&c.$$

Thus we have these two expressions of w, viz.

$$w = x\cdot\lambda = 2\sqrt{t}\cdot\lambda$$
$$w = x\cdot c^{\frac{1}{2}\int vdt} = 2\sqrt{t}\cdot c^{\frac{1}{2}\int vdt}$$

each of which, being multiplied by a constant quantity, will exhibit the general value, on the supposition that w vanishes with x: but the constant quantity is not necessary for the purpose we have in view.

Now, let $z = \frac{w\cdot s}{2}$: then, on account of the equations (1) and (2), we shall readily get

$$\frac{dds}{dx^2} + \frac{ds}{xdx} + 2\frac{dw}{wdx}\cdot\frac{ds}{dx} = \frac{s}{\sqrt{1-\frac{w^2s^2}{4}}} - s \ldots (A)$$

which may be thus written:

$$\frac{d\cdot\left(\frac{ds}{xdx}x^2\right)}{xdx} + 2\frac{dw}{wxdx}\cdot\frac{ds}{xdx}x^2 = \frac{s}{\sqrt{1-\frac{w^2s^2}{4}}} - s;$$

but $xdx = 2dt$, $\frac{ds}{xdx}x^2 = 2\frac{ds}{dt}t$, and $2\frac{dw}{wxdx} = \frac{1}{2}\cdot\frac{1}{t} + \frac{1}{2}v$; therefore, we have

$$\frac{d\cdot\left(\frac{ds}{dt}t\right)}{dt} + \frac{ds}{dt} + v\frac{ds}{dt}t = \frac{s}{\sqrt{1-\frac{w^2s^2}{4}}} - s;$$

and if we multiply both sides by $c^{\int vdt}$, and expand the radical on the right hand side, we shall get

$$\frac{d\cdot\left\{\frac{ds}{dt}t^2 c^{\int vdt}\right\}}{t\,dt} = \frac{t}{2}\cdot s^3\cdot c^{2\int vdt} + \frac{3t^2}{8}\cdot s^5\cdot c^{3\int vdt} + \frac{5t^3}{16}\cdot s^7\cdot c^{4\int vdt} + \&c.$$

In order to integrate this expression, assume

$$\frac{ds}{dt}t^2 = k^3\cdot M + k^5\cdot M' c^{\int vdt} + k^7\cdot M''\cdot c^{2\int vdt}, \&c.$$

$$s = k + k^3\cdot N + k^5\cdot N' c^{\int vdt} + k^7\cdot N''\cdot c^{\int 2vdt} + \&c.$$

then by substituting these values, and equating the terms containing the like powers of k, we shall get

$$\left.\begin{aligned}\frac{dM}{dt} + vM &= \frac{t^2}{2}\cdot c^{\int vdt}\\ \frac{dN}{dt} &= \frac{M}{t^2}\end{aligned}\right\}$$

$$\left.\begin{aligned}\frac{dM'}{dt} + 2vM' &= \frac{3}{8}t^3 c^{\int vdt} + \frac{3t^2}{2}N\\ \frac{dN}{dt} + vN' &= \frac{M'}{t^2}\end{aligned}\right\}$$

&c.

Now, if we expand $c^{\int vdt} = \lambda^2$ in a series, we shall get, by means of the first two equations, first a value of M, and then one of N, each in a series; and by a like procedure with the other equations, it will be found that

$$N = t\cdot Q = t\cdot\left\{\frac{t}{12} + \frac{t^2}{36} + \frac{11\cdot t^3}{1440} + \frac{t^4}{1200} + \frac{19\cdot t^5}{120960} + \&c.\right.$$

$$N' = t^2\cdot Q' = t^2\cdot\left\{\frac{t}{32} + \frac{t^2}{128} + \frac{17\cdot t^3}{5760} + \frac{t^4}{7560} + \&c.\right.$$

$$N'' = t^3\cdot Q'' = t^3\cdot\left\{\frac{t}{64} + \frac{3\cdot t^2}{640} + \frac{163\cdot t^3}{161280} + \frac{823\cdot t^4}{2257920} + \&c.\right.$$

$$N''' = t^4\cdot Q''' = t^4\cdot\left\{\frac{7\cdot t}{768} + \frac{t^2}{256} + \frac{t^3}{286720} + \&c.\right.$$

These formulæ will enable us to compute the value of Q, Q′, &c. with sufficient exactness when t is not extremely large. By substituting in the assumed value of $s = \frac{2z}{w} = \frac{2z}{x\cdot\lambda}$, and observing that $\lambda^2\ c^{\int vdt}$, we shall get

$$\frac{2z}{x\cdot\lambda} = k + k^3\cdot t\lambda^2\cdot\frac{Q}{\lambda^2} + k^5 t^2\lambda^4\cdot\frac{Q'}{\lambda^2} + \&c.$$

and hence if we put $f = \frac{kx\lambda}{2z}$, we shall have

$$1 = f + f^3\cdot\frac{Qz^2}{\lambda^2} + f^5\cdot\frac{Q'z^4}{\lambda^2} + f^7\cdot\frac{Q''z^6}{\lambda^2} + f^9\cdot\frac{Q'''z^8}{\lambda^2} + \&c.\,.\ (3)$$

In this method of proceeding the co-efficients in the series for f are in every case very small, and decrease so fast, that a few of the first terms determine the value of f with sufficient exactness. In reality, as t increases, each of the co-efficients increases from 0 to a certain limit; whence it follows that f will decrease from 1 to a certain limit, which is greater than $\frac{24}{25}$.

In order to prove what has been advanced, and to determine the limit of f, assume $w = \frac{u}{\sqrt{x}}$, and substitute in the equation (2); then,

$$\frac{ddu}{dx^2} = \left(1 + \frac{3}{4}\cdot\frac{1}{x^2}\right)\cdot u:$$

Again, put $u = c^{\int\varrho dx}$; then,

$$\frac{d\varrho}{dx} + \varrho^2 = 1 + \frac{3}{4}\cdot\frac{1}{x^2};$$

and hence,

$$\varrho = 1 + \frac{3}{8}\cdot\frac{1}{x^2} + \frac{3}{8}\cdot\frac{1}{x^3} + \frac{63}{128}\cdot\frac{1}{x^4} + \&c.$$

In consequence of the different assumptions, we have

$$w = x\cdot\lambda = \frac{c^{\int\varrho dx}}{\sqrt{x}}.$$

The expression $\frac{c^{\int\varrho dx}}{\sqrt{x}}$ will represent every value of w that vanishes with x; for it vanishes with x, and we conceive that $\int\varrho dx$ contains an arbitrary constant not necessary to be determined here.

If now we substitute this value of w in the equation (A), and observe that $2\frac{dw}{wdx} = -\frac{1}{x} + 2\varrho$, we shall get

$$\frac{dds}{dx^2} + 2\varrho\frac{ds}{dx} = \frac{s}{\sqrt{1-\frac{s^2}{4x}\cdot c^{2\int\varrho dx}}} - s.$$

and, by multiplying both sides by $c^{2\int\varrho dx}$, and expanding the radical, we have

$$\frac{d\cdot\left\{\frac{ds}{dx}c^{2\int\varrho dx}\right\}}{dx} = \frac{1}{4}\cdot\frac{s^3}{2}\cdot\frac{c^{2\int\varrho dx}}{x} + \frac{1}{16}\cdot\frac{3s^5}{8}\cdot\frac{c^{4\int\varrho dx}}{x^2} + \&c.$$

In order to integrate this expression, we may assume

$$\frac{ds}{dx} = \frac{k^3}{4}\cdot M\, c^{2\int\varrho dx} + \frac{k^5}{16} M'\, c^{4\int\varrho dx} + \&c.$$

$$s = k + \frac{k^3}{4}\cdot N\, c^{2\int\varrho dx} + \frac{k^5}{16}\cdot N'\, c^{4\int\varrho dx} + \&c.$$

then, by substituting and proceeding as before, we shall get

$$\left.\begin{aligned} &\frac{dM}{dx} + 4\varrho\cdot M = \frac{1}{2}\cdot\frac{1}{x} \\ &\frac{dN}{dx} + 2\varrho\cdot N = M \end{aligned}\right\}$$

$$\left.\begin{aligned} &\frac{dM'}{dx} + 6\varrho M' = \frac{3}{8}\cdot\frac{1}{x^2} + \frac{3}{2}\cdot\frac{N}{x} \\ &\frac{dN'}{dx} + 4\varrho N' = M' \end{aligned}\right\}$$

&c.

By means of the first two equations we get

$$N = \frac{1}{16}\cdot\frac{1}{x} + \frac{3}{64}\cdot\frac{1}{x^2} + \frac{1}{128}\cdot\frac{1}{x^3} - \frac{9}{128}\cdot\frac{1}{x^4} - \&c.$$

This series will coincide with its first term in the extreme case when x is very great; and by applying the like method of investigation to the other quantities sought, it will be found that

$N = \frac{1}{16}\cdot\frac{1}{x}$; $N' = \frac{5}{256}\cdot\frac{1}{x^2}$; $N'' = \frac{119}{12288}\cdot\frac{1}{x^3}$;

$N''' = \frac{393}{65536}\cdot\frac{1}{x^4}$. Now, let these quantities be substituted in the assumed value of s, and, because

$$w = x\cdot\lambda = \frac{c^{\int\varrho dx}}{\sqrt{x}}$$, we shall get

$$= \frac{2z}{x\cdot\lambda} = k + \frac{1}{16}\cdot\frac{k^3x^2\lambda^2}{4} + \frac{5}{256}\cdot\frac{k^5x^4\lambda^4}{16} + \&c.$$

and hence, by putting $f = \frac{kx\lambda}{2z}$, $1 = f + f^3\cdot\frac{z^2}{16} + f^5\cdot\frac{5z^4}{256} + f^7\cdot\frac{119\cdot z^6}{12288} + f^9\cdot\frac{393\cdot z^8}{65536} + \&c.$

from which we derive

$$f = 1 - \frac{z^2}{16} - \frac{z^4}{128} - \frac{35\cdot z^6}{12288} - \frac{137\cdot z^8}{98304} - \&c.$$

This is the limit to which f tends as x increases, and with which it coincides when x is infinitely great.

It remains now to apply the formulæ that have been investigated. If, in the equation $\beta^2 zr = \int yrdr$ (sect. 8), we substitute $q + y'$ for y, we shall get

$$\beta^2 z = \frac{qr}{2} + \frac{\int y'rdr}{r},$$

and the smaller the diameter of the tube, the more nearly will this equation approach to $\beta^2 z = \frac{1}{2}qr$. Therefore, l being the diameter of the tube, the value of $4\beta^2 z$ will be equal to ql, that is, to the product of the elevation or depression by the diameter of the tube, when the bore is very small. When mercury is contained in tubes of glass, the value of $4\beta^2 z$, assigned by the English philosophers, is ·015; and Laplace, from the experiments of Gay Lussac, makes it equal to ·01469. There is also some uncertainty in the value of z, or the cosine of the angle of contact, which seems to be between the limits 0·75 and 0·729. We may assume $4\beta^2 z = \cdot 015$, and $z = \cdot 735$, whence $\beta = \frac{1}{14}$; these numbers being recommended by their simplicity, and lying between the limits of the errors of observation.

Now, $t = \frac{x^2}{4} = \frac{r^2}{4\beta^2} = \left(\frac{l}{4\beta}\right)^2 = \left(\frac{7\,l}{2}\right)^2$: the series denoted by λ, and the co-efficients of the series for f, will therefore be known in numbers, and hence f may be found. Again, when $x = 0$, we have $s = \frac{2z}{x\cdot\lambda} = \frac{2z}{x} = k = \frac{q}{\beta}$; and because $x = \frac{r}{\beta} = \frac{l}{2\beta}$, we get $f = \frac{kx\lambda}{2z} = \frac{ql\lambda}{4\beta^2 z}$; and hence

$$q = \frac{4\beta^2 z}{l\cdot\lambda}\times f = \frac{\cdot 015}{l\cdot\lambda}\times f \ldots (4).$$

If we compute the value of the limit to which f approaches when l is very great, we shall find $f = 0\cdot 9635$: and hence, in the case of tubes with very large diameters, we have

$$q = \frac{\cdot 015}{l\cdot\lambda}\times \cdot 9635 = \frac{\cdot 01445}{l\cdot\lambda} \ldots (5).$$

It remains to ascertain in what cases this last formula may be safely used.

If we make l successively equal to ·3 and ·4, we shall find

$l = \cdot 3$; $t = 1\cdot 1025$; $f = \cdot 9696$; $q = \cdot 02916$;
$l = \cdot 4$; $t = 1\cdot 96$; $f = \cdot 9649$; $q = \cdot 01534$.

Now, this last value of f approaches very nearly to the ultimate value; and if q be computed by the formula (5), we shall find

$$q = \cdot 01532.$$

We may therefore use the formula (5) in all cases when the diameter of the tube is greater than four tenths of an inch. In other cases, we must compute the depression by the formula (4), having first found f by means of the following expression, in which all the quantities too small to affect the exactness of the result are left out, viz.

$$1 = f + f^3 \times \frac{z^2}{\lambda^2} \cdot \left\{ \frac{t}{12} + \frac{t^2}{36} + \frac{11 \cdot t^3}{1440} + \frac{t^4}{1200} \right.$$
$$+ f^5 \times \frac{z^4}{\lambda^2} \cdot \left\{ \frac{t}{32} + \frac{t^2}{128} + \frac{17 \cdot t^3}{5760} \right.$$
$$+ f^7 \times \frac{z^6}{\lambda^2} \cdot \left\{ \frac{t}{64} + \frac{3 \cdot t^2}{640} + \frac{163 \cdot t^3}{161280} \right.$$
$$+ f^9 \times \frac{z^8}{\lambda^2} \cdot \left\{ \frac{7 \cdot t}{768} + \frac{t^2}{256} \right.$$

To compute f from this formula, assume $f = 1 - \alpha$: Then, α being always less than $\frac{1}{25}$, its square and higher powers may be neglected.

By the procedure just described, the following table has been constructed, in which all the numbers may be reckoned exact, with the uncertainty of one unit in the last place of figures.

Table of the Depression of Mercury in Glass Tubes.

Diam. of Tube.	Depression.	Diam. of Tube.	Depression.	Diam. of Tube.	Depression.
0·05 in.	0·29494 in.	·30 in.	·02916 in.	·60 in.	·00443 in.
·10	·14028	·35	·02110	·70	·00228
·15	·08628	·40	·01534	·80	·00119
·20	·05811	·45	·01117		
·25	·04075	50	·00835		

(J. I.)

The whole of the formulæ in this article are founded on the supposition that the distance to which molecular attraction extends, is inconceivably smaller than that to which the surface of a fluid is disturbed by the immersed plate.

The admissibility of this supposition has been denied by the writer of a paper given in the *Edin. Phil. Journal*, of date Feb. 1830; he contends that, on this supposition of Laplace, a particle placed at the point P of figure 6 is attracted by the adjoining fluid in a direction normal to the surface at P; but that, being beyond the range of attraction of the plate, the only other tendency is that of gravitation, so that the resultant must be in a direction *not* normal to the surface, and that, therefore, the fluid cannot be in a state of rest.

This difficult subject is treated of in a different manner under the head HYDRODYNAMICS, which see. See also MOLECULAR ATTRACTION.

CAPILUPI, CAMILLO, a native of Mantua, who lived in the sixteenth century, and wrote a book entitled *Lo Stratagema di Carolo IX.*, which is an account of the massacre on St Bartholomew's day. It is, however, blended with some fictions.

CAPILUPI, *Lelio*, younger brother of the preceding, was born at Mantua in 1498, and distinguished himself by some centos of Virgil which display considerable ingenuity. His several Latin poems are inserted in the *Deliciæ Poetarum Italorum*. He died in 1560. His brother Julio was also distinguished as a man of letters.

CAPISCOLUS, or CABISCOLUS, in ecclesiastical writers, denotes an official in certain cathedrals, answering to what in other churches is called *chanter* or *precentor*.

CAPITAL (from the Latin *caput*, the head), is used in various ways to express the relation of a head, chief, or principal: thus, CAPITAL *City*, the principal city of a kingdom, state, or province; CAPITAL *Stock*, in commerce, the sum of money which individuals contribute to make up the common stock of a partnership; CAPITAL *Crime*, such a one as subjects the criminal to capital punishment.

CAPITANATA, a province of the kingdom of Naples, in the southern part of Italy. It is bounded on the north and the east by the Adriatic sea, on the S.E. by the provinces Bari and Basilicata, on the south by the Principato-Ulteriore, on the west by Molise, and on the N.W. by Abruzzo. Area, 2920 square miles. On the N.E. the mountainous range of Gargano covers an extent of more than 800 square miles. On the S.W. side of the province the Apennines occupy a part of the space. Though the more mountainous parts are sterile, yet between them there are rich valleys. The chief products are wheat, maize, pulse, fruits, tobacco, liquorice, hemp, flax, oil, and wine. The breeding of cattle, especially of sheep, is very extensively pursued. The manufactures are few, the principal being those of linen, coarse hats, leather, and soap; and it has some little coasting-trade with the other Italian countries. Pop. (1851) 318,415. The province is divided into three districts, namely, Foggio, St Severo, and Manfredonia. The capital is Foggio.

CAPITANIA, an appellation given to the twelve governments established by the Portuguese in the Brazils.

CAPITATION, a tax or imposition upon each head or person; a poll-tax.

CAPITE, in *Law* (from *caput*, that is, *rex*, whence *tenere in capite* is to hold of the *king*, the *head* or lord-paramount of all the lands in the kingdom), an ancient tenure of land, held immediately of the king, as of the crown, either by knight's service or by soccage.

CAPITE *Censi*, in *Antiquity*, the lowest rank of Roman citizens, so denominated because they were rather counted by their heads than by their estates. The *capite censi* formed part of the sixth class of citizens, being below the *proletarii*, who constituted the other moiety of that class. They were not enrolled in the army, as being judged unable to support the expense of war; for originally the Roman soldiers maintained themselves. It does not appear that before the time of Caius Marius any of the Roman generals enlisted the *capite censi* in their armies.

CAPITO, or KOEPSTEIN, *Wolfgang Fabricius*, an eminent Reformed divine, born 1478, died 1541. On the termination of his studies at Basle, he removed to Strasburg, where he officiated as pastor till his death. He took a prominent part in the earlier ecclesiastical transactions of the sixteenth century, was present at the second conference of Zurich, and the conference of Marburg, and along with Bucer was appointed to present to the Emperor the confession of Augsburg. From his endeavours to conciliate the Lutheran and Zuinglian parties in regard to the sacraments, he seems to have incurred the suspicions of his own friends; while from his intimacy with several divines of the Socinian school, he drew down on himself the charge of a leaning to Arianism. He first married the widow of Œcolampadius, whose life he prefixed to an edition of his Commentary on Ezekiel. His second wife was a lady of great accomplishments, who was associated with him in his studies His death was caused by the plague. He wrote *Institutionum Hebraicarum libri duo; Enarrationes in Habacuc et Hoseam Prophetas;* and *Explicatio doctissima in Hexhameron opus Dei.*

CAPITOL, CAPITOLIUM, the temple of Jupiter at Rome; or rather a general denomination under which not only that edifice, but also the citadel, was included. The former occupied the southern summit of the Mons Capitolinus (formerly named Saturnius, and also Tarpeius); while the northern and somewhat more elevated summit of the hill was crowned by the *Arx* or citadel. The Capitolium is said to have been so called because in laying its foundations the head of a man (*caput Toli*) was dug up in a fresh and perfect condition. The building was commenced by Tarquinius Priscus, and completed by Tarquinius Superbus; but it was not dedicated till the third year after the expulsion of the kings, B.C. 507, when this ceremony was performed by the consul M. Horatius. It was destroyed by fire in B.C. 83, but was rebuilt by Sulla, and dedicated by Q. Catulus in B.C. 69; and was again burnt A.D. 70, by the soldiers of Vitellius, and rebuilt by Vespasian. In the reign of Titus, A.D. 80, it was burned a third time; but Domitian restored it with greater magnificence than ever.

The temple contained, under one roof, three *cellæ*, which were consecrated respectively to Jupiter, Juno, and Minerva

The central cell was the temple of Jupiter, who is hence called *media qui sedet æde Deus.*

The form of the Capitol was a square, 200 feet on each side; the gates were of bronze; and it was approached from the forum by a flight of 100 steps. Both the inside and the outside of the building were adorned with extraordinary magnificence, the gilding alone having cost 12,000 talents, a sum equivalent to L.1,976,250 sterling. In the Capitol the Sibylline books were deposited; here the consuls and magistrates offered sacrifices when they first entered upon their offices; and hither the victorious general to whom the honour of a triumph was decreed was conducted in his triumphal car.

The ancient Capitol also contained other temples, as those of Terminus, Jupiter Feretrius, &c. The term Capitol was likewise applied to the principal temples of other cities.

The Capitoline Mount, as being the highest part of Rome, and everywhere strongly fortified, was sometimes called simply *arx;* and sometimes the term Capitolium was applied to the whole hill. Again, in contradistinction to the arx proper, the capitol itself is sometimes called *Arx Tarpeia*, or *Arx Capitolina.* The site of the ancient temple is now in part occupied by the Palazzo Caffarelli, and that of the Arx by the church of Ara Celi. The ancient name of Capitolium has been corrupted into Campidoglio.

The present buildings, forming three sides of a square, were erected by Michael Angelo; and one of them contains the magnificent collection of antiquities known as the Capitoline Museum.

CAPITOLINE Games, (*Ludi Capitolini*), annual games instituted on the suggestion of Camillus, B.C. 387, in honour of Jupiter Capitolinus, and to commemorate the escape of the capitol from capture by the Gauls. One of the amusements at these games consisted in a herald's offering the Sardiani for sale by auction, and leading about an old man with a golden bulla about his neck, and wearing a toga prætexta, for the purpose of exciting merriment. (Plutarch; Festus). This ceremony, according to some ancient writers, was designed to ridicule the conquered Veientes, who were called Sardiani from Sardis the capital of Lydia, whence they were supposed to have come; while the old man represented their king in appropriate costume, since the use of the bulla, like that of the prætexta, was derived from the Etruscans. It is, however, more probable that the name Sardiani referred to the Sardinians, who were subdued by the Romans, B.C. 238, and sold as slaves, whose bad qualities gave occasion to the proverb—*Sardi venales; alius alio nequior.*

These games, after having fallen into oblivion, were re-instituted by Domitian, and under the name of *Agones Capitolini* were celebrated every fifth year, when rewards and crowns were bestowed on poets, champions, orators, historians, and musicians. These games became so famous that, instead of computing time by lustra, they began to calculate it by the Capitoline games, as the Greeks did by Olympiads; but this custom does not appear to have been of long continuance.

CAPITOLINUS, Julius, a Roman historian who flourished towards the end of the third and beginning of the fourth century. He wrote the biographies of Antoninus Pius, Marcus Aurelius Antoninus, L. Verus, Pertinax, Clodius Albinus, Opilius Macrinus, the Maximini, the Gordians, Maximus, and Albinus. His works are classed with those of Spartianus, Gallicanus, Lampridius, Pollio, and Vopiscus, under the title "*Historiæ Augustæ scriptores sex.*"

CAPITULARIES are certain laws enacted under the auspices of kings of the Frankish race. They are called *Capitularia* by a word of no classical authority, but derived from *capitulum*, the diminutive of *caput;* and they are so described from the circumstance of their being enacted or digested *capitulatim*, by heads or chapters.[1] The term is very frequently used in a general sense, but in other instances capitularies are distinguished from laws.

The laws of the Franks were enacted "consensu populi, constitutione regis." Liberty was the chief inheritance of the ancient people of Germany; nor were they governed by laws which they had no share in enacting. It has been remarked by Dr Stuart, that "the short, but comprehensive and sentimental work of Tacitus, on the manners of Germany, is the key to the institutions, the Capitularies, and the codes of the barbarians."[2] In the opinion of the same able jurist, the foundation and principles of the Anglo-Saxon constitution are to be found in the institutions and manners of the ancient Germans; and he has accordingly endeavoured to trace the most essential principles of that constitution to the forests of Germany. But the national assemblies of those who were capable and worthy of bearing arms, appear to have been gradually superseded by a select council, composed of the two orders of the clergy and nobility; and if the great body of the people attended their deliberations, it seems to have been more in the capacity of spectators than of actual legislators. This was the form of the constitution in the time of Charlemagne, in whose name a great proportion of the Capitularies are promulgated, though some of them belong to a more recent, and others to a much more early period, the collection commencing with an enactment of King Childebert, dated in the year 554. The Capitularies are written in the Latin language, and this task was doubtless performed by the ecclesiastics. The Latin copies were deposited among the national archives, but the laws were divulged to the people in their mother tongue.[3]

Savigny, whose name ought to be familiar to all those who study the history or jurisprudence of the middle ages, has supplied us with the following statement:—"The imperial ordinances of the Franks, *Capitularia*, which, after the extension of their empire, were distinguished from the national laws, *Leges*, arose from the enlargement of the same principle. All royal enactments, particularly in later times, were called Capitularia, or Capitula. The king had a double character; the one, as chief of each individual tribe, and the other as head of the whole nation. Hence the Capitularies also are of two classes; those defining the law of a particular race; *e. g.* 'Capitula addita ad Legem Salicam,' and those of general application over the whole Frank territory. In the kingdom of the Franks, with which so many different nations were incorporated, the Capitularies are so frequently general under the Carlovingian dynasty, that when their character is not specially fixed they may be understood as belonging to that class. In Lombardic Italy on the contrary, where the Lombards and Romans were the only distinct people, most of the ordinances of Charles and his successors must be understood as constituting exclusively Lombardic law. For this reason, probably, they have been inserted in all the early collections of that law, and were consequently never obligatory on the Romans.—It is, however, of great importance to determine accurately the limits of the general Capitularies. The laws of the race of Charlemagne have been erroneously supposed to apply to all the subjects of their extensive empire. These princes reigned over three distinct kingdoms, the Frankish, Lombardic, and that which under the name of Rome and the Exarchate had recently constituted part of the Greek empire. No Capitulary, however general, could overstep the boundaries of that state in which it had originated. The only exceptions to this rule were some clerical laws; and their universal validity arose

[1] *Augustinus de Emendatione Gratiani*, p. 327, edit. Baluzii. Paris, 1672, 8vo

[2] Stuart's *Historical Dissertation concerning the Antiquity of the English Constitution*, p 108, 2d edit. Lond. 1771, 8vo.

[3] Bieneri *Commentarii de Origine et Progressu Legum Juriumque Germanicorum*, part i. p. 168. Lipsiæ, 1787-95, 2 part. 8vo.

from the unity of the church, and from the common old ecclesiastical authorities, on which they were founded. No example of a similarly general application is found in any of the temporal ordinances."[1]

The earliest editor of the Capitularies was Vitus Amerpachius, who published at Ingolstadt, in the year 1545, " Præcipuæ Constitutiones Caroli Magni de Rebus ecclesiasticis et civilibus." The history of the various editions we cannot here detail, but must refer the more inquisitive reader to the copious and elaborate preface of Baluze, who has himself surpassed all preceding and all subsequent editors. His great collection appeared under the following title: " Capitularia Regum Francorum; additæ sunt Marculfi monachi et aliorum Formulæ veteres,[2] et notæ doctissimorum virorum: Stephanus Baluzius Tutelensis in unum collegit, ad vetustissimos codices manuscriptos emendavit, magnam partem nunc primum edidit, notis illustravit." Paris, 1677, 2 tom. fol. This valuable work was long afterwards reprinted in Italy; Venetiis, 1771, 2 tom. fol. Another edition, for which Baluze had himself made preparations, remains to be mentioned:[3] " Nova editio, auctior ac emendatior ad fidem autographi Baluzii, qui de novo textum purgavit, notasque castigavit et adjecit: acessere Vita Baluzii, partim ab ipso scripta, Catalogus Operum hujus viri clarissimi, cum animadversionibus historicis, et Index variorum Operum ab illo illustratorum, quorum plurimorum novas meditabatur Editiones: curante Petro de Chiniac, Regi a Consiliis, Prosenescallo Generali Civili Userchæ, e Regia Humaniorum Litterarum Academia Montis-Albani." Paris, 1780, 2 tom. fol. This edition is splendidly printed, but is somewhat disfigured by a French translation of the preface, exhibited column for column. The Capitularies may likewise be found in two more recent publications; in Georgisch's *Corpus Juris Germanici antiqui*, Halæ Magd. 1738, 4to, and in Canciani's *Leges Barbarorum antiquæ*. Venetiis, 1781–91, 5 tom. fol. (D. I.)

CAPITULATION, the act of capitulating or surrendering to an enemy upon stipulated terms or conditions.

CAPITULATION, in German polity, a contract which the emperor entered into with the electors, in the name of the princes and states of the empire, before he was raised to the imperial dignity.

CAPITULUM, in ecclesiastical writers, denoted part of a chapter of the Bible read and explained. In this sense they said, *ire ad capitulum*, to go to a lecture. Afterwards the place or apartment where such theological exercises were performed was denominated *domus capituli*.

CAPMANY, ANTONIO DE MONTPALAN Y (1742–1813), an eminent Spanish historian and philosopher, a native of Barcelona. He spent the early part of his life in military service; but abandoning it in 1770, he removed to Madrid, where he was elected secretary of the Royal Academy of History. His principal works are, *Memorias historicas sobre la Marina, Commercio y Artes de la antiqua ciudad de Barcelona*, 4to, Madrid, 1779–1792; *Teatro historico-critico de la Elocuencia castellana*, 4to, Madrid, 1786; *Dictionario Frances-Español*, 4to, Madrid, 1805; and *Questiones criticas sobre varios puntos de historia, economica, politica y militar*, 8vo, 1807.

CAPNOMANCY (καπνος smoke, and μαντεια divination), a kind of divination by means of smoke, used by the ancients in their sacrifices. When the smoke was thin and light, and rose straight, it was a good omen; if the contrary, it was a bad one.

CAPO D'ISTRIA (the ancient *Ægida*), a fortified seaport-town of Illyria, in the government of Trieste, and circle of Istria. It stands on a small island in the gulf of Trieste. eight miles south of that city, and is connected with the mainland by a causeway half a mile in length. It is the seat of a bishopric, and has a cathedral and about thirty other churches, a citadel, gymnasium, prison, &c. It has manufactures of salt, leather, and soap; besides which it exports wine, oil, and fish. The harbour is large, but is little frequented except by fishing boats. Pop. 6000. E. Long. 13. 50., N. Lat. 45. 40.

CAPO D'ISTRIA, *John*, Count, was born at Corfu, where his father was a physician, in 1780. At first he devoted himself to the study of medicine in the academies of Padua and Venice, but joined the Russian diplomatic service when at the treaty of Tilsit the Ionian Islands were ceded to the French. He held the office of secretary for foreign affairs under the Emperor Alexander, and was president of the Greek republic after the battle of Navarino. Having been suspected of treachery to the republican cause, he was assassinated when entering a church at Napoli de Romania, October 9, 1831. See GREECE.

CAPON, a young cock that has been emasculated.

CAPONIERE, or CAPPONIERE, in *Fortification*, a covered lodgment sunk four or five feet into the ground, encompassed with a parapet about two feet high, serving to support several planks covered with earth. The caponiere is large enough to contain fifteen or twenty soldiers, and is usually placed in the glacis at the extremity of the counterscarp, and in dry moats, with embrasures through which the soldiers may fire.

CAPPADOCIA, an ancient kingdom of Asia Minor, comprehending originally all the country which lies between Mount Taurus and the Euxine Sea. It was divided by the Persians into two satrapies, which under the Macedonians were erected into two kingdoms, the one called *Cappadocia ad Taurum*, the other *Cappadocia ad Pontum*, and commonly *Pontus*. See PONTUS.

CAPPADOCIA AD TAURUM, or *Cappadocia Magna*, was bounded north by Galatia and Pontus; east by Armenia and Mount Taurus; west by Galatia and Lycaonia; and south by Mount Taurus. Its early history and condition are wrapped in obscurity. The only authentic accounts which have come down to us do not remount beyond the period of its subjection to Persia, and the native princes who held it in fief from the Persian king. The first of these was Pharnaces, who is said to have married Atossa, the sister of Cambyses, and to have been slain in a war with the Hyrcanians. The princes who succeeded him (Smerdis, Atamnas, Anaphas I. and II., Datames, Ariamnes I., Ariarathes I., and Olophernes) continued faithful to the Persian interest, and under Ariarathes II., who (disregarding the previous and somewhat fabulous line of kings), is generally called Ariarathes I., the Cappadocians continued to struggle for their independence, when the rest of the kingdom had been overrun and dismembered by Alexander the

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[1] Savigny's *Geschichte des Römischen Rechts im Mittelalter*, Bd i. S. 143. We quote Mr Cathcart's translation, the best, so far as it goes, that we have hitherto chanced upon. See likewise Eichhorn's *Deutsche Staats und Rechtsgeschichte*, Th. i. S 346, and Conringius *De Origine Juris Germanici*, p. 88, edit Helmestad, 1720, 4to.

[2] In reference to this subject, the reader may consult a work entitled "Commentatio de Marculfinis aliisque similibus Formulis, Liber singularis; auctor Dr J. A. L. Seidensticker." Jenæ, 1818, 4to.

[3] The work described in the *Biographie Universelle* as a publication of various manuscripts, is merely a catalogue of Baluze's library. "Bibliotheca Baluziana, seu Catalogus Librorum Bibliothecæ v. cl. Stephani Baluzii Tutelensis." Paris, 1719, 2 tom. 8vo. This library contained 10,799 printed books, and many hundred manuscripts. Of one of his early publications, which we had no opportunity of inspecting, we have copied a French title from Niceron, but the work is written in Latin; " Disquisitio Seculi quo vixit Sanctus Sacerdos, Episcopus Lemovicensis." Tutelæ Lemovicum, 1655, 8vo.

Great. After the death of Alexander, Perdiccas, marching into Cappadocia with a powerful and well-disciplined army, succeeded in taking Ariarathes prisoner, and crucified him and all those of the royal blood who fell into his hands. His son Ariarathes II., however, having escaped the general slaughter, fled into Armenia, where he lay concealed till the civil dissensions which arose among the Macedonians after the death of Eumenes (to whom Perdiccas had surrendered the kingdom), gave him a favourable opportunity of recovering the throne. Having defeated Amyntas in a pitched battle, he compelled the Macedonians to abandon all the strongholds, and after a long and undisturbed reign, left his kingdom to his son Ariamnes II., under whose peaceful administration Cappadocia made great progress. Under Ariarathes III., who waged a successful war with Arsaces, founder of the Parthian monarchy, the territory of Cappadocia was considerably enlarged.

He was succeeded by Ariarathes IV., who joined Antiochus the Great against the Romans, and after his defeat was obliged to atone for taking up arms against the people of Rome by paying a fine of two hundred talents. He afterwards assisted the republic with men and money against Perseus king of Macedon, and was honoured by the senate with the title of *the friend and ally of the Roman people*. He left the kingdom to his son Mithridates, who took the name of Ariarathes V.

During the reign of this prince, surnamed *Philopater*, from the strength and constancy of his filial affection, the Cappadocians remained in close alliance with Rome. In the beginning of his reign, having been relieved from an invasion by Mithrobarzanes the king of Lesser Armenia, whom he himself had placed on the throne at the intervention of the republic, he presented the senate with a golden crown, and received in return a staff and chair of ivory. Not long before this, Demetrius Soter, king of Syria, had offered Ariarathes in marriage his sister, the widow of Perseus king of Macedon, an honour which he declined for fear of offending the Romans. Demetrius, greatly incensed at the slight, set up a rival to the throne of Cappadocia in the person of Olophernes a supposititious son of the deceased king, and succeeded in driving Ariarathes from his throne.

The usurper having sent a present to Rome in token of his allegiance, contrived to make his case appear so plausible to the senate that he was invested by them with a share of the kingdom; but in the following year he was expelled by Attalus, who had succeeded Eumenes on the throne of Pergamus.

Ariarathes, being thus restored, avenged the refusal of the Priennians to restore four hundred talents of gold which Olophernes had deposited with them, and would have stormed their capital if the Romans, to whom they appealed, had not commanded him to desist. Disappointed of his revenge in this respect, Ariarathes hastened into Assyria to avenge himself on Demetrius Soter, by whose instrumentality he had been driven from the throne. By joining his forces to those of Alexander Epiphanes, who had already taken the field against the Syrian king, the war was quickly ended. In the very first engagement Demetrius was slain, and his army entirely dispersed. Some years afterwards Ariarathes, having espoused the cause of the Romans in their contest with Aristonicus, a claimant of the throne of Pergamus, he was slain in the same battle in which Crassus proconsul of Asia was taken, and the Roman army cut to pieces. He left six sons by his wife Laodice, on whom the Romans bestowed Lycaonia and Cilicia. But Laodice, fearing lest her children when they came of age should take the government out of her hands, poisoned five of them; the youngest only having escaped her cruelty by being conveyed out of the kingdom. She was soon, however, put to death by her subjects, who rose in rebellion against her tyrannical government.

Laodice was succeeded by Ariarathes VI, who soon after his accession married Laodice, daughter of Mithridates the Great, wishing to gain the alliance of that powerful prince in his contest with Nicomedes king of Bithynia, who laid claim to part of his kingdom. Mithridates, however, instead of assisting, procured the death of Ariarathes by poison, and under pretence of maintaining the rights of the Cappadocians against Nicomedes, proclaimed himself regent till the children of Ariarathes should be competent to govern the kingdom. The Cappadocians at first acquiesced; but finding him unwilling to resign the regency in favour of the lawful king, they rose in arms, expelled the foreign garrisons, and placed Ariarathes VII., eldest son of the late king, on the throne.

The new prince found himself immediately engaged in a war with Nicomedes; but, being assisted by Mithridates, not only drove him out of Cappadocia, but stripped him of a great part of his hereditary dominions. On the conclusion of the peace, the refusal of Ariarathes to recal Gordius the murderer of his father, led to a war with Mithridates. When the two armies met on the frontiers of Cappadocia, Mithridates invited Ariarathes to a conference, and openly stabbed him with a dagger which he had concealed in his dress. The terror-stricken Cappadocians immediately dispersed, and submitted to the yoke of Mithridates; but, unable to endure the tyranny of his prefects, they quickly rose in rebellion, and recalling the exiled brother of the late king they placed him on the throne. He had scarcely ascended the throne when Mithridates invaded the kingdom at the head of a numerous army, defeated the army of the Cappadocians with great slaughter, and compelled Ariarathes VIII. to abandon the kingdom. The unhappy prince soon after died of grief, and Mithridates bestowed the kingdom on his own son, a youth only eight years old, giving him also the name of Ariarathes. But Nicomedes Philopater, king of Bithynia, dreading the increase of power in a rival already so formidable, claimed the throne for a youth who pretended to be the third son of Ariarathes, and whom he sent with Laodice to Rome, to advocate his cause. Having received the declaration of Laodice that the petitioner was one of three sons which she had borne to Ariarathes, and whom she had kept concealed lest he should share the fate of his brothers, the senate assured him that they would reinstate him in his kingdom. Mithridates, receiving notice of these transactions, despatched Gordius to Rome to advocate his cause, and to persuade the senate that the youth to whom he had resigned the kingdom of Cappadocia was the lawful son of the late king, and grandson to Ariarathes, who had lost his life in the service of the Romans against Aristonicus. On receiving this embassy, the senate inquired more narrowly into the matter, discovered the whole plot, and ordered Mithridates to resign Cappadocia. The Cappadocians enjoyed their freedom for a short time, but soon sent ambassadors to Rome, requesting the senate to appoint a king. Leave was given them to elect a king of their own nation; and as the family of Pharnaces was now extinct, they chose Ariobarzanes, who received the sanction of the senate, and continued steadily attached to the Roman interest.

Ariobarzanes had scarcely taken possession of his kingdom when he was driven out by Tigranes, king of Armenia, who resigned Cappadocia to the son of Mithridates, in terms of an alliance previously concluded between them. Ariobarzanes fled to Rome, and by the assistance of Sylla, who routed Gordius the general of Mithridates, he was quickly reinstated in his kingdom. On the retreat of Sylla, however, Ariobarzanes was again driven out by Ariarathes, the son of Mithridates, whom Tigranes had set up as king. By the intervention of Sylla, Ariobarzanes was again placed on the throne; and immediately after Sylla's death he was a third time forced to abandon his kingdom, when Pompey, after

defeating Mithridates near Mount Stella, restored the unfortunate monarch, and rewarded him for his services during the war with the provinces of Sophene, Gordyene, and a great part of Cilicia. Wearied with such a succession of disasters, soon after his restoration he resigned the crown to his son Ariobarzanes, and spent the rest of his life in retirement.

Ariobarzanes II. proved no less faithful to the Romans than his father had been. On the breaking out of the civil war between Cæsar and Pompey, he sided with the latter; but after the death of Pompey he was received into favour by Cæsar, who bestowed upon him a great part of Armenia. While the emperor was engaged in a war with the Egyptians, Pharnaces, king of Pontus, invaded Cappadocia and stripped Ariobarzanes of all his dominions; but Cæsar, after defeating Pharnaces, restored the king of Cappadocia, and honoured him with new titles of friendship. After the murder of Cæsar, Ariobarzanes, refusing to join Brutus and Cassius, was declared an enemy to the republic, and soon afterwards taken prisoner and put to death. He was succeeded by his brother Ariobarzanes III., who shared the same fate at the hands of Antony. With him the royal family became extinct.

Archelaus, the grandson of the general of the same name who commanded against Sylla in the Mithridatic war, owed his elevation to the throne of Cappadocia solely to the intrigues of his mother Glaphyra with Mark Antony, to whom he remained faithful in the contests with Augustus. On the defeat of Antony, he was pardoned by the emperor at the intercession of the Cappadocians, and received Armenia Minor and Cilicia Trachæa as a reward for having assisted the Romans in clearing the seas of pirates, who infested the coast of Asia. He contracted a strict friendship with Herod the Great, king of Judea; and married his daughter Glaphyra to Alexander, Herod's son. On the accession of Tiberius (who entertained a secret hostility to Archelaus on account of his previous neglect of his merits during the lifetime of Caius Cæsar), he was decoyed to Rome by the fair promises of Livia, the emperor's mother; but being accused before the senate, and loaded with reproaches at the court, he died of grief, after a reign of fifty years.

On the death of Archelaus, the kingdom of Cappadocia was reduced to a Roman province, and governed by men of the equestrian order. It shared the fortunes of the Eastern Empire till the rise of the Turkish power and the fall of Byzantium. Under the Turkish rule it is comprehended in the Ejalet, or government of *Ssiwas*.

In the time of the Romans, the inhabitants of Cappadocia were so infamous for vice and profligacy that among the neighbouring nations a worthless man was aptly termed a *Cappadocian*. The reception of Christianity, however, produced a wondrous change on the character of the population; and in the struggles of the early church we find them taking a prominent part. In ecclesiastical history, several of its cities have become among the most famous of antiquity. Nyssa and Nazianzum, the cities of the two Gregories; Cæsarea, the city of Basil; to say nothing of Tyana and Samosata.

We have now no system of the Cappadocian laws, and scarcely anything by which to form an estimate of Cappadocian jurisprudence. Their commerce was limited to a trade in horses, great numbers of which were reared in the tablelands, and taken to the fairs of Tyre to be sold; as we learn from Ezek. xxvii. 14. It is probable that they also acted as carriers of the mineral produce of the Cappadocian Pontus.

The religion of the ancient Cappadocians resembled that of the Persians, but was largely interspersed with Grecian myths. At Comana there was a rich and stately temple in which the bloody rites of Bellona were celebrated; and the temples of Apollo, Catanius, and Jupiter, were thronged with crowds of votaries. The chief priest of Jupiter was next in rank to that of Bellona, and, according to Strabo, had a yearly revenue of fifteen talents. Diana Persica was worshipped in a city called Castaballa, where women devoted to the worship of that goddess were reported to tread barefooted on burning coals without receiving any hurt. The temples of Diana at Diospolis, and of Anias at Zela, were likewise held in great veneration both by the Cappadocians and Armenians, who flocked to them from all parts. In the latter were taken all oaths in matters of importance; and the chief priest, who was attended by a royal retinue, possessed unlimited authority over all the inferior servants and officers of the temple. The Romans, who readily adopted all the superstitious rites of conquered nations, greatly increased the revenues of the temples, and thus made the priesthood the willing tools of their ambitious designs. It is said that human sacrifices were offered at Comana; and that this barbarous custom was brought by Orestes and his sister Iphigenia from Tauris Scythica, where men and women were immolated to Diana. But this custom, if ever it obtained in Cappadocia, was abolished in the times of the Romans.

CAPPOQUIN, a small town of Ireland, in the county of Waterford, on the Blackwater, 27 miles west of Waterford. Pop. (1851) 2145. It has a church, Roman Catholic chapel, and a dispensary.

CAPPERONIER, Claude (1671–1744), an eminent classical scholar, was the son of a tanner at Mont-Didier. He studied at Amiens and Paris, and took orders in the church of Rome, but devoted himself almost entirely to classical studies. He declined a professorship in the university of Basle, and was afterwards appointed to the Greek chair in the university of Paris. He published an edition of Quintilian, and left behind him at his death an edition of the Ancient Latin Rhetoricians. His nephew, Jean Capperonier, was also a famous linguist.

CAPRAJA, the ancient *Capraria*, a small island of the Sardinian States, lying in the Mediterranean, between the N.E. point of Corsica and the coast of Piombino. It is about 15 miles in circumference, and possesses a town of the same name, which has a good harbour. The principal product is wine. Pop. about 1000. E. Long. 9. 52. N. Lat. 43. 3.

CAPRI, the ancient *Capreæ*, a small island of Naples, on the south side of the entrance to the Bay of Naples, about 3 miles west of Cape Campanella. It is about 4 miles in length by 3 in breadth, and is almost surrounded by lofty cliffs, steep and inaccessible, except at the port of Capri, a small fortified town on its south side. The climate is mild and salubrious; but the greater part of the island is rocky, though where cultivated it is very fertile, producing grain, grapes, olives, and other fruits. Vast numbers of quails are annually caught here. Capri is celebrated in history as being the retreat of Tiberius, where he spent the last ten years of his life, and whence he issued the *verbosæ et grandes Epistolæ*, mentioned by Juvenal. He erected twelve villas in different parts of the island, the remains of several of which are still to be seen. Mosaic pavements, bas-reliefs, and other relics of antiquity, have been dug up here. Pop. about 6000.

CAPRIATA, Pietro Giovanni, an eminent Genoese lawyer and historian, who died about the year 1660. He wrote a history of the wars of Italy, entitled *Istoria sopra i Movimenti d'arme successi in Italia dell' Anno* 1613 *fino al* 1646. 8vo, 2 parts, Genoa, 1644–1648; and a third part was afterwards published by his son. The whole work was translated into English by Henry Earl of Monmouth, 1663, folio.

CAPRICORN (Latin *Capricornus*, from *caper* a goat, and *cornu* a horn), in *Astronomy*, one of the twelve signs of the zodiac; the winter solstice.

The ancients accounted Capricorn the tenth sign; but the stars being advanced a whole sign towards the east, Capricorn is now rather the eleventh sign; and it is at the

sun's entry into Sagittarius that the solstice happens, though the ancient manner of speaking is still retained.

This sign is represented on ancient monuments, medals, &c., as having the fore part of a goat, and the hind part of a fish, which is the form of an Ægipan; and sometimes simply under the form of a goat. In books it is characterized thus, ♑.

Capricorn, Tropic of, a lesser circle of the sphere, which is parallel to the equinoctial and at 23° 30′ distance from it southwards, passing through the beginning of Capricorn.

CAPSA, in *Ancient Geography*, a large and strong town of Numidia, the site of which is occupied by the modern Gafsa, 74 miles W.N.W. of Cabes.

CAPSICUM. See Cayenne Pepper.

CAPSTAN, or Capstern, a strong massive column of timber, formed like a truncated cone, and having its upper extremity pierced with a number of holes to receive the bars or levers. It is let perpendicularly down through the decks of a ship, and is fixed in such a manner that the men, by turning it horizontally with their bars, may perform any work which requires an extraordinary effort.

The following descriptions present a view of some important improvements on capstans by Captain Phillips of the royal navy. (See Plate CLVIII.)

Fig. 1 is an elevation of the upper capstan and works, and an elevated section of the lower capstan, of a frigate; A, the upper capstan, is fitted securely to the spindle by two iron crosses at the upper and lower ends of the barrel; B, the spindle, runs the full length of both capstans, is a fixture to the upper one, and revolves freely on turned bearings in the lower capstan; C C, a strong hexagonal plate, fitted to the spindle and upper part of the trundle-head. D D, the trundle-head, fits hexagonally over the barrel U, which is connected with the spindle by the plates C C and E E; the trundle-head is further secured by being bolted to the plate E E. By using a barrel instead of a plain trundle-head, a greater bearing is obtained upon the spindle, which must prevent the head from working, when the men bear much at the outer end of the bars. E E, the trundle-head lower plate, is fixed to the hexagonal part of the spindle, and to the trundle-head, as above described. F F are fixed bolts that connect the plates C and E together; G G, drop-bolts, that serve either to attach the trundle-head to, or detach it from, the lower body. The size of the bolts is larger in diameter than the largest mooring chain of a line-of-battle ship; and from there being three in use, there can be no risk of their breaking. H is an hexagonal part of the spindle, on which the plates C and E fit, as well as the barrel U. I I, the upper plate of the lower body, secures the body and whelps together. It has a circular hole in the centre, through which the spindle passes; the bearing is bushed with brass. K K, the lower body, is composed of a barrel, whelps, and pecul-head, like any other capstan, but revolving in turned bearings round the spindle. L L, drop-bolts, which attach the lower body to the frame that carries the works, or detach it from them, as may be required, by means of chains running over the upper cheek. M M, the lower plate of the body, revolves with a turned bearing round the spindle. N N, the frame that carries the centre of the intermediate pinions N N N, which frame revolves in turned bearings round the spindle. O, the centre pinion, is fixed to the spindle. P P, the large wheel, is a fixture to the beams. Q, a collar, is bolted to the spindle on which the lower body rests. R, a collar to support the frame U. S, the step, is a strong piece of wood passing from beam to beam; it is secured by bolts to the beams, and supported by stanchions from the deck; an iron cup with a brass bushing is let into it, to receive the lower end of the spindle.

Fig. 2 is a plan of the works used in fig. 1, which shows that the centre wheel is but one-half the size of the exterior wheel, although possessing a power of three to one. The parts of the works are lettered similar to those of fig. 1, being a plan corresponding with that elevation.

Fig. 3 is a plan of the works in fig. 4, the parts being lettered the same, and answering to the elevation described in fig. 4.

Fig. 4 shows the elevation of the upper capstan, with the works partly in section, partly in elevation, and an elevated section of the lower capstan of a frigate. A, the upper capstan, is firmly secured to the spindle by crosses and an iron bolt. B, the spindle, which runs the length of both capstans, is a fixture to the upper one and false head, but revolves freely in the lower capstan. C C, the false head, is attached to a hexagon on the spindle; it may be let on in halves, and when fixed to the spindle will prevent the lower capstan from rising. D D, the lower capstan, is made entire; head, whelps, body, and pecul-head, similar to any other capstan, but revolving in turned bearings round the spindle. E, the collar that carries the lower capstan. F, the partners, are made like those of plain capstans, with iron spindles, with a cup let in to receive the toe. G G, drop-bolts, which serve to connect or disconnect the false head to the lower capstan. H H, the standards, are secured at their base to the trundle-head, and on their upper end is fixed a circular ring, which supports the centres of the intermediate pinions N N N; which ring is attached by pillars to the upper flange N N, with the pinions working between the plates N N. O, the centre pinion, is let on the hexagonal part of the spindle, and is consequently a fixture to it. Q Q, the guides, are iron carriages, that are secured to the beams, and in which the bolts R R traverse. R R, the bolts which serve to fix the large wheel when the increased power is in use, by grooves in stubbs, fixed at opposite diameters of the rim of the large wheel. These bolts slide backwards and forwards in the guides Q Q. S S is a blocking of wood attached to the beams to support the carriages of the bolts R R. T T are the upper and lower deck beams, shown in section.

Fig. 5 is an elevation of the lower capstan of a frigate, with the spindle separated beneath the quarter-deck, and is constructed in every way similar to fig. 1, excepting that the trundle-head is connected to the body and whelps, and plays loosely round the spindle. A fixed head or plate, firmly secured to the spindle, attaches the lower capstan to the spindle by the upper deck bolts G G; it will therefore be only necessary to describe those parts that differ from fig. 1. C C, the false head, is secured to the spindle on an hexagonal bearing; D, the trundle-head, is a fixture to the lower body. The bolts G G and L L will be correspondent in strength to the spindle.

The mode of using these capstans will be more fully understood by referring to the letters in the plate and description.

When the upper bolts G G in fig. 1 are down, and the lower ones L L are suspended by the chains to the upper cheek, the capstan has no power beyond the leverage of the bars, as the works are totally disconnected with the capstans. To increase the power, elevate the bolts G G, and let the chains loose that suspend the bolts L L, when these bolts will fix themselves by their weight in the frame N N, and thus connect the lower body with the works. By the upper bolts G G being elevated, the lower body becomes detached from the head; and in this state, when the upper capstan is hove round, the lower capstan receives its motion by the bolts L L through the medium of the works. The lower head D, being a fixture to the spindle, has the power of setting the works in motion, as well as the upper capstan, and consequently the power may be acted upon on either deck. When all the bolts are up, the capstans are separated; the lower capstan will then remain stationary, and the upper capstan may be used to spring the ship, or for

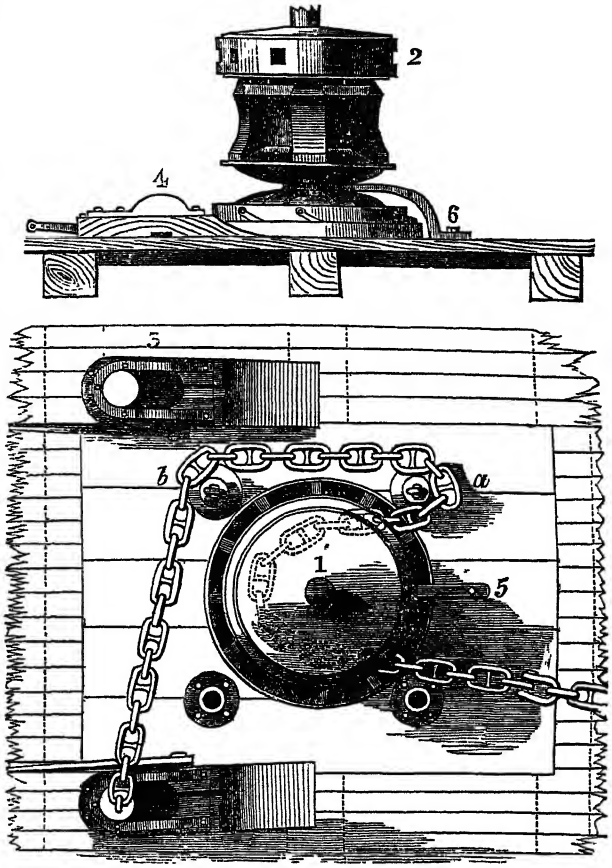
any other distinct purpose, whilst the messenger may remain during this period passed round the lower capstan body, ready to weigh the anchor.

In fig. 4 the works are between the quarter-deck beams. To increase the power, lock the large wheel P (that is, secure it by the bolts R R), and disconnect the false head C C from the lower capstan by elevating the bolts G G. Heave round on the quarter-deck capstan, and the power will be in action by the lower capstan being set in motion by the pillars H H through the medium of the works. To use it as a plain capstan, unlock the large wheel by withdrawing the bolts R R, and dropping the upper bolts G G, when both capstans and the works will traverse round together. To disconnect the capstans (that is, to use them for separate purposes), suspend the bolts G G and withdraw the bolts R R, when the works will go round with the lower capstan by means of the pillars H H, and the spindle with the upper one.

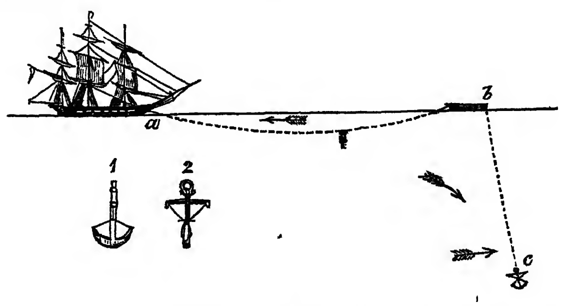
In fig. 5 the false head is a fixture to the spindle, and the lower capstan revolves round it. To increase the power, elevate the bolts G G, and drop the lower bolts L L. To use the capstan for separate purposes, lift all the bolts and keep them suspended; to make it a plain capstan, suspend the lower bolts L L, and keep the upper ones G G down.

The wheel work is so arranged that the power may be applied or relieved from it almost instantaneously; and the leading feature of the improvement is, that both capstans traverse the same way, either as a plain capstan, or when set in motion by the machinery; and the increase of power obtained is in the ratio of one revolution of the first mover more than the revolution gained by the difference of diameter between the first period and the large wheel. This is gained by making the large wheel stationary, and the centres of the intermediate pinions the means of communication with the capstan. Considerable improvements have of late years been made in Phillips' capstans, which in their original form are not now much used in her Majesty's service. A part of Phillips' plan, however, is retained, that namely of connecting the upper and lower capstan together, on the latter of which marked * on Plate CLVIII., there is a toothed wheel, which in revolving enters the link of the chain-messenger. This latter is relieved after going half round the capstan, which is likewise fitted for a rope-messenger in case the chain become defective. A French plan was recently devised (marked in the Plate*), in which, instead of the wheel, an iron flange is fitted to take the three cables (the one above and the other below the class, or rate, for ships), and by this means a messenger is not required. Messengers are generally of chain; but rope ones are also supplied to each ship in case the chain ones should become defective. The chain-messenger is made with a large link and a small one. This latter the spikes of the wheel enter as the wheel revolves. This messenger is passed half round the capstan, taken forward round the rollers in the bow, and the two parts of the messenger shackled together. Rope-messengers are passed three times round the capstan, and with an eye at each end lashed together. The rope-messengers in all ships are cut from five to eight fathoms longer than the distance between the capstan and the bow, in order that the men may hold on when the cable is hove in. Nippers made of rope from four to five fathoms long are used to attach the cables to the messenger. These are taken off when the cable is hove in, and come aft to the chain locker (or if the cable is hempen to the hatchway near the tier).

A patent has lately been taken out by Mr Thomas Brown of London, in which various improvements are introduced. The principal of these are illustrated in the sub joined woodcuts. The numbers 1 and 2 represent the pla and elevation of the capstan flange, for working various sizes of chain cable; 3 and 4 are the plan and elevation of the deck-pipe stopper, to be used for checking the cable when bringing the ship to, and for riding by when at anchor; 5 and 6 are the plan and elevation of the clearing guide.



The following woodcut represents Mr Aylen's mode of anchoring a ship during a calm, when out of soundings, to prevent her drifting when a strong current is running against her.



Supposing a ship of from 500 to 600 tons in a calm, with the current running three knots against her, and out of soundings; let go the kedge anchor, having previously secured two pieces of canvas to it as per figure, No. 1 and 2; veer out 40 to 50 fathoms of 3 to 4 inch hawser; then lower the quarter boat or cutter, and stop the above hawser to the ring in the bow and stern of the boat; then veer from the ship 70 to 80 fathoms on the hawser, between the boat and ship; put on a snatch block to traverse, with one or two pigs of ballast, to be used according to the strength of the current.

Supposing that the current at from 40 to 50 fathoms deep is running in a different direction from that of the surface—as has been frequently observed in clear water at sea—

it is plain that a great strain is taken off the anchor by using the boat, inasmuch as the whole strain would be on the hawser *b c*, the greater part of which is borne by hawser *a b*; that if the ship rode immediate at *b*, the whole of the strain being at *b c*, would naturally require a greater weight to hold her; in fact, a bower anchor with 60 fathoms of cable would not be sufficient, besides the difficulty of again recovering the anchor.

If the surface and deep current should happen to run in the same direction, the ship would not then separate from the boat; all would drift together. This plan for anchoring, there is every reason to suppose, will answer near the equator, or at any place at a distance from the main land, but it is not intended for a tide way. (J. A.)

CAPTAIN (French *capitaine*, Italian *capitano*, from the Latin *caput*), literally a head, or chief officer; but the term is used in particular to denote an officer holding a certain rank in the army or the navy. In the army, a captain is the officer who commands a troop of cavalry, or a company of infantry, or of artillery. His full pay in horse regiments is 14s. 7d. a-day; in the infantry 11s. 7d. Captains in the Life and Foot Guards rank with the Colonels of other regiments, and their full pay is 15s. a-day.

CAPTAIN-*General*, the commander-in-chief of an army, or of the militia.

CAPTAIN-*Lieutenant*, is an officer who, with the rank of captain, but the pay of lieutenant, commands a troop or company in the name and place of some other person. Thus the colonel of a regiment being usually captain of the first company, that company is commanded by his deputy under the title of *Captain-Lieutenant*.

CAPTAIN *of a Ship of War*, the officer who commands a ship of the line or a frigate. Officers who command smaller vessels are called commanders. In ships of the line a commander is also appointed with the captain; the former is therefore second captain. The charge of a captain in her majesty's navy is very comprehensive, inasmuch as he is not only answerable for any bad conduct in the military government, navigation, and equipment of the ship he commands, but also for any neglect of duty or mismanagement on the part of his inferior officers, whose several charges he is appointed to superintend and regulate. See NAVY.

CAPTAIN *of a Merchant Ship*, he who has the direction of the ship, crew, lading, &c. He is more ordinarily called the *master*.

CAPTAIN *Bashaw*, or *Capudan Pasha*, the Turkish high admiral. He possesses the third office of the empire, and is invested with the same power at sea as the vizier has on shore. Solyman II. instituted this office in favour of the famous Barbarossa, with absolute authority over the officers of the marine and arsenal.

CAPTION, in *Scots Law*, a writ issuing under her majesty's signet, in her majesty's name, obtained after decree at the instance of a creditor in a civil debt, commanding messengers at arms and other officers of the law to apprehend and imprison the person of the debtor until he pay the debt.

CAPTIVITY, a term distinctively applied to the expatriation of the Jewish people. See JEWS.

CAPTURE, a prize or prey, particularly that of a ship taken at sea. See PRIZE.

CAPUA, a large and important city of ancient Italy, capital of Campania, was situated in the midst of a very fertile and valuable territory two miles from the bank of the Vulturnus, and about half that distance from the mountain Tifata. Much diversity of opinion has prevailed as to the date of its foundation, and the people by whom it was originally inhabited. It is now generally agreed that Capua was one of the twelve cities which the Tuscans were said to have founded in the south of Italy at the beginning of the ninth century B.C. The city soon rose in importance, and its inhabitants became renowned throughout the whole peninsula for their wealth, and the luxurious magnificence of their lives. In course of time, as was natural, they degenerated so far, that from having been originally a brave and warlike people, they could no longer resist the encroachments of the Samnites, who in 424 B.C. made themselves masters of the city, and put the inhabitants to the sword. The material prosperity of the city remained undiminished under the rule of the Samnites, who in less than a century had become as effeminate and degenerate as the Capuans had been. When they in turn were attacked by the mountaineers, they were compelled to apply to Rome for assistance, which was immediately granted. At the close of the Latin war, in which the Capuans had assisted the allies, they were deprived of the *Campanus Ager* the most valuable district in Italy, but were admitted to take rank as citizens of Rome. They still continued, however, to select their own rulers. When the second Punic war broke out, the Capuans, elated with the prospect of retrieving their high position, opened their gates to Hannibal, who spent an entire winter with his army in the city. To the enervating contagion of Capuan effeminacy, historians have always attributed the want of success which subsequently attended the Carthaginian commander in his Italian campaigns. When the Romans at length made themselves masters of the city, in the seventh year of the war, they took a terrible revenge, and only forbore to raze the city to the ground in consideration of the great natural advantages of its site. For its fidelity in the social war, the Romans restored to Capua all its municipal privileges, and the city recovered all its commercial, though it never regained its political importance. Under Julius Cæsar, the Campanus Ager was distributed among 20,000 citizens of Rome, and Capua became a Roman colony. Under the emperors it continued to prosper commercially, and seems to have been as rich and populous at the downfal of the western empire as during the time of its political independence, and its wealth marked it out as a special object of attack to the Vandals, who took and nearly destroyed it under Genseric, A.D. 456. What was left undone by the Vandals was completed by the Saracens, who burnt the city to the ground in 840. The inhabitants who had fled for shelter to the neighbouring mountains returned on the departure of their eastern invaders, and established themselves at Casilinum, a stronghold distant a short way from their ancient home. Casilinum is the modern Capoua, one of the strongest forts in the kingdom of the Two Sicilies. The site of the ancient Capua is now occupied by the village of Casale, in the neighbourhood of which extensive ruins of the old capital of Campania may still be distinctly traced.

CAPUCHINS, monks of the order of St Francis, who cover their heads with a stuff cap or cowl, *capuce* or *capuchon;* whence their name. They are clothed in brown or gray, go barefooted, and never shave their faces. The Capuchins are a reformed body of the order of Minors, commonly called *Cordeliers*, and were instituted in the sixteenth century by Matthew de Baschi, a *frater de Observantia* of the monastery of Montefiascone. Matthew, who was an honest but simple man, imagined that he was commissioned by a special revelation from heaven to restore the institutes of St Francis to their original integrity; and with this view, after obtaining permission from Clement VII., in 1525 he retired with many followers to a desert. In 1528 they obtained the pope's bull; and in the following year the order was brought into complete form, Matthew was elected general, and the chapter framed constitutions. In 1543 the right of preaching was taken from the Capuchins by the pope, but in 1545 it was restored. In 1578 there were already seventeen general chapters in the order of Capuchins.

CAPUT, a Latin word signifying the head, chief, &c.

Caput *Baroniæ*, the head of the barony, in ancient customs, denotes the chief seat or castle of a nobleman, where he held his court. It was sometimes also called *caput honoris*, or the head of the honour. The *caput baroniæ* could not be settled in dowry, nor divided among the daughters in case there were no son to inherit, but descended entire to the eldest daughter, *cæteris filiabus aliunde satisfactis*.

Caput *Lupinum*. In ancient times an outlawed felon was said to have *caput lupinum*, *i.e.* a *wolf's head*, and might be slain by any one who should meet him.

Caput *Mortuum*, a fanciful Latin term used by the old chemists to denote the fixed residue of chemical operations, from which the volatile matters had been driven off.

CAR, a splendid kind of chariot used in triumphs, and at the entries of princes. The word is derived from the ancient Gaulish or Celtic *carr* mentioned by Cæsar in his *Commentaries* under the name of *carrus*. The car on medals, when drawn by horses, lions, or elephants, usually signifies either a triumph or an apotheosis; sometimes it indicates a procession of the images of the gods; and sometimes of those of some illustrious family at a funeral.

The word car is used to denote several kinds of modern carriages, usually of light construction, and drawn by one horse.

CARABINE, or Carbine, a short gun carrying a ball of twenty-four to the pound, borne by light horsemen, and hung by a belt suspended over the left shoulder. The barrel is two feet and a half long, and the bore is sometimes rifled.

CARABINEERS, or Carbiniers, regiments of light horse, carrying longer carabines than others, and sometimes employed on foot.

CARACALLA, Marcus Aurelius Antoninus, the Roman emperor, was born at Lyons a.d. 188. His original name was Bassianus, and the name Caracalla was derived from the favourite long tunic which he wore and introduced into the army. On the death of his father Severus, whom he made an open attempt to assassinate, he ascended the throne with Geta his brother. He soon procured the assassination of his colleague, and sacrificed twenty thousand persons of both sexes who were suspected of belonging to his brother's party. The rest of his reign was spent in wandering from place to place, making havoc wherever he went, in an endeavour to banish the recollection of his past guilt by engaging in new enormities. In Alexandria he repaid the pleasantries in which the inhabitants had indulged by a general massacre; and he laid waste Mesopotamia in revenge for a slight which he had received from Artabanus the Parthian king. On his progress to Carrhæ, he was assassinated at the instigation of Macrinus, his successor, a.d. 217. See Roman History.

Caracalla, in *Antiquity*, an outer garment provided with a capuchin or hood, and not unlike the Roman *lacerna*. The caracalla, as worn in Gaul, reached no lower than the knee; but after its introduction by the Emperor Aurelius Antoninus Bassianus (who thence obtained the surname of Caracalla), it was lengthened so as to reach the ankle, and its use became general among the Romans, both in the city and the camp. Such garments were commonly called Antonian, to distinguish them from the Gallic caracalla. (Aurel. Vict. *Epit.* 21; *De Cæs.* 21; Spartian. *Sev.* 21.) Salmasius, Scaliger, and after them Du Cange, derive the word *casaque* or *cassock* from *caraque*, for *caracalla;* and St Jerome mentions (*Ep.* 128) that the caracalla, with a retrenchment of the capuchin, became an ecclesiastical garment.

CARACAS, a large city of South America, capital of the Republic of Venezuela, and of the department of Caracas, is situated on the declivity of a mountain nearly 2900 feet above the level of the sea, 16 miles S.S.E. of La Guayra, its port on the Caribbean sea. N. Lat. 10. 30., W. Long. 67. 4. Population estimated at about 50,000. The city is finely situated, and has a temperate and healthy though variable climate. The mean temperature of the year is about 72° Fahr., being in the hot season 75°, and in the cold season 66°. The thermometer, however, sometimes rises to 84° or 85°, and at other times descends as low as 51° or 52°. Rain is abundant during the months of April, May, and June, but not so incessant as in other tropical countries; the rest of the year is rather dry. It is much subject to earthquakes, from which it has frequently suffered: in that of 1812, 12,000 persons are said to have perished. Caracas stands on a declivity near four streams, namely, the Guayra, the Anauco, the Caroata, and the Catucho, which, after passing the town, unite, and mingling their waters with those of the Tuy, fall into the ocean thirty-six miles east of Cape Codera. The town is well and regularly built; the streets wide and well paved, crossing each other at right angles. There are several squares in this city, of which the Plaza Mayor, or great square, is the most worthy of notice. The east side is principally occupied by the cathedral, the south by the college, and the west by the public prison. This square is a great market for provisions, fruit, and other articles, and contains a sort of inner square in which are ranges of shops. The Catucho furnishes the city with water, which is supplied to the inhabitants by public fountains, as well as in pipes and reservoirs. The chief public building is the cathedral, which is two hundred and fifty feet in length by seventy-five in breadth, and is supported by twenty-four pillars, without beauty or proportion. There are several parish churches, three monasteries for friars, two nunneries, three hospitals (one of which is for lepers alone), and a theatre. Caracas was founded by Diego Loseda in 1567.

CARACCI, Lodovico, Agostino, and Annibale, three celebrated Italian painters, were born at Bologna in 1555, 1558, and 1560 respectively. Lodovico, the elder, was cousin to the two younger brothers, Agostino and Annibale, and had nearly finished his professional studies before the others had begun their education. From being a reputed dunce at school, he gradually rose by an attentive study of nature and a careful examination of the works of the great masters, preserved at Bologna, Venice, Florence, and Parma, to measure himself with the teachers of his day, and ultimately projected the opening of a rival school in his native place. Finding himself unable to accomplish his design without assistance, he sent for his two cousins, and induced them to abandon their handicraft for the profession of painting. Agostino he first placed under the care of Fontana, retaining Annibale in his own studio, but afterwards sent them both to Venice and Parma, to copy the works of Titian, Tintoretto, and Correggio, on which his own taste had been formed. On their return, the three friends opened an academy of painting under the name of the Incamminati, assisted by an eminent anatomist, Anthony de la Tour, and provided with numerous casts, books, and bassi-relievi, which Lodovico had collected in his travels. From the affability and kindness of the Caracci, and their zeal for the scientific education of the students, their academy rose rapidly in popular estimation, and soon every other school of art in Bologna was deserted and closed. They continued together till, at the invitation of Cardinal Farnese, Annibale and Agostino went to Rome to paint the gallery of the cardinal's palace. The superior praises awarded to Agostino inflamed the jealousy of Annibale, already kindled by the brilliant reception given by the pupils of the Incamminati to Agostino's picture of the *Communion of St Jerome*, and he was dismissed to Parma to paint the great saloon of the Casino. Here Agostino died in 1602, when on the eve of finishing his celebrated painting of *Celestial, Terres-*

trial, and Venal Love. Annibale continued to work alone at the Farnese gallery till the designs were completed; but, disappointed at the miserable remuneration offered by the cardinal, he retired to Naples, where an unsuccessful contest for a great work in the church of the Jesuits threw him into a fever, of which he died in 1609. Lodovico still continued at his academy in Bologna, which, though invited to execute paintings in all parts of the country, he had never quitted except for a short visit to his cousin at Rome. He died in 1619, and was interred in the church of St Mary Magdalene. The works of Lodovico are nearly all to be found in the chapels of Bologna. The most famous are—*The Madonna standing on the moon, with St Francis and St Jerome beside her, attended by a retinue of angels*; pictures of *John the Baptist, St Girolamo, St Benedict, and St Cecilia*, and of the *Limbo of the Fathers.* He was by far the most amiable of the three friends, rising superior to all feelings of jealousy towards his rivals; and though realizing large sums for his productions, yet, from his almost unparalleled liberality to the students of the academy, he died poor. With skill in painting, Agostino combined the greatest proficiency in engraving (which he had studied under Cornelius de Cort), and high accomplishments as a scholar. He died under the deepest remorse for the indecencies which, in accordance with the corrupt taste of the time, he had allowed to creep into his engravings. The works of Annibale are more diversified in style than those of the others, and comprise specimens of painting after the manner of Correggio, Titian, Paolo Veronese, Raphael, and Michael Angelo. The most distinguished are the *Dead Christ in the lap of the Madonna*, the *Infant and St John, St Catharine, St Roche distributing Alms* (now in the Dresden Gallery), and the *Saviour taken down from the Cross in presence of the Virgin*, at present in possession of the Earl of Carlisle. The reputation of Annibale is greatly tarnished by his jealousy and vindictiveness towards his brother, and the licentiousness of his disposition, which brought him to an early grave.

CARACOL (French *caracole*), in the manège, the half-turn which a horseman makes either to the right or left. In the army, the cavalry make a caracol after each discharge, in order to pass to the rear of the squadron.

CARACOL, in *Architecture*, denotes a staircase in a helix or spiral form.

CARACTACUS, a renowned king of the Silures, an ancient British people who inhabited South Wales. Having valiantly defended his country for nine years against the Romans, he was at length defeated, and fled for protection to his stepmother Cartismandua, queen of the Brigantes; but she treacherously delivered him up to the Romans, who carried him to Rome, A.D. 51. When brought before Claudius, he addressed that emperor in a speech at once so noble and pathetic that he immediately obtained a pardon for himself and his friends. (Tac. *Ann.* xii., *Hist.* iii.; Dion Cass. lx.) See BRITAIN.

CARAITES, in ecclesiastical history, a religious sect among the Jews, of which there are still some members existing in Poland, Russia, Constantinople, Cairo, and other places of the Levant. Their distinguishing tenet and practice it is to adhere closely to the words and letter of the Scripture, exclusive of allegories, traditions, and the like.

Leo of Modena, a rabbi of Venice, observes, that of all the heresies among the Jews before the destruction of the temple, there is none now left but that of the *Caraim*, a name derived from *Micra*, which signifies the pure text of the Bible, because of their keeping to the Pentateuch, observing it to the letter, and rejecting all interpretations, paraphrases, and constitutions of the rabbin. Aben Ezra, and some other rabbin, treat the Caraites as Sadducees; but Leo de Juda calls them, more accurately, Sadducees Reformed, because they believe in the immortality of the soul, paradise, hell, the resurrection, and other doctrines which the ancient Sadducees denied. He adds, however, that they were doubtless originally real Sadducees, and sprung from among them. But M. Simon, with more probability, supposes them to have had their origin in this way, namely, that the more rational among the Jews who opposed the dreams and reveries of the rabbin, and used the pure texts of Scripture to refute their groundless traditions, received the name of *Caraim*, which signifies the same as the barbarous Latin *Scripturarii*, that is, persons attached to the text of Scripture. The other Jews gave them the odious name of Sadducees, from their agreement with those sectaries on the head of traditions. Scaliger, Vossius, and Spanheim, rank the Caraites among the Sabæans, Magi, Manichees, and Mussulmans, but by mistake. Wolfgang, Fabricius, and others say that the Sadducees and Esseni were called Caraites in opposition to the Pharisees; while others regard them as the doctors of the law so often mentioned in the Gospel. But these are all conjectures; for Josephus and Philo make no mention of them, which proves that they are more modern than either of those authors. In all probability this sect was not formed till after the collection of the second part of the Talmud, or the Gemera; perhaps not till after the compilation of the Mischna, in the third century. The Caraites themselves pretend to be the remains of the ten tribes led captive by Shalmaneser. Wolfius, from the Memoirs of Mardacheus a Caraite, refers their origin to a massacre among the Jewish doctors under Alexander Jannæus, their king, about a hundred years before Christ; because Simon, son of Schetach, and the queen's brother, making his escape into Egypt, there forged his pretended traditions, and, at his return to Jerusalem, published his visions, interpolating the law after his own fancy, and supporting his novelties from the notices which God, he said, had communicated by the mouth of Moses, whose depositary he was. He gained many followers, and was opposed by others, who maintained that all which God had revealed to Moses was written. Hence the Jews became divided into two sects, the Caraites and Traditionists. Among the first, Juda, son of Tabbai, distinguished himself; among the latter, Hillel. Wolfius reckons not only the Sadducees, but also the Scribes, in the number of Caraites. But the address of the Pharisees prevailed against them all, and the number of Caraites decreased. In the eighth century, Annan indeed retrieved their credit a little; Rabbi Schalomon did the same in the ninth; and they prospered pretty well till the fourteenth; but since that time they have been declining.

But little is known of the Caraites, their works having fallen only into very few hands. Buxtorf never saw more than one, and Selden two; but Trigland says he has recovered enough to speak of them with assurance. He asserts that, soon after the prophets had ceased, the Jews became divided on the subject of works and supererogation, some maintaining their necessity from tradition, whilst others, keeping close to the written law, set them aside; and it was from these last that Caraitism commenced. He adds, that after the return from the Babylonish captivity, in re-establishing the observance of the law there were several practices found proper for that end; and these being once introduced were looked upon as essential, and as appointed by Moses. This was the origin of Pharisaism, while a contrary party who continued to adhere to the letter, founded Caraitism.

The modern Caraites, Leo of Modena observes, have their synagogues and ceremonies. They pretend to be the sole proper Jews, or observers of the laws of Moses, calling the rest by the term *rabbinim*, or "followers of the rabbin." The latter despise the Caraites, refusing to ally or even to converse with them, and treating them as *mamzeim* or bastards, because of their rejecting the constitutions of the

rabbin relating to marriages, repudiations, the purification of women, and the like. This aversion is so great, that if a Caraite should become a rabbinist he would never be received by the other Jews.

The Caraites, however, do not absolutely reject all kinds of traditions, but only such as appear to be not well grounded. Selden, who is very express on this point, observes in his *Uxor Hebraica*, that besides the mere text, they have certain interpretations which they call hereditary, and which are proper traditions. Their theology seems to differ only from that of the other Jews in being purer, and clearer of superstition; and they give no credit to the explications of the Cabbalists, chimerical allegories, nor to any constitutions of the Talmud, but such as are conformable to the Scripture, and may be drawn from it by just and necessary consequences.

Peringer observes of the Caraites in Lithuania, that they are very different, both in aspect, language, and manners, from the rabbinists, with whom the country abounds. Their mother tongue is the Turkish; and this they use in their schools and synagogues. In visage they resemble the Mohammedan Tartars. Their synagogues are placed north and south; and the reason they give for this is, that Shalmaneser brought them northward; so that in praying they must turn to the south, in order to look to Jerusalem. He adds, that they admit all the books of the Old Testament; contrary to the opinion of many of the learned, who hold that they reject all but the Pentateuch.

Caleb, a Caraite, reduces the difference between them and the rabbinists to three points: 1, In that they deny the oral law to have come from Moses, and reject the Cabbala; 2, in that they abhor the Talmud; 3, in that they observe the feasts, as the sabbaths, &c., much more rigorously than the rabbin do; and to these may be added, that they extend the degree of affinity in which marriage is prohibited almost to infinity.

CARAMAN, or KARAMAN, a town of Asia Minor, in the district of Caramania, on the border of an extensive plain at the foot of Mount Taurus. N. Lat. 37. 13., E. Long. 33. 28. It was once the capital of a prosperous kingdom, and contains several remains of its former greatness. It still continues to trade with Smyrna and the other towns of Asia Minor, and to manufacture coarse cloth from the wool obtained in the neighbouring highlands, a considerable portion of which is wrought with cotton into a fabric for the use of the inhabitants. Pop. according to Filcher, 20,000.

CARAMANIA, or KARAMANIA, an extensive district on the southern coast of Asia Minor, comprising on its eastern portion a large tract of fertile table-land, and possessing a coast-line nearly 400 miles long. Its limits do not seem to be very well defined, and are doubly indistinct as not being coincident with the great natural features of the country. The only distinctly marked boundary is the coast-line, consisting of two large rounded headlands, and the intervening bays. It presents a high and precipitous front to the sea. In ancient times it was interspersed with towns of considerable importance; but is now almost deserted, and its inaccessible cliffs are the haunts of pirates. The interior of the country is mountainous, but many of the hills are wooded, and the inclosed valleys afford abundant pasturage. In the eastern district of Adana agriculture is prosecuted with care and success; but elsewhere, owing to the indolence of the inhabitants and the oppressive rule of the Turks, scarcely any attempt is made to develop the resources of the province. It is divided into several administrative districts. The principal towns are Konia, Caraman, and Adana. See Beaufort's *Karamania*.

CARAMNASSA, a river of Hindustan, rising in the British district of Shahabad, within the presidency of Bengal. It is only remarkable in differing from the other streams of India in that Hindus are forbidden to touch it. Pilgrims consequently cross it with the utmost caution, as it is believed that contact with its baneful waters destroys the efficacy of their religious austerities. The legendary ground of the abhorrence in which it is held is variously reported. According to one authority, a certain rajah committed the heinous sins of murdering a Brahmin and marrying a stepmother. A good-natured saint took compassion on the guilty man, and removed his impurity, by collecting water from all the sacred streams in the world and washing him in this powerful bath, which was made on the place whence the Caramnassa (deprived of virtue) has ever since flowed. According to another account, the rajah, relying on his religious austerities and spells, attempted to ascend to heaven, but was opposed by the gods, who suspended him halfway with his head downwards. From his mouth issues a baneful saliva, which infects the waters of the Caramnassa with the baneful qualities attributed to them. The Caramnassa falls into the Ganges on the right side, in Lat. 25. 8., Long. 83. 58.

CARAT, the weight which expresses the degree of fineness of gold. The word is also written *carract*, *carrat*, *karract*, and *karrat*. Its origin is contested; but the most probable opinion is that of Kennet, who derives it from *carecta*, a term which anciently denoted any weight, and came afterwards to be appropriated to that which expresses the fineness of gold and the gravity of diamonds.

Carats are not real determinate weights, but only imaginary. The whole mass, whatever be the weight, is conceived to be divided into twenty-four carats: and as many twenty-fourth parts as it contains of pure gold, it is called *gold of so many carats*, or *so many carats fine*. Thus, gold of eighteen carats is a mixture, of which eighteen parts are pure gold, and the other six of inferior metal.

Carat is also a certain weight which goldsmiths and jewellers use for weighing precious stones and pearls. In this sense the word is supposed by some to be derived from the Greek κεράτιον, a fruit which in Latin is called *siliqua*, the *carob bean*, each of which may weigh above four grains of wheat; and hence the Latin *siliqua* has been used for the weight of four grains. This carat weighs four grains; but they are sometimes lighter than the grains of other weights. Each of these grains is subdivided into $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, &c. See WEIGHTS and MEASURES.

CARAUSIUS, Emperor of Britain. See BRITAIN, p. 380; and ALLECTUS.

CARAVACA, a town in the province of Murcia, Spain, near a cognominal stream, which is tributary to the Segura. N. Lat. 38. 6., W. Long. 2. 2. It stands on the northern extremity of a fertile plain, the agriculture of which is the principal employment of the inhabitants. Caravaca is commanded by the ancient castle of Santa Cruz, and has an old parish church, with several convents, hospitals, and schools. The hills in the neighbourhood yield several kinds of marble, and in a mountain on the west is the stalactite cavern of Barquilla. Pop. 10,000. The miraculous cross of Caravaca is famous for its healing powers.

CARAVAGGIO, a town of Lombardy, 15 miles S.S.W. of Bergamo, with about 6000 inhabitants. It is celebrated as being the birthplace of the two painters, Polidoro Caldara and Michael Angelo Amerighi, who received their surname of Caravaggio from this town.

CARAVAGGIO, *Michael Angelo Amerighi da*, a celebrated painter, born in 1569 in the village of Caravaggio, from which he took his name. He adopted a style of strange contrasts of light and shadow of colours, laid on with a sort of fury, emblematic of that fierce temper which led the artist to commit a homicide at Rome. To avoid the consequences of his crime he fled to Naples and to Malta, where he was imprisoned for another attempt to avenge a quarrel. Escaping to Sicily, he was attacked by a party sent in pursuit of him, and severely wounded. Being pardoned, he

set out for Rome, where, being arrested by mistake, he expired at a gate of the city in his fortieth year. His best pictures are the *Entombment of Christ*, now in France; *St Sebastian*, in the Roman Capitol; and the *Supper at Emmaus*, in the Borghese Palace. See Painting.

Caravaggio, *Polidoro Caldara da*, a celebrated painter of frieze and other decorations in the Vatican, whose merits were such, that while a mere mortar-carrier to the artists engaged in that work, he attracted the admiration of Raffaello, then employed on his matchless pictures in the Loggie of that palace. Polidoro was born in 1495. His works, as well as those of his master Maturino, have mostly perished, but are well known by the fine etchings of San Bartoli, Alberti, &c. On the sack of Rome by the army of the Constable Bourbon in 1527, Polidoro fled to Naples. Thence he went to Messina, where he was much employed, and gained a considerable fortune, with which he was about to return to Italy, when he was robbed and murdered by his servants in 1543.

CARAVAN (in Arabic *kairawan*, from *karan* to follow, to proceed from place to place; or derived from the Persian *kervan* or *cârvân*, a trader or dealer), is an organized company, either of merchants or of pilgrims, or both, who associate together for the purpose of travelling in greater security. In Eastern countries it is necessary to resort to this mode of travelling in order to escape the dangers arising from the vast deserts that intersect these regions, as well as from wild beasts and bands of marauding Arabs, which are too numerous for single traders or solitary travellers to encounter. Through this kind of intercourse, at once cheap and expeditious, most of the inland commerce of the East is carried on; and the possession of the camel affords facilities for journeying over barren and sandy regions which are inaccessible to wheel-carriages, and the difficulties and privations of which no other beast of burden could endure. The company composing a caravan often consists of several hundred persons, and as many as a thousand camels; and the packing and unpacking of the camels employ a great many hands, some of whom often raise themselves from the condition of servants to the status of merchants who travel on their own account. Any person can, under certain regulations, form a caravan at any time; but generally there are stated periods, which are well known as the regular starting-times for the mercantile journeys. In the hot season the travelling is performed at night. About eight o'clock the whole party put themselves in motion, and continue their journey without interruption till midnight or later. At other seasons they travel all day, only halting for rest and refreshment during the heat of noon. The distances are measured by a day's journey; and from seven to eight hours seem to have been a usual day's journey for caravans (Hornemann, p. 150); so that, estimating the slow and unwieldy gait of a camel at $2\frac{1}{2}$ miles an hour, the average rate of travel will be from seventeen to twenty miles a day.

The earliest caravan of merchants we read of is the itinerant company to which Joseph was sold by his brethren. This caravan was a mixed one, consisting of three classes, Ishmaelites, Midianites, and Medanites, who would seem, like the nomad tribes of Africa in the present day, to have engaged themselves as commercial travellers, and were then on the high caravan-road for the market of Egypt.

Besides these communities of travelling merchants in the East, there are caravans of pilgrims, *i. e.* of those who go for religious purposes to Mecca, comprising vastly greater multitudes of people. Four of these start regularly every year: one from Cairo, consisting of Mohammedans from Barbary; a second from Damascus, conveying the Turks; a third from Babylon, for the accommodation of the Persians; and a fourth from Zibith, at the mouth of the Red Sea, which is the rendezvous for those coming from Arabia and India. The organization of the immense hordes which, on such occasions, assemble to undertake a distant expedition is accomplished in the East by a few simple arrangements, which are the result of long experience. When travelling by night and through extensive deserts, the songs of the Arab servants, and the incessant jingling of innumerable bells fastened to the necks of the camels, enliven the patient beasts, frighten animals of prey, and keep the party together. To meet all the exigencies of the journey, the caravan is placed under the charge of a *caravan bashě*, the chief who presides over all, and under whom there are five leading officers appointed to different departments:—one who regulates the march; a second, whose duties only commence at halting time; a third who superintends the servants and cattle; a fourth who takes charge of the baggage; a fifth who acts as paymaster, &c.; and besides these, there are the officers of the military escort that always accompanies it. The highest functionary is the *hybeer* or guide (from the Arabic verb *hubbar*, to inform or direct), whose services are indispensable in crossing the great deserts, such as that along the coast of the Red Sea, or on the western extremities of Africa. For this office a person of influence is generally chosen, who, besides his known truth and fidelity, possesses an extensive and accurate acquaintance with the whole features of the land. As he has the lives and property of the whole caravan in his power, it is absolutely necessary that he understand the prognostics of the weather, the tracts exposed to the simoom or shifting sands, the exact locality and qualities of the wells, the oases that afford the refreshment and pasture, the situation of hostile or treacherous tribes, and the means of escaping those threatened dangers.

In addition to the overland caravans, there are several naval companies of merchant-pilgrims, which sail from the western ports of the Red Sea to Djidda, and thence travel by land to Mecca.

CARAVANSERAI, in eastern countries, a place appointed for receiving and loading caravans. It is commonly a large square building, with a spacious court in the centre; and under the arches or piazzas that surround it the merchants and those who travel with them take up their lodgings. Over the gates that lead into the court there are sometimes little rooms, which are let out at a high price. Though caravanserais in the East serve in place of inns, there is this radical difference between them, that in general the traveller finds in a caravanserai neither food for himself, nor provender for his cattle. There is no caravanserai, however, without a well or spring of water. The existence of these buildings is chiefly owing to the charity of the Mohammedans; and while there, the persons and the property of travellers are secure. There are also caravanserais where most things may be obtained for money; and as the profits of these are considerable, the magistrates of the cities to whose jurisdiction they belong take care to store them well. At the departure of each caravan, an inspector fixes the price of the night's lodgings, from which there is no appeal.

CARAVANSERASKIER, the steward or keeper of a caravanserai. He keeps an account of all the merchandise sold upon trust, and demands payment of the sums due to the merchants for what has been sold in the caravanserai, on the seller's paying two per cent.

CARAWAY, the fruit or seed of the *Carum Carui*, a biennial umbelliferous plant, with an edible fleshy root about six inches long and as thick as the thumb. The stem rises from two to three feet in height, and produces numerous umbels of small whitish or reddish flowers; and each flower is succeeded by two single-seeded capsules, which are the caraway seeds of commerce. These have a strong peculiar odour, with an aromatic bitter taste; and yield on distillation about 4 per cent. of a volatile oil, on which their properties depend. This aromatic is chiefly used in this country by confectioners; but on the continent it is more largely employed, not only to flavour liqueurs, cakes, &c.,

but also bread, cheese, and various articles of daily food. Its cultivation in Britain is chiefly followed in the counties of Essex and Suffolk, where it is sown on old pasture lands broken up for the purpose, and generally along with coriander and teazle. The coriander, being an annual, yields a crop the first year. The caraway, being a biennial, ripens the second year in July, and the teazles in autumn. If kept clear of weeds, the caraways and teazles would yield smaller crops for several successive years, but it is not found profitable to continue them after the third crop.

CARBON, pure charcoal. See CHEMISTRY.

CARBONARI (*i. e. makers of charcoal*), a designation assumed by the political reformers of middle and lower Italy in this century, intimating that in their number were included the most laborious of the working classes. They consisted, however, of persons of various ranks, who had entered into a secret association for the purpose of emancipating their country. See ITALY.

CARBOY, a large globular bottle of green glass, protected by wicker-work; used chiefly for holding acids and highly corrosive liquids. The average capacity of these bottles is 12 gallons.

CARBUNCLE, a beautiful gem of a rich blood-red colour, found in the East Indies. The carbuncle so highly prized by the ancients was probably a variety of noble garnet.

CARBUNCLE, in *Heraldry*, a charge or bearing consisting of eight radii, four of which make a common cross, and the other four a saltier.

CARCAGENTE, a town in the province of Valencia, Spain. N. Lat. 39. 4., W. Long. 0. 31. It contains about 1500 houses, which are well built, and is inhabited chiefly by an agricultural population, but has a considerable manufacture of linen and woollen stuffs, and silk thread from the silk produced in the neighbourhood. Roman remains have been found in the vicinity. Pop. 7280.

CARCASSONNE, the capital of an arrondissement of the same name in the department of Aude, France, is situated on both sides of the river Aude, 55 miles S.E. of Toulouse. On the right bank of the river, on an elevation, stands the old city, which is connected with the new town on the opposite side by a bridge of ten arches. The city is very ancient, and retains unchanged, to a greater extent perhaps than any other in France, the aspect of a fortress of the middle ages. It is inclosed by double ramparts and towers. A portion of the inner line is attributed to the Visigoths; the rest, including the castle, seems to belong to the eleventh or twelfth century, while the outer circuit has been referred to the latter end of the thirteenth century. The new town is clean, well-built, and flourishing, the streets intersecting each other at right angles. It is surrounded by boulevards occupying the site of its ramparts, and has numerous marble fountains and planted walks. There are several large woollen factories; and not less than 7000 persons of the town and vicinity are engaged in the manufacture of cloth, chiefly exported to the Levant, Barbary, and South America. It has a new and old cathedral, the latter containing the tomb of Simon de Montfort; a town-hall, public library, hospitals, theatre, barracks, commercial college, normal school, &c. Pop. (1851) of town 18,473; of arrondissement 94,970.

CARCERES (*carcer*, a prison), in the Roman circus, were cells or stalls in which the chariots and horses were stationed till the signal for starting was given, when the gates, by an ingenious contrivance, were opened simultaneously. In poetical language the carceres were sometimes designated *claustra, crypta, fauces, ostia, repagula*, &c.

CARD, among artificers, an instrument for combing and disentangling the fibres of wool or flax, freeing them from the coarser parts and from extraneous matter, so as to render them fine and soft for spinning. A card consists of bent wire-teeth inserted in a thick piece of leather, which is nailed by the edges to a piece of board about a foot in length, and half a foot in breadth; and in the middle of one of the longer sides a handle is fixed. They are of various kinds, as hand-cards, stock-cards, &c. These are now in a measure superseded; wool, cotton, &c., being generally carded in mills by teeth fixed on wheels moved by water or steam-power. See WOOL AND ITS MANUFACTURES.

CARDS, *Playing Cards*, oblong pieces of fine pasteboard, commonly three inches and a half long and two and a half broad, on which are painted various points and figures. The invention of playing cards has, by some, been referred to the Romans, but this opinion is undoubtedly erroneous. It is however certain that they were known in Europe at least as early as the year 1275. Though the blocks used for stamping the devices were similar to those that were afterwards employed for the earliest printed books, their application in this way appears to have been long overlooked. Without absolutely affirming that the art of making playing cards really suggested that of printing, it may be noticed as a very remarkable fact, that a period of more than 150 years should have been suffered to elapse before such blocks were applied to the nobler purpose of that art which has done more than any other to advance civilization and ameliorate the condition of mankind.

In the manufacture of playing cards blocks are still employed; but the pips or characters are more commonly produced by the process called stencilling; in which the device is formed by means of an oiled cloth or paper in which apertures are cut, representing spades, diamonds, &c. This is laid above the card, and then the surface of the stencil or pattern is painted over with a brush full of red or black water-colour of rather a thick consistence, or with oil-colour. On removing the stencil, those parts of the card that were exposed will exhibit the corresponding pattern. When perfectly dry, the surface of the card may be polished by simple friction with a soft brush. If it be desired to give to pasteboard the appearance of ivory, this may be effected by covering it with a mixture of size and French white, with a small proportion of clear drying oil. The colour, of course, must not be applied till the pasteboard so prepared be thoroughly dry. The gilding, silvering, or bronzing of any part of the card may be effected by covering the corresponding part of the block with gilder's size, instead of colour, and powdering the surface with gold-dust, &c., by means of a soft dapper. The duty of one shilling per pack on cards sold in 1841 produced the sum of L.9223, 18s.

Among sharpers, divers sorts of false and fraudulent cards have been contrived; as, 1. *Marked* cards, where the aces, kings, queens, knaves, are marked on the corners of the backs with spots of different number and order, either with clear water or water tinged with pale Indian ink. 2. *Breef* cards, those which are longer or broader than the rest; chiefly used at whist and piquet, to enable a person to cut the cards disadvantageously to his adversary, and draw the person unacquainted with the fraud to cut them favourably for the sharper. As the pack is placed either endwise or sidewise to him that is to cut, the long or broad cards naturally lead him to cut them. 3. *Corner bend* denotes four cards turned down finely at one corner, to serve as a signal to cut by. 4. *Middle bend*, is where the tricks are bent two different ways, which causes an opening or arch in the middle, to direct the cutting.

In the learned work of J. G. Immanuel Breitkopf on Playing Cards, we find that they are mentioned in the *Stadtbuch* of Augsburg in 1275; where it is said that the emperor "Rudolph I. amused himself with playing-cards, and other games." They are also noticed in other works as used in Germany in 1286, and in various periods between that and 1384. Tiraboschi mentions their use in Italy as early as 1299, from a manuscript of Pippozzo di Sandro, tom. vi.

1163. The *invention*, therefore, cannot be ascribed to the French in 1390, as Mezérai asserts, although cards were used in France about that year to divert Charles VI., who had fallen into a state of melancholy. The figures of the four suits were regarded as symbolical representations of the four principal classes of men. By the *cœurs* (hearts) are meant the *gens de chœur*, choir-men, or ecclesiastics; and therefore the Spaniards have *copas*, or chalices, instead of hearts. The nobility, or prime military part of the kingdom, are represented by the ends or points of lances or pikes; which, from our misconception of the meaning or resemblance of the figure, were called *spades* in England. The Spaniards have *espadas*, swords, in lieu of pikes, which are of similar import. By diamonds (*carreaux*, square stones, tiles, or the like) are designed the order of citizens, merchants, or tradesman. *Trèfle*, the trefoil-leaf, or clover-grass, corruptly called *clubs*, alludes to the husbandmen and peasants. But how this suit came to be called *clubs* is not easily explained; unless, borrowing the game from the Spaniards, who have *bastos* (staves or clubs) instead of the trefoil, we gave the Spanish signification to the figure of the trefoil. The four kings were David, Alexander, Cæsar, and Charles (names which long continued to be retained on the French cards), and represented the four celebrated monarchies of the Jews, Greeks, Romans, and Franks under Charlemagne. By the queens were intended Argine, Esther, Judith, and Pallas, typical of royal birth, piety, fortitude, and wisdom. *Argine* is an anagram for *regina* or queen. The knaves represented the attendants of knights, for *knave* originally merely meant *servant*. Some suppose that the knights themselves were designed by those cards, because Hogier and Labire, two names on the old French cards, were famous knights at the time when cards began to be used in France.

CARDAMOMS, aromatic seeds furnished by various species of *Amomum* and *Renealmia*, belonging to the natural order Zingiberaceæ, and to the Linnæan class and order Monandria Monogynia. Various kinds are known in commerce, such as the great or Madagascar cardamom, the produce of the *Amomum angustifolium;* the Java cardamom, produced by the *A. maximum;* the round cardamom, *A. Cardamomum;* the Malabar or clustered cardamom, the most esteemed of all, from the *Renealmia Cardamomum;* paradise grains or Malagueta pepper, produced by the *A. Grana Paradisi;* besides several others of inferior note from other members of the same genera. Cardamom seeds are the most grateful of all the aromatics, are largely used to give flavour to aromatic cordials, and enter into the composition of very many of the preparations of drugs used in medicine. With the exception of the grains of paradise, all the kinds of cardamoms are imported in their bluntly triangular somewhat conical shaped leathery capsules, which are full of the small, compressed, rough, trapezoidal seeds in which the flower abounds.

CARDAN, Jerome, a celebrated Italian physician, mathematician, and philosopher, was born at Pavia in 1501. He was a natural son of Facio Cardan, a celebrated jurisconsult of Milan; and in his book *De vitâ propriâ* he represents himself as from his very infancy exposed to the most extraordinary complication of misfortunes. His mother, during her pregnancy, in vain attempted to procure an abortion, and he was delivered only by the cæsarian operation. In the house of his father at Milan, notwithstanding his delicate constitution and tyrannical treatment, he made great progress in mathematics; and though at first he joined the Franciscan order he quickly abandoned the life of the cloister for the eager pursuit of medicine and philosophy. Having studied for a year at Pavia he removed to Padua, where, in the absence of his professor, he was frequently called to conduct the classes of geometry and dialectics, and afterwards received the degree of doctor of medicine. He continued to support himself by his practice for six years at Sacco, where he married Lucia Bandareni, the daughter of a needy Venetian adventurer. Soon afterwards he was withdrawn from his retirement by Archbishop Archinto to lecture on mathematics and medicine at Milan. Induced by extravagant promises from the inhabitants, he accepted the chair of medicine at Pavia, but on the failure of their promises he again returned to Milan. In 1546 he received an invitation from the King of Denmark to fill the chair of medicine at Copenhagen, but declined to quit Milan. About six years later he went to Scotland to visit John Hamilton, archbishop of St Andrews, whom he completely cured of a violent asthmatic affection which had withstood the skill of the most eminent German physicians. He attributed his success to the accuracy with which he calculated the primate's nativity. On his return he removed to Pavia, where he remained till 1652. At the urgent solicitation of several foreign princes, Cardan made a tour through Germany, France, and England, visiting Edward VI., to whom, after a calculation of his nativity, he predicted a long life and reign. From Pavia he removed to Bologna, where he taught until thrown into prison for debt in 1570; but being released in a few months, in order to escape his creditors he removed to Rome, where he was admitted a member of the college of physicians and pensioned by Gregory XIII. He spent the rest of his life without any public employment, and died at Rome in 1576, a few weeks after he had finished his autobiography. Julius Scaliger and De Thou affirm, that having made a calculation of his nativity, he starved himself in order to insure its fulfilment; but this allegation does not rest on sufficient authority. The works of Cardan, consisting of about 122 treatises on physics, mathematics, astronomy, astrology, rhetoric, history, ethics, dialectics, natural history, music, medicine, and anatomy, are of the most varied description, and such a mixture of profound ideas and capricious absurdities as might be expected of a man who piqued himself on being totally unlike all other mortals. The eccentricity of his habits was so great that he was universally reputed mad; and to the violent and revengeful temper which he received from the harshness of his early education he added a firm belief in astrology, and in the constant presence of a familiar spirit which enabled him to hold converse with the other world. Although justly regarded as heterodox by the theologians of the day, there is not sufficient ground for regarding him as an atheist. Most of his works have been collected in an edition edited by Charles Spohn.

CARDASS, an instrument for carding flocks of silk, to make it into cappadine.

CARDERS, persons who card wool, &c. for spinning.

CARDIA, a city at the northern extremity of the Thracian Chersonesus on the eastern shore of the Sinus Melanis or Gulf of Melas.

CARDIAC (Latin *cardiacus*, Greek *καρδιακός*, from *καρδία*, the heart), pertaining to the heart. The word in a substantive form denotes medicine that stimulates the stomach, and animates the spirits; otherwise termed a cordial.

CARDIFF, a municipal and parliamentary borough in the county of Glamorganshire, 170 miles west from London by South Wales railway. N. Lat. 51.28.; W. Long. 3.10. It is situated on the river Taff, about 2 miles from its efflux in the Bristol Channel, and amongst the towns of South Wales ranks next in importance to Swansea. The general aspect of the town is ancient and venerable. The streets are regular,—some of them spacious and handsome,—clean, and well paved. The extension and improvement of the town have been greatly promoted by the construction of the *Bute Ship-Canal and Docks*, accomplished by the late Marquis of Bute at the cost of not less than L.300,000. On passing the dock-gates, which are 45 feet wide, and have a depth of water varying from 17 to 32 feet, vessels enter a capacious basin, which communicates by a lock, 36 feet wide, with an inner dock, extending in a conti-

Cardiff. nuous line 1450 yards long, with a uniform width of 200 feet. It has an area of about 200 acres of water, and is capable of accommodating, in perfect safety, 400 ships of all classes. Quays are built at the sides, comprising more than a mile of wharfs, with ample space for warehouses. To preserve the channel free from deposit, a feeder from the river Taff supplies a reservoir, 15 acres in extent, which can be discharged when necessary so as to deliver at the rate of 100,000 tons of water in an hour.

Immediately contiguous are the Glamorgan canal, the Taff Vale railway, and the South Wales railway, and thus the port of Cardiff becomes the great outlet for the vast mining districts and iron and tin works of the eastern part of Glamorganshire, and possesses facilities for communication with all parts of the kingdom. Besides the extensive exports of iron, tin, coal, and other minerals, Cardiff carries on a considerable trade with Bristol and other ports in the agricultural productions of South Wales. There is daily communication by steam-packets with Bristol, and once or twice in a week with Gloucester and with Swansea. The limits of the port of Cardiff are from the river Rumney on the east to Nash Point on the west. In 1852 there were registered as belonging to the port, 62 sailing and 9 steam vessels, with a burden of 6814 and 366 tons respectively. In the same year, in the coasting trade, there cleared and entered 7185 sailing, and 843 steam vessels, with a burden of 458,943 and 78,010 tons respectively. In the foreign and colonial trade there cleared and entered 2186 sailing vessels, with a burden of 425,500 tons.

Cardiff was in ancient times a place of considerable importance. It possessed a fortified castle, which was surrounded by embattled walls with five entrance gates, a moat, and ramparts. These are believed to have been commenced in 1080, by Jestyn ap Gwrgan, Lord of Glamorgan, and to have been completed on an extended plan by the Norman chief Robert Fitzhamon in 1110. The name is supposed to be derived from *Caer-daff* (fortress on the Taff), or *Caer Didi* (the fort of Aulus Didius). The *Castle* appears to have been long the residence of princes, the seat of judicature, and the scene of many important actions and events. Here, according to tradition, Robert Duke of Normandy, eldest son of the Conqueror, was confined for twenty-six years by order of his brothers William Rufus and Henry I. In 1648, being garrisoned by royalists, it was closely besieged by Oliver Cromwell in person. The bombardment was kept up with great vigour for three days, and possession was at length obtained through the treachery of a deserter from the garrison, who was afterwards hanged by the command of the Protector. Every part of the ancient castle, except an old octagonal keep, has given place to the modern mansion now occupied by the Marquis of Bute. It contains several portraits by Kneller, and one by Vandyck. The castle commands extensive views of the surrounding country.

Cardiff has two parish churches. St John's, about the middle of the town, is an ancient and finely-proportioned edifice, with a noble quadrangular tower, surmounted by pierced battlements and four open Gothic pinnacles. The body of the church may be referred to the thirteenth century, but the tower is obviously of later date. St Mary's is a modern erection, opened in 1843, near the Bute canal. It has two towers in the Norman style of architecture. In this parish a fine old church and many other buildings were destroyed by an inundation in the year 1607. Dissenters of various denominations have places of worship; and in all of them services are conducted both in English and Welsh.

The other public buildings are the town-hall, county gaol, law courts, theatre, infirmary, union poor-house, national, British, and infant schools, and custom-house. The corporation consists of a mayor, 6 aldermen, and 18 councillors. The autumn assizes are held here. Markets are held on Wednesday and Saturday. In conjunction with Cowbridge and Llantrisaint, Cardiff sends one member to the House of Commons. The population is increasing, from the opening of new collieries in the Aberdare Valley; and in 1851 amounted to 18,351.

Cardiganshire. CARDIGANSHIRE, a maritime county in South Wales, is bounded on the north by Merioneth; on the east by Montgomery, Radnor, and Brecon; on the south by Caermarthen and Pembroke shires; and on the west by the Irish Sea. Its greatest length from south to north is about 30 miles, and its greatest breadth from east to west about 40 miles; but these dimensions give a very imperfect idea of its size, as it almost exactly represents in figure a "half boot," the line of the sole being from east to west, with the toe at the extreme west. It possesses an area of 693 square miles, or 443,387 acres, and is therefore the fifth in size of the Welsh counties.

The whole area of this county is occupied by the lower Silurian geological formation. It does not therefore possess mines of coal, or iron, or limestone; but, as if to compensate for this want, it is the richest of all the Welsh counties in its metalliferous lodes. Its lead mines have long been famous; and it was from the profits of his mining speculations, carried on chiefly in this county, that the celebrated Sir Hugh Myddelton was enabled to carry out his gigantic project for supplying London with water, by means of the New River, which he introduced. The Lisburne, Goginian, Cwrn Ystwith, and other mines, still yield largely, and have been sources of great profit to the adventurers. Some of the lead raised is very rich in silver; and in the seventeenth century the quantity of silver obtained was so considerable, that a mint existed for coining it on the spot, by virtue of letters-patent.

Cardiganshire is exceedingly wild and mountainous; but the mountains generally have little of grandeur in their character, and present rather the appearance of a sea of rounded hills, intersected here and there by a valley of greater depth and extent than usual. There is a considerable tract of flat land lying along the sea coast, especially towards the S.W.; but the general aspect of the county is so dreary and desolate, that it has been called, and with good reason, the desert of Wales. In that district it is almost possible to pass in a straight line for 30 miles without seeing a house, or a road, or a human being. The principal mountains are Plymlymon, just within the county boundary on the N.E., rising to the height of 2463 feet, and Tregaron mountain, near Tregaron, in the S.E., 1747 feet in height. Few of the others exceed 1000 feet in elevation. According to well-authenticated tradition, a great portion of what is now the bay of Cardigan was at one time dry land, protected from the incursions of the sea by dikes and dams, similar to those in use at the present time in Holland. It is generally believed that this district was very fertile, and contained no less than 16 towns; and that it was submerged in the year A.D. 520. At low water, remains of apparently artificial structures are still pointed out, as proofs of the truth of the tradition.

The scenery of the vale of Teifi presents views of great beauty and interest, especially as it approaches the sea. There are some fine old ruins on its banks, amongst others those of Kilgerran Castle, near Cardigan, which heighten the interest of the otherwise romantic scenery. The valleys of the Aeron, the Ystwith, and the Rheidol, also present scenes of great beauty, especially the latter, in which is the famous Devil's Bridge, with the falls of the Rheidol, one of the most celebrated pieces of Welsh scenery.

This county abounds in lakes and rivers. The chief of the latter is the Teifi, which rises in a lake of the same name (Llyn Teifi), about 8 miles N.E. of Tregaron; and flowing through the centre of the county, in a N.W. direction, till it reaches Lampeter, becomes from thence the

Cardiganshire. county boundary, separating it from Caermarthen and Pembroke shires; and after a course of about 50 miles from its source, falls into the sea at Cardigan. The Aeron takes its rise in some lakes in a low range of hills called Mynydd Back, and first flowing in a southerly direction, and afterwards nearly due west, falls into the sea at Aberaeron. The Ystwith and Rheidol both rise in Plymlymon, and flowing west, cross the county, falling into the sea at Aberystwith; and the Towy forms the county boundary, separating it from Brecknockshire on the S.E. Besides these streams there are a great number of minor importance.

Cardiganshire has been called the lake county of Wales, an appellation which it well deserves. The most important are Llyn Teifi, Llyn Fyrddyn Fawr, Llyn Egnant, Llyn Gynon, and Llyn Eiddwen; but hardly any of them exceeds three-quarters of a mile in length. They abound in trout, and are now a good deal resorted to by anglers.

There are numerous British and Roman antiquities in this county, consisting of Druidical circles, camps, and stations, and also the remains of a Roman road (the Sarn Helen), about 4 miles from Tregaron.

The climate on the coast is mild and salubrious, but suffers from an excess of rain. The climate of the hill country is cold, wet, and bleak. The cultivated crops consist of wheat, oats, barley, turnips, and potatoes; and in the lower districts on the coast, especially in the neighbourhood of Aberaeron, Llanrhystyd, and Cardigan, good crops are raised; and at the latter, as well as at Lampeter, great improvements are now being effected by means of the government drainage bill, in draining and improving several large estates. The hill district is entirely occupied with wild heathy pastures, which are stocked with the small mountain sheep of the country, and with herds of ponies and cattle, which are annually drafted off by dealers to be fattened in the more fertile districts of Wales or England. Cardiganshire has long been famous for its breed of horses, and for these high prices are obtained from English dealers, who now visit the fairs in considerable numbers. Black cattle, sheep, pigs, butter, barley, oats, woollen manufactures, slates, and lead and lead ore, form the principal articles of export. The farmers are generally a very ignorant, but hardworking and industrious race. In no county of Wales is the blood of the Cymry to be found so unalloyed by any foreign admixture; and it may well be doubted whether the manners and customs, or agricultural practice of the more remote districts, have undergone any change or improvement over those practised in the same districts centuries ago. Some of the sheep farms are of great extent. It is calculated that one-half only of the lands are inclosed.

There is no railway as yet in this county, although a line from Caermarthen to Cardigan has been surveyed, and will probably be shortly formed. There is generally a coach during the summer months every alternate day from Caermarthen to Aberystwith, through Lampeter, and every day from Caermarthen to Cardigan; which are the only public conveyances the county possesses.

The principal towns are, Cardigan, Aberaeron, at which, in consequence of its central situation, the county sessions are held, Aberystwith, Llanbadarn Fawr, Tregaron, Lampeter, and Adpar; which last is the name given to the portion of Newcastle Emlyn, on the Cardigan side of the Teifi. The county returns one member to parliament, and has done so since 1536. The political influence is divided between the families of Powell of Nanters (conservative), and Pryse Loveden of Gogerthan (liberal), one of whom usually sits for the county, and the other for the district. Constituency in 1852, 2235. The average gross rental of the county is estimated at 7s. 5d. per acre. The annual value of real property paying income tax is L.205,328.

The population of the county by the last census was 70,796, giving an average of 102 persons to a square mile, or 6·3 acres to each person. Of the total number, 32,961 were males, and 37,835 females, showing a great disproportion of the sexes, in the great excess of females, a state of population which prevails only in two other of the Welsh counties, Pembroke and Caermarthen. It may be perhaps accounted for by the emigration of men to the mining districts, especially Glamorganshire, where the excess of males would just balance the deficiency in the three counties named. The number of inhabited houses in 1851 was 14,978, uninhabited 544, and building 70, giving an average of 22 inhabited houses to a square mile, and 4·7 persons to each house. The following table gives the census returns for the last 50 years:—

YEARS.						Increase of population per cent. in fifty years.
1801.	1811.	1821.	1831.	1841.	1851.	
42,956	50,260	57,784	64,780	68,766	70,796	65

It is calculated that the condition of about one-fourth of the whole population is that of labourers, servants, &c. About thirteen per cent. live by agriculture, and about eight per cent. by trade, while upwards of 2000 persons possess independent means, and about 400 follow professions.

In 1847 the total number of children of the working classes at day schools within the county was 3885. The total number of schools was 101, of which 37 were church or national, with 1643 scholars; 49 private or adventure, with 1617 scholars; 2 British schools, with 136 scholars; 5 dissenting, with 307 scholars; and 8 dame schools, with 182 scholars. The average annual income of each school was only L.25, 0s. 4¾d., and the average annual income of the teachers, from all sources, only L.23, 16s. 7¾d. The total number of Sunday schools was 206; of which 55 were Church of England schools, with 4074 scholars; 18 Baptist, with 2025 scholars; 70 Calvinistic Methodist, with 13,776 scholars; 44 Independent, with 5483 scholars; and 19 Wesleyan Methodist, with 1773 scholars. In 159 of those schools instruction was given in the Welsh language only; in 10 in the English language only; and in 37 in both tongues. It is calculated that not more than 3000 of the whole population of the county use the English language, there being upwards of 67,000 who habitually use the Welsh language.

The women in Cardiganshire all dress in the picturesque costume of Wales, and have their heads surmounted by the high-crowned broad-brimmed hat. Some of the customs are curious. On the occasion of a marriage, a *bidder* goes from house to house inviting the inmates to the wedding. It is expected that all the guests are to bring presents of money and provisions. The marriage always takes place on a Saturday; but the guests assemble on Friday with their presents. All these are set down on paper, that, if demanded, they may be repaid; but this seldom happens. The furnishing of the bride is also brought home on this day. On Saturday ten or twenty of the man's friends who are best mounted go to demand the bride. She is placed on a horse, behind her father, who rides off as fast as he can. He is soon, however, overtaken. Presents continue to be received on Saturday and Sunday, and on Monday they are sold, and sometimes realize with the money received L.50 or L.60.

This was one of the counties involved in the singular disturbances known as the Rebecca riots.

It is in the diocese of St David's; and at Lampeter there is a college for the education of the Welsh clergy.

Cardigan. CARDIGAN, the capital of the county of the same name, a market and borough town. It is situated in the S.E. of Cardigan bay, at the mouth of the Teifi, which there divides the county from Pembrokeshire. The houses are

mostly constructed of slate rock; and the town presents a singular appearance, from the custom which prevails of annually washing the whole houses, roofs as well as walls, with lime. There is a large and fine church about 200 years old, and there are several places of worship belonging to the different dissenting bodies. There is a handsome national school; but the other public buildings are of a very simple character.

The corporation consists of a mayor, four aldermen, and twelve councillors. The borough, in conjunction with Aberystwith, Lampeter, and Adpar, has returned one member to parliament since 1836. Constituency in 1832, 672; in 1847, 662. The assessed taxes yield annually L.1478, and the annual value of real property paying income tax is L.29,864. There is a weekly market on Wednesday, and several fairs in the course of the year. The assizes are held here.

The port of Cardigan is capable of being entered at high spring tides by vessels drawing 15 to 18 feet of water. In 1853 there entered the harbour, with cargoes, 370 vessels engaged in general trade, having a tonnage of 9967 tons, besides a great number of vessels engaged in carrying limestone, of which no account is kept. During the same period there left the port, with cargoes, 38 vessels, of 1155 tons burthen, besides a great number laden with slates, of which no account is kept. The principal imports are timber, coal-culm, and general merchandise.

CARDINAL (Latin *cardinalis*), chief, principal, pre-eminent, or fundamental, is an appellation given to things on account of their pre-eminence. The word is formed from the Latin *cardo*, a hinge; as denoting the fundamental point on which things turn. Thus justice, prudence, temperance, and fortitude, were denominated by the Pagans the four *cardinal virtues*, as being the basis of all others.

Cardinal Numbers, in *Grammar*, are the numbers one, two, three, &c.; in distinction to the ordinal numbers, first, second, third, fourth, &c.

Cardinal Points, in *Cosmography*, are the four intersections of the horizon with the meridian and the prime vertical circle, or *North* and *South, East* and *West.* The cardinal points, therefore, coincide with the four cardinal regions of the heavens, and are 90° distant from each other. The intermediate points are called *collateral points.*

Cardinal Points, in *Astrology*, are the rising and setting of the sun, the zenith, and nadir.

Cardinal Signs, in *Astronomy*, are Aries, Libra, Cancer, and Capricorn.

Cardinal Winds are those that blow from the cardinal points.

Cardinal, an ecclesiastical prince in the Romish Church, who has a voice in the conclave at the election of a pope, who is taken from their number. Some say that the cardinals were so called from the Latin *incardinatio*, which signifies the adoption in any church of a priest of a foreign church, driven thence by misfortune; and that the use of the word commenced at Rome and Ravenna, which, as the revenues of the churches of those cities were very great, became the common refuge of the unhappy priests of all other churches.

The cardinals compose the pope's council. They are divided into three classes or orders, containing 6 bishops, 50 priests, and 14 deacons, and making in all 70, who constitute what is called the *sacred college.* The cardinal bishops, who are as it were the pope's vicars, bear the titles of the bishoprics assigned to them, and the rest take such titles as are given them. The number of cardinal bishops has been fixed, but that of cardinal priests and deacons, and consequently the sacred college itself, is always fluctuating. Till the year 1125 the college consisted of 52 or 53, and the council of Constance reduced them to 24; but Sixtus IV. raised them again to 53, and Leo to 65. Thus, as the number of cardinal priests was anciently fixed at 28, new titles were to be established as new cardinals were created.

In the Vatican there is a constitution of Pope John which regulates the rights and titles of the *cardinals*, and declares, that as the pope represents Moses, so the cardinals represent the 70 elders, who, under the pontifical authority, decide private and particular differences.

Cardinals, in their first institution, were only the principal priests, or incumbents, of the parishes of Rome. In the primitive church the chief priest of a parish, who immediately followed the bishop, was called *presbyter cardinalis*, to distinguish him from the other petty priests, who had no church or preferment. The term seems to have been first applied to them in the year 150; but some say that this took place under Pope Silvester, A.D. 300. These cardinal priests were alone allowed to baptize and administer the eucharist. When the cardinal priests became bishops, their cardinalate became vacant, as they were then supposed to be raised to a higher dignity. Under Pope Gregory, cardinal priests and cardinal deacons were only such priests and deacons as had a church or chapel under their particular care; and this was the original use of the word. Leo IV. in the council of Rome held in 853, calls them *presbyteros sui cardinis;* and their churches, *parochias cardinales.* The cardinals continued on this footing till the eleventh century; but as the grandeur and state of his holiness then became exceedingly augmented, he wished his council of cardinals to make a better figure than the ancient priests had done. It is true that they still preserved their ancient title, but the thing expressed by it ceased to exist. It was a long time, however, before they had the precedence over the bishops, or got the election of the pope into their hands; but when they once became possessed of those privileges, they soon got the red hat and purple; and growing still in authority, became at length superior to the bishops, by the sole quality of being cardinals.

Du Cange observes, that there were originally three kinds of churches; the first or genuine churches were properly called *parishes;* the second, which were chapels joined to hospitals, and served by deacons, were denominated *deaconries;* the third were simple *oratories*, where private masses were said, and were served by local and resident chaplains. He adds, that to distinguish the principal or parish churches from the chapels and oratories, the name *cardinales* was given to them. Accordingly, parish churches gave titles to cardinal priests; and some chapels also, at length, gave the title of *cardinal deacons.*

Others observe, that the term *cardinal* was given not only to priests, but also to bishops and deacons who were attached to certain churches, to distinguish them from those who only served them *en passant*, and by commission. Titular churches, or benefices, were a kind of parishes, or churches, assigned each to a cardinal priest, with some stated district depending on it, and a font for administering baptism, in cases where the bishop himself could not administer it. These cardinals were subordinate to the bishops; and accordingly, in councils, particularly that held at Rome in 868, subscribed after them.

It was not, however, only at Rome that priests bore this name; for we find that there were cardinal priests in France. Thus, the curate of the parish of St John de Vignes is called in old charters the *cardinal priest* of that parish. The title of *cardinal* is also given to some bishops, *quatenus* bishops, as for instance, those of Mentz and Milan. The Archbishop of Bourges is also, in ancient writings, called *cardinal;* and the church of Bourges a *cardinal church.* The abbot of Vendôme used to style himself *cardinalis natus.*

According to Onuphrius, it was Pope Pius IV. who first enacted, in 1562, that the pope should be chosen only by the senate of cardinals; whereas till that time the election

was by all the clergy of Rome. Some say the election of the pope rested in the cardinals exclusively of the clergy, in the time of Alexander III. in 1160. Others go higher still, and affirm that Nicholas II. having been elected at Sienna, in 1058, by the cardinals alone, occasioned the right of election to be taken from the clergy and people of Rome, leaving them only that of confirming him by their consent, which was at length, however, taken from them. (See his decree for this purpose, issued in the Roman council of 1059 in Hardouin's *Acta Conciliorum*, tom. vi. part i. p. 1165.) It appears, indeed, that the cardinals who had the right of suffrage in the election of his successors were divided by this pontiff into *cardinal bishops* and *cardinal clerks*, meaning by the former the seven bishops who belonged to the city and territory of Rome, and by the latter the *cardinal presbyters*, or ministers of the 28 Roman parishes or principal churches. To these were added in process of time, under Alexander III. and other pontiffs, new members, in order to appease the tumults occasioned by the edict of Nicholas II.

At the creation of a new cardinal, the pope performs the ceremony of opening and shutting his mouth, which is done in a private consistory. The shutting his mouth implies the depriving him of the liberty of giving his opinion in congregations; and the opening his mouth, which is performed fifteen days after, signifies the taking off this restraint. However, if the pope happens to die during the time a cardinal's mouth is shut, he can neither give his voice in the election of a new pope, nor be himself advanced to that dignity.

The dress of a cardinal is a red soutane, a rochet, a short purple mantle, and a red hat. The cardinals began to wear the red hat at the council of Lyons in 1243. The decree of Pope Urban VIII., by which it is appointed that the cardinals be addressed by the title of *eminence*, is of the year 1630; till then they were called *illustrissimi*.

When cardinals are sent to the courts of princes, it is in quality of legates *a latere;* and when they are appointed governors of towns, their government is called by the name of *legation*.

Cardinal has also been applied to secular officers. Thus the prime ministers in the court of the Emperor Theodosius were called *cardinales*. Cassiodorus, lib. vii. formul. 31, makes mention of the cardinal prince of the city of Rome; and in the list of officers of the Duke of Bretagne, in 1447, we meet with one Raoul de Thorel, cardinal of Quillart, chancellor, and servant of the Viscount de Rohan, which shows it to have been an inferior quality.

CARDIOID, an algebraic curve, so called from its resemblance to a heart.

CARDONA, a town of Spain, in the province of Catalonia, with 2800 inhabitants. It occupies the summit of a hill near the banks of a small river, the Cardonera, a branch of the Lobregat. It is remarkable for the famous mountain of rock salt in its vicinity. It forms a mountain mass in the head of a valley, and is covered by a thick bed of a reddish brown clay, and apparently rests on a yellowish gray sandstone, that slightly effervesces with acids. It is rather, according to Dr Traill (*Geolog. Trans.*), a valley filled with salt than a mountain of that material as commonly stated. The salt is generally more or less translucent, but large masses of it are quite transparent; and pieces cut from it are worked by artists in Cardona, into images, crucifixes, and many articles of an ornamental kind. N. Lat. 41. 57., E. Long. 1. 37.

CARDUCHI (the modern Kúrds), ancient warlike mountain tribes, who inhabited the hill country lying between Mesopotamia and the great table-land of Persia. They uniformly baffled all the attempts made at different times by the Persian monarchs to subdue them. The Ten Thousand on their retreat after the battle of Cunaxa suffered severely as they passed through the difficult country of the Carduchi. A complete account of their modes of life, habits, and customs, will be found in the opening chapters of the fourth book of Xenophon's Anabasis, in which their skill in archery is thought worthy of special notice.

CAREENING, the bringing a ship to incline on one side, in order to cleanse, repair, pitch, or caulk the opposite side.

CAREER, in the manège, a place inclosed with a barrier, in which they run the ring. It also denotes the race itself.

Career, in falconry, a flight or tour of the falcon, about 120 yards.

CARET (Latin *caret*, there is wanting, from *careo*), in writing, a character marked thus ʌ, to indicate that something added on the margin, or interlined, should be read in that place.

CAREW, George, was the brother of the author of the *Survey of Cornwall*, and like him passed his early life in studying at Oxford, at the Inns of Court, and in continental travel. At the recommendation of Queen Elizabeth, who conferred on him the honour of knighthood, he was appointed secretary to Sir Christopher Hatton, and afterwards, having been promoted to a mastership in chancery, was sent as ambassador to the king of Poland. In the reign of James he was employed in negotiating the treaty of union with Scotland, and for several years held the office of ambassador to the Court of France. On his return he wrote a *Relation of the State of France*, with sketches of the leading persons at the Court of Henry IV. It is written in the classical style of the Elizabethan age, and has been appended by Dr Birch to his *Historical View of the Negotiations between the Courts of England, France, and Brussels, from* 1592 *to* 1617. During his residence in France, he communicated much important information to the historian De Thou in regard to the affairs of Poland, which has been incorporated into that author's History of His Own Times. He died about the year 1613.

Carew, *George*, Earl of Totness, and Baron Carew of Clopton, Warwickshire, was born in 1557. After completing his studies at Oxford, he joined the army, and held an important command in the Irish wars against the Earl of Desmond and the rebels. He was successively appointed governor of Askeaton castle, lieutenant-general of artillery, and after a successful expedition to Cadiz (1596) lord-president of Munster, treasurer to the army, and ultimately one of the lords judges of Ireland. When he entered on his duties, the whole country was in open rebellion; but by prudent and vigorous policy, backed by his own intrepidity in the field, he soon reduced the rebels to submission. His greatest exploit was the capture of Dunboy castle, an event which disappointed the Spanish allies, and in reality put an end to the war. For his services in Ireland he was made governor of Guernsey, and raised to the peerage. He was afterwards made privy-councillor to James VI., and died at London in 1629. Carew wrote an account of the wars in Ireland in a book called *Hibernia pacata*, published after his death; and made several collections for the history of Henry V., which were afterwards digested into Speed's *History of Great Britain*.

Carew, *Richard*, author of the *Survey of Cornwall*, was born in 1555. At an early age he became a distinguished student of Christ Church, Oxford, and when only fourteen was chosen to dispute extemporaneously with Sir Philip Sydney, in presence of the Earls of Leicester, Warwick, and other noblemen. From Oxford he removed to the Middle Temple, where he spent three years, and then went abroad. On his return he was appointed sheriff of Cornwall, and published his Survey of the county, a work which enjoyed a high reputation, and has been several times reprinted. His other works are entitled, *The Examination of Men's Wits*, a translation from the Italian, part of which is said to have been executed by his father; *The True and Ready*

Way to learn the Latin Tongue, a tract included in Hartlib's book on the same subject; and *A Translation of the first Five Cantos of Tasso's Gierusalemme*. He died in 1620.

CAREW, *Thomas*, an English poet, was born about the year 1589. He studied at Oxford, and on the completion of his course was made gentleman of the privy chamber to Charles I. At court he was highly esteemed for the vivacity of his wit and the elegance of his manners; and his poetical tastes gained him the friendship of Ben Johnson, Sir William Davenant, and other celebrated literary men. He wrote several sonnets, amorous pieces, and masques, which were set to music by Henry Lawes and other eminent masters. His best known work is a masque called *Cœlum Britannicum*, performed by the king and several of the nobles at Whitehall on Shrove Tuesday 1633. He died in the prime of life about the year 1639.

CAREY, HENRY, a humorous poet and musical composer, was an illegitimate son of George Savile, Marquis of Halifax, and was born about the end of the seventeenth century. He studied music under Lennert, Roseingrave, and Geminiani, but never attained to excellence in the higher departments of composition. His ballads and songs, however, were exceedingly popular at the time. He wrote several dramatic pieces for Covent Garden theatre, among which may be mentioned a burlesque tragedy called *Chrononhotonthologos*; a farce called the *Honest Yorkshireman*; two interludes, called *Nancy* and *Thomas and Sally*; and two burlesque operas, called *The Dragon* and *Margery or the Dragoness*. His songs were collected and published by himself in a work called *The Musical Century*; and the tune of one of them, beginning "Of all the girls that are so smart," still survives in the popular air of *Sally in our Alley*. Carey, who seems to have been of an amiable but exceedingly irritable disposition, put an end to his life in 1744, probably in a fit of despondency caused by the malicious attacks of rival composers.

CAREY, *William*, a celebrated Baptist missionary and oriental scholar, was born at Paulerspury, Northamptonshire, in 1761. When a youth he wrought with his father, who was a shoemaker, and before he was twenty years of age he joined the Baptists, and devoted a large portion of his time to village preaching. In 1787 he became pastor of a Baptist congregation in Leicester, and five years after was chosen by a Baptist missionary association to proceed to India as their missionary. On reaching Bengal, Carey and his companions lost all their property in the Hooghly; but having received the charge of an indigo factory at Malda, he was soon placed in a favourable position for prosecuting the work of translating the Bible into Bengalee. In 1799 he quitted Malda for Serampore, where he established a church, a school, and a printing press for the publication of the Scriptures and philological works. In 1801 Carey was appointed professor of oriental languages in a college founded at Fort-William by the Marquis of Wellesley, and soon after received a doctor's degree from his native country. From this time till his death he devoted himself to the preparation of numerous philological works, consisting of grammars and dictionaries in the Mahratta, Sanscrit, Punjabee, Selinga, Bengalee, and Bhotanta dialects. The Sanscrit dictionary was unfortunately destroyed by a fire which broke out in the printing establishment. From the Serampore press there were issued no fewer than 24 different translations of the Scripture, which were all edited by Dr Carey. He died in 1834.

CARGADORS, the Dutch name for those brokers who find freight for ships, and give notice to merchants of the ships that are ready to sail, &c.

CARGILL, DONALD, one of the leaders of the Covenanters, was born in 1610. He was educated at St Andrews, and afterwards attached himself to the Protesters. He was soon after appointed one of the ministers of Glasgow, and made himself obnoxious to government by his open resistance to their measures. Compelled to remain at a distance from his charge, he ventured back to celebrate the communion and was arrested, but was liberated at the instance of some of his private friends. He was afterwards wounded at the battle of Bothwell Bridge, and fled to Holland, where he remained a few months. On his return he joined Richard Cameron in publishing the Sanquhar declaration (see BRITAIN, p. 432), and was immediately after apprehended. He was tried at Edinburgh for high treason, and beheaded on the 27th July 1681.

CARGO (Spanish *carga* or *carcazon*, a load), the goods, merchandise, or other effects with which a ship is laden. The person employed by merchants to proceed with the ship in charge of the cargo, and to dispose of it to the best advantage, is called the *super-cargo*.

CARIA, a maritime province in the S.W. corner of Asia Minor. The boundaries of the kingdom, as possessed by the original Carians, seem to have undergone rapid changes with the advancement of Dorian and Ionian colonization on the coast. Accordingly the earlier geographers assign it a much larger territory than those who wrote at a later period. The principal encroachment seems to have been made in the north, where the Ionian settlers dispossessed the Carians entirely of the plain between the Messogis range and the Mæander, which from that time forward became the northern boundary of Caria. The Dorian immigrants contented themselves with seizing on the islands and part of the sea-coast, which however still remained as the great natural boundary of the Carian province. The eastern frontier is distinctly marked by the range of Mount Cadmus; and the river Calbis, near the left bank of which stood Calynda, the frontier town according to Strabo, sufficiently divides the province from Lycia on the south. The interior of the country consisted chiefly of a fertile plain, inclosed by the Mæander and the Messogis hills, and several smaller valleys inclosed by the ridges which stretch from the eastern boundary in a south-westerly direction to the sea, and are prolonged in the various peninsulas and islands on the coast. Beyond the cultivation of the olive and vine, and the tending of their flocks of sheep on the highlands, the Carians paid little attention to agricultural pursuits. They served like the modern Swiss as mercenaries to almost all their more powerful neighbours; and while indifferent to everything but their pay, they were generally planted in the front of the battle, and fought with the greatest bravery. Their mercenary character in ancient times, however, gave rise to several proverbs in which cheapness, rudeness, and treachery were associated with the Carian name. *In Care periculum* indicated headless daring. *Cum Care Carissa* was a common mode of designating clownish behaviour. The islands on the coast were too widely scattered, and too much exposed to the powerful maritime states in the neighbourhood, to remain long in connection with an oppressed people on the mainland; but must have afforded admirable shelter to the Carians when they were the pirates of the Ægean. Syme alone remained faithful to the continental interest. Of the Carian ancestry very conflicting accounts have come down to us from antiquity. They piqued themselves in being an aboriginal people, but their Cretan rivals gloried in affirming that they had been once subjects of the great Minos. They seem originally to have been extensively scattered over the islands of the Ægean, and to have been confined within, if not actually driven to, their possessions on the mainland by the flood of Dorian and Ionian colonies, which seized on every convenient point for maritime settlements. According to Thucydides, their characteristic armour was to be seen in the graves of Delos; while vestiges of a totally distinct, although perhaps an allied people, were to be found

on the mainland which afterwards went by their name. If these native Pelasgi were dispossessed by the Carian fugitives, they themselves shared the same fate at the hands of the Dorian and Ionian colonies, and the enterprising Rhodians, who stripped them respectively of Cnidus and Halicarnassus, Mycale and Miletus, Peræa, and what was afterwards called the Rhodian Chersonese. Notwithstanding the presence of these invaders in their territory, the Carians still enjoyed a large measure of independence, retaining their own dialect, and preserving their own political constitution. Their Chrysoræum or convention met in the interior at the temple of Zeus Chrysoræus and settled their private affairs, even after the surrounding districts had yielded to a foreign yoke. The Persians, who, not without a protracted contest, reduced them to obedience after the Ionian revolt, pushed their conquests no farther than to establish a line of native princes, who ruled at Halicarnassus, and were dependent on the Persian crown. On the approach of Alexander the Great, Ada the rightful queen vindicated her claim to Grecian descent by detaching herself from the Persian interest, and was rewarded for her allegiance with the throne of Caria. Her descendants did not fare as well from the subsequent Macedonian princes, who established themselves in her dominions, and paved the way for their occupation by Antiochus the Great. On the rise of the Roman power in Asia Minor, the district of Caria was dismembered and partitioned between Eumenes, king of Pergamus, and the Rhodians, and soon after incorporated with the Roman province of Asia. On the fall of the Eastern empire it passed into the hands of the Turks.

CARIACO, a seaport-town of South America, in the republic of Venezuela and county of Cumana. It is situated in a large plain near the head of the gulf of the same name, 40 miles E.N.E. of Cumana. The climate is unhealthy and the town small, but it has some trade in cotton. Pop. 7000; N. Lat. 10. 30., W. Long. 63. 40.

CARIBBEAN SEA, that part of the Atlantic Ocean lying between the coasts of Central and South America and the islands of Cuba, Hayti, Porto Rico, and the Leeward and Windward Islands.

CARIBBEE ISLANDS, in its more extended sense, is applied to the whole of the West Indies; but strictly, it only comprehends that cluster of islands stretching from Porto Rico to the coast of South America, and known as the Leeward and Windward Islands. See West Indies.

CARICATURE (Italian *caricatura*, from *carica*, a load), a figure or a description in which beauties are concealed and blemishes exaggerated, but still so as to preserve a resemblance to the object.

CARICOUS, an epithet given to tumours that bear a resemblance to the form of a fig.

CARIGNANO, a town of Northern Italy, kingdom of Sardinia, and province of Turin, is situated on the left bank of the Po, here crossed by a wooden bridge 11 miles south of Turin. It is surrounded by old walls, and has a handsome church, a communal college, and several convents. Population about 8000, principally engaged in the spinning of silk and the manufacture of confectionery. The royal family name is derived from this place.

CARILLON, the French term for a chime of bells.

CARIMATA, an island in the Eastern Archipelago, lying off the west coast of Borneo, in E. Long. 108. 54., S. Lat. 1. 36. It is woody and mountainous, with a peak in the centre rising to the height of 2000 feet.

CARINA (Latin, *the keel of a ship*, or *a ship*), in the *Ancient Architecture*, was sometimes used to denote the vaulted portion of a building, from its resemblance to the form of a ship; as we designate the central vault of a Gothic cathedral the *nave*, from the Latin *navis*, a ship. For the same reason a place in Rome between the Cœlian and Esquiline hills was called *Carinæ*.

CARINI, a town of Sicily, in the intendancy of Palermo, on a rivulet of the same name, 12 miles W.N.W. of Palermo. It is pleasantly situated on an elevation, and is a neat clean town, with a Gothic castle, several churches, and other public buildings. Pop. 7000. Near it are ruins of the ancient Hyccara.

CARINTHIA. See Austria.

CARISBROOKE, a village and parish in the Isle of Wight, formerly a market-town, and capital of the island. It is situated at the base of a steep conical hill, on which stands its castle, one mile S.W. of Newport. The original fortress is supposed to have been built by the Saxons as early as the sixth century. Various additions were made to it at different times, the last by Queen Elizabeth, when the outer walls which still remain were made to inclose about 20 acres; and the old fortress, with its keep, covers an area of two acres. Here Charles I. was confined for thirteen months previous to his being delivered up to the parliamentary forces. Within the walls is a remarkable well 200 feet in depth. The church is of great antiquity, and adjoining it are some remains of a Cistercian priory. Pop. of parish (1851) 6712.

CARK (Saxon *carc*), care, distress, anxiety.

CARLETON, Sir Dudley, was born in Oxfordshire in 1573, and educated at Christ Church College, Oxford. He went in a diplomatic capacity to the Low Countries when King James resigned the cautionary towns to the States; and he was afterwards employed for twenty-nine years as ambassador to Venice, Savoy, and the United Provinces. Charles I. created him Viscount Dorchester, and appointed him one of his principal secretaries of state, an office which he held till his death in 1651. He published several works, consisting chiefly of speeches, letters, and other productions on political subjects. The most valuable was published after his death, and consist of a selection of letters to and from Sir Dudley Carleton during his embassy to Holland, from January 1616 to December 1620, 4to, 1757.

CARLI, Gian-Rinaldo, Count of, a celebrated Italian writer on antiquities and economics, was born at Capo d'Istria, in 1720. He was early distinguished for the extent and variety of his acquirements; for at the age of twenty-four he was appointed by the senate of Venice to the newly-established professorship of astronomy and navigation in the University of Padua, and intrusted with the superintendence of the Venetian Marine. After filling these offices for seven years with great credit, he resigned them in order to devote himself to antiquities and general economics. In 1754 he published the first volume of his great work *Delle Monete, e delle Instituzione delle Zecchi d'Italia*. This laborious work, which in nine years had increased to seven volumes 4to, was completed in 1785. An edition in 19 vols. 8vo appeared also at Milan from 1784 to 1794. In his speculations on the Balance of Trade, though he did not anticipate Adam Smith on this point, he was the first continental philosopher who maintained that what is termed the Balance of Trade between two nations is no criterion of the prosperity of each; for that both may be gainers by their reciprocal transactions, on the same principles as developed by Smith. His merits were appreciated by the discerning Leopold of Tuscany, afterwards Emperor of Germany, who in 1765 placed Count Carli at the head of the Council of Public Economy, and of the Board of Public Instruction. The duties of these honourable offices he continued to discharge for some years; but for several years before his death he was relieved from their toils; retaining, however, their emoluments, as a reward for his important services. It was during the leisure thus afforded that he completed and published his very valuable *Antichità Italiche*, Milan, 5 vols. 4to, 1788–91, in which the literature and arts of his country are ably discussed. It is highly praised for its research and erudition by Tiraboschi, Bossi, and

Ugoni. The accomplished author died at Milan in February 1795. (T. S. T.)

CARLINE, or CAROLINE THISTLE. This plant is said to have been discovered by an angel to Charlemagne, to cure his army of the plague; whence its denomination.

CARLINE, or *Caroline*, a silver coin current at Naples, worth about 4d. sterling.

CARLINES, or CARLINGS, in a ship, two pieces of timber ranging fore and aft from one beam to another directly over the keel. On these rest the ledges to which the planks of the deck are fixed. Carline knees are timbers lying athwart the ship, from the sides to the hatchway, and serving to sustain the deck.

CARLINGFORD, a seaport-town of Ireland, in the county of Louth, situated on a bay to which it gives name, ten miles from Dundalk. It is an inconsiderable town, and its inhabitants, amounting in 1851 to 887, are chiefly engaged in the oyster fishery in the bay. Previous to the union, it returned two members to the Irish parliament.

CARLISLE, a parliamentary and municipal borough, the capital of Cumberland, 301 miles N.N.W. from London; N. Lat. 54. 54., W. Long. 2. 55. It is situated on an eminence nearly inclosed by three streams, the Eden, the Caldew, and the Peteril, which are crossed by several handsome bridges. It is supposed to be of British origin, and seems to have been a Roman station, though not one of great importance. It was first fortified about the time of Agricola, but the erection of the castle does not date beyond the time of William Rufus. In border warfare Carlisle suffered severely; it was taken by David King of Scots, and afterwards besieged unsuccessfully by William the Lion. In the civil wars it declared for Charles I., and suffered from the armies of the Commonwealth. In 1745 it surrendered to Prince Charles Stuart; and, on being retaken by the Duke of Cumberland, was the scene of many cruel severities upon the conquered. After the junction of the two crowns it fell into decay, but has made rapid increase during the present century. Pop. (1801) 10,221; (1821) 15,476; (1841) 23,012; (1851) 27,484.

The principal business of the town consists in the manufacture of cotton goods and ginghams; and a considerable profit is derived from the coasting trade of Port-Carlisle on the Solway Frith, and of Bowness which communicates with Carlisle by a ship canal 11 miles long. The vessels belonging to the port in 1852 numbered 35, with a tonnage of 2023, besides two steam vessels of small burden. The coasting-trade (1852) employed 243 sailing and steam vessels, which entered with a tonnage of 32,554; while 442 cleared, with a tonnage of 41,155.

The municipal government of Carlisle is vested in a mayor, 10 aldermen, and 30 councillors. Since Edward I. it has returned two members to parliament. It is the see of a bishop (income L.3000), and contains an ancient cathedral in various styles of architecture, in the interior of which is a monument erected to Dr Paley, who was archdeacon of Carlisle. Besides the cathedral, there are four other Established churches, and several places of worship for Independents, Presbyterians, Baptists, Wesleyans, &c. Its educational establishments comprise the National, British, Fawcett, (so called from Rev. John Fawcett, late of St Cuthbert's Church,) industrial and private schools; its scientific and literary institutions include two literary associations, a mechanics' institute, public library, news-rooms, &c.; its charities consist of an infirmary, fever hospital, dispensary, and humane society. A county-court is held at Carlisle. The court-houses were erected at a cost of L.100,000. Among the more recent buildings, the custom-house, the fish-market, the news-room, and the railway station, have added considerably to the improvement of the town. A market is held on Wednesdays and Saturdays, and fairs in August and September. A considerable part of the ancient castle still remains, and it is now used as quarters for the garrison. Towards the north are the apartments in which Mary Queen of Scots was confined after the battle of Langside. The earldom of Carlisle is one of great antiquity, and is held by a branch of the Howard family.

CARLISLE, *Fifth Earl of.* See HOWARD, *Frederick.*

CARLISLE, *Sir Anthony*, an eminent English surgeon, was born at Durham in 1768. He studied under Mr Green, the founder of the hospital in that city, and afterwards in London under the two Hunters, Cruickshank, and Baillie. On the death of Mr Watson he was appointed surgeon to the Westminster Hospital; and was lecturer on anatomy and surgery in the College of Surgeons, of which body he was also elected the president. In 1808 he was appointed professor of anatomy to the Royal Academy, which office he held for sixteen years. He was the author of several detached papers on various professional subjects; in which he showed himself a better observer than a systematic author. To him we are indebted for the introduction of the straight-bladed amputating knife, and the concealed bistoury for such operations as *fistula in ano.* His essay "On the Disorders of Old Age" is his principal work. He died in 1840. (T. S. T.)

CARLOCK, a sort of isinglass imported from Russia. It is made of the sturgeon's bladder, and is used chiefly for clarifying wine.

CARLOS, SAN, a town of South America, in the republic of Venezuela, on the river Aguare, 150 miles S.W. of Caracas. It was formerly a place of considerable importance, but has now probably not more than 5000 inhabitants, principally engaged in the rearing of cattle and in the cultivation of indigo, coffee, and the other productions of the district.

CARLOVINGIAN, pertaining to Charlemagne; as, the *Carlovingian dynasty.*

CARLOW, an inland county of Ireland, in the province of Leinster; situated between 52. 26.—52. 54. N. Lat., and 6. 30.—7. 12., W. Long.; comprising, according to the Ordnance Survey, an area of 346 square miles, or 221,342 acres, of which 184,059 are arable, 31,249 uncultivated; 4927 in plantations; 620 in towns, and 505 under water. Carlow is bounded north by Kildare and Wicklow, east by Wicklow and Wexford, south by Wexford, and west by Queen's County and Kilkenny. Excepting Louth it is the smallest county in Ireland.

Previous to the arrival of Strongbow, and for some time afterwards, what is now the county of Carlow was divided into the districts of Hy Cabanagh and Hy Drone, forming the northern portion of the principality of Hy Kinselagh. Its most ancient Irish families were the Kavanaghs (descended from the celebrated Macmurrough, king of Leinster, who, in the reign of Henry II., for his own preservation, solicited the assistance of the English), the O'Ryans, the O'Nolans, and the O'Mores. After the English settlement, the families of St Aubin, De la Frayne, Bermingham, Carew, De la Landes, Grace and Butler, held extensive possessions here. In the time of Queen Elizabeth appear the families of Bagnal, Eustace, Burton, O'Brien, Ponsonby, Hamilton, Coke, Bernard, Vigors, Burdett, Bunbury, Beresford, Bruen, Bagot, and Browne.

Under the name of Catherlogh, the present county was made shire-ground in the reign of King John, and is now divided into seven baronies: Carlow, Forth, Idrone East and West, Kathvilly and St Mullins Lower and Upper; containing forty-four parishes and parts of parishes. It is within the diocese of Leighlin, of which it forms the greater part. In military arrangement, it is in the Kilkenny district, and contains barracks for cavalry and infantry at Carlow, where the staff of the county militia is also stationed. The headquarters of the constabulary force, consisting of 159

men and officers, are at Carlow; those of the four districts, comprising twenty stations, at Carlow, Bagnalstown, Tullow, and Borris. The assizes are held at Carlow, where the county prison, the county infirmary, and district lunatic asylum are situated. Quarter sessions are held at Carlow, Tullow, and Bagnalstown. There are loan funds at Leighlin Bridge and Tullow, but no savings-bank exists in the county. The only union workhouse is that of Carlow, but portions of the county are within the unions of Shillelagh, Enniscorthy, and New Ross. The amount of property valued under the Act 6th & 7th Will. IV., cap. 84 (Griffith's valuation) is L.164,795, and the net annual value of property rated to the poor is L.166,638. The principal towns are Carlow, pop. in 1851, 9121; Tullow, 2963; and Bagnalstown, 2292. The county returns three members to the imperial parliament, two for the county at large; constituency under 13th & 14th Vict., cap. 69, in 1851, 2090; and one for Carlow borough, constituency 237. Previous to the union with Great Britain, Carlow returned six members to the Irish parliament; two for the county, two for the borough of Carlow, and two for Leighlin borough. According to Ptolemy, the district was inhabited by the *Brigantes* and *Cauci;* Whitaker, however, considers it as forming the possessions of the *Coriundi.* In common with most other parts of Ireland, Carlow was occasionally devastated by the Danes, but not to the same extent as the maritime counties. The relics of antiquity in the county consist of large cromlechs at Browne's Hill near Carlow, and at Tobinstown. A rath near Leighlin Bridge, in which were found several urns of baked earth, contained only small quantities of dust. Some relics of ecclesiastical and monastic buildings exist, and also the remains of several castles built after the English settlement. The ruins of a round tower existed at the commencement of the present century near the church of Kellystown, but are not now visible.

The surface of the county is in general level or gently undulating, and of pleasing appearance, excepting the elevated tract of land known as the ridge of Old Leighlin, forming the commencement of the coal district of Leinster, and the south-eastern portion of the county bordering on Wexford, where the wild and barren granitic range of Mount Leinster and the Blackstairs mountain present a bolder aspect.

There are no lakes or canals in the county, neither does it contain the source of any important river; but on its western side it is intersected from north to south by the "goodly Barrow," which is navigable throughout the whole extent of the county, and affords means of communication with the port of Waterford; and on the eastern border by the Slaney, which passes out of Carlow into Wexford at Newtownbarry, but is not navigable in any part of its course through the county of Carlow. A branch of the Great Southern and Western railway connects the town of Carlow with Dublin, and the Irish South-Eastern line, commencing at Carlow, passes by Bagnalstown to Kilkenny, whence the Kilkenny and Waterford railway completes the means of communication by railway with Waterford.

The soil of the county rests mainly upon the lowest of the three formations of limestone observed in Ireland; but the granite formation of the county of Wicklow is exhibited in the south-eastern border of the county in the Mount Leinster range and the Blackstairs mountain. The great coal district of Leinster commences in the western edge of the county. The sandstone of this formation is frequently of such a nature as to split easily into layers, known in commerce as Carlow flags. Porcelain clay exists in the neighbourhood of Tullow; but no attempt has yet been made to turn this production to use. No metalliferous indications worth mentioning have been observed in any part of the county, and the few chalybeate springs which exist are of no medicinal importance.

The population of the county at the several periods when taken by the census was as follows:—

Year.	No. of souls.	Increase.	Decrease.
1813	69,566	...	...
1821	78,952	9386	...
1831	81,988	3036	...
1841	86,228	4240	...
1851	68,075	...	18,153

The soil of the county is of great natural richness, and generally of a calcareous nature; but although agriculture is the chief occupation of the inhabitants, and the system of tillage not behind what is usually practised in Ireland, much remains to be done in the way of improvement before the capabilities of the soil be fully developed. The extent of land under crops in 1847 was 85,246 acres, and in 1853, 84,422 acres, viz.:—wheat, 6687; oats, 27,707; barley, bere, rye, pease, and beans, 6712; potatoes, 10,608; turnips, 6306; other green crops, 1502; flax, 43; meadow and clover, 24,837. The cultivation of wheat is decreasing, while that of oats, potatoes, and green crops is on the increase. The number of farms in 1847 was 7762, which had declined in 1851 to 5250. The pasture land is of excellent quality, and generally occupied as dairy farms; the butter made in this county maintaining a high reputation in the Dublin market. The farms are frequently large; and great attention is paid to the breeding of cattle. In 1852 the stock of the county consisted of 7291 horses, 2532 mules and asses, 34,581 cattle, 42,825 sheep, 22,618 pigs, 3501 goats, and 106,654 poultry, of the total value of L.366,490.

The staple trade of the county, which has no manufactures, is in corn, flour, meal, butter, and provisions, which are exported in large quantities.

The manners and appearance of the peasantry differ little from those of the agricultural parts of the southern portion of Ireland. The people are, generally speaking, peaceable and industrious, exhibiting few indications of a tendency to agitation or turbulence. They dwell chiefly in detached cottages, or in small villages, there being but three towns, Carlow, Tullow, and Bagnalstown, of which the population exceeds 2000 souls.

In December 1851, there were 59 national schools in operation, attended by 6948 children, 3133 males and 3815 females; and at the same time the following was ascertained to be the state of elementary instruction among the population:—

	Rural Districts.	Civic Districts.	Total.	Per cent. in 1851.	Per cent. in 1841.
Could read and write,.........	7451	2700	10,151	32	27
Could read only, ...	7409	2084	9,493	30	32
Could neither read nor write,	9493	2775	12,268	38	41

The Roman Catholic is the prevailing religion, but what proportion its adherents bear to those of the Established Church is not ascertained. The number of Presbyterians and other Protestant Dissenters is very small.

Carlow, a parliamentary borough, and the capital of the county of Carlow, situated in the heart of the beautiful and well-cultivated vale formed by the river Barrow, which is navigable for small craft to its junction with the Grand Canal at Athy, and affords great facilities for the exportation of grain, butter, &c. to Dublin and Waterford. The population of Carlow in 1841 was 10,400, and in 1851, 9121, inhabiting 1375 houses. It is a neat and in some parts a well-built town, of modern aspect. The principal buildings are—the Roman Catholic College of St Patrick, a plain but spacious building, which, under the superintendence of the late Dr Doyle, rivalled Maynooth as a preparatory seminary for the Roman Catholic priesthood; the parish church, an old building, with a handsome steeple of modern erection; the Roman Catholic chapel or cathedral, a large and elegant structure; the old court-house, and the new court-house where the assizes are held, an octagonal stone

building with a handsome Ionic portico; the lunatic asylum for this and the adjoining counties; the county gaol; the union workhouse; the Wellington bridge over the river Barrow; and a barrack for cavalry and infantry.

This town was formerly of considerable importance. In the reign of Edward III. the king's exchequer was removed hither, and L.500, a large sum at that period, applied towards surrounding the town with a strong wall. The castle (supposed to have been founded by Hugh de Lacy, but sometimes attributed to King John), situated on an eminence overlooking the river Barrow, is still a chief feature of attraction in the general view of the town, but has lost much of its original grandeur in consequence of the blasting operations performed by a physician, who in 1814 attempted unsuccessfully to adapt it for the purposes of a lunatic asylum. It consisted of a hollow quadrangle, with a massive round tower at each angle. In the early part of the reign of Queen Elizabeth it was taken, and the town burned by the Irish chieftain Rory Oge O'More. When summoned to surrender by Cromwell, during the disastrous war of 1641, Carlow submitted without resistance. In the insurrection of 1798, the castle was attacked by an undisciplined body of insurgents, many of whom were intoxicated. They were speedily repulsed, and suffered severe loss, no quarter being given; and, in the confusion of their flight, many of the insurgents took refuge in houses, which the king's troops immediately set on fire. After the slaughter, about 420 bodies were collected and buried.

Carlow obtained a charter of incorporation at an early period, and was re-incorporated, with enlarged privileges, by James I. The corporation, which was styled "The Sovereign, Free Burgesses and Commonalty of the Borough of Catherlagh," and was authorized to return two members to the Irish parliament, was extinguished by the Municipal Reform act. The borough now sends one member to the imperial parliament; constituency in 1853 numbering 208.

Carlow is 49 miles S.W. of Dublin, with which it is connected by a branch of the Great Southern and Western railway. (H. S—R.)

CARLOWITZ, a town of the Austrian dominions, in the Slavonian military frontier and circle of Peterwardein, is situated on the right bank of the Danube eight miles S.E. of Peterwardein. Pop. 5800. It is the seat of the Greek archbishop in the Austrian dominions, and has, besides the cathedral, two Greek churches, a Roman Catholic church, seminaries for the Greek and Catholic clergy, a lyceum, hospital, &c.

CARLSBAD, a town of Bohemia, in the circle of Elbogen, on the Teple, near the junction with the Eger, 70 miles W.N.W. of Prague. It is situated in a narrow valley between steep granite mountains, and consists chiefly of lodging-houses and hotels for the accommodation of visitors, but has also some good shops and private houses, a theatre, hospital, reading-rooms, &c. Carlsbad is the most aristocratic watering-place in Europe. It is most frequented from the middle of June to the middle of August, and the number of visitors averages 5000. The permanent population is only about 3000. The springs differ but little from each other in their component parts, the principal ingredients being sulphate of soda, carbonate of soda, and common salt. The principal springs are the Sprugel, Muhlbrunnen, Neubrunnen, and Theresienbrunnen, having respectively a temperature of 165°, 138°, 147°, and 132° Fahr. They are said to have been discovered during a hunting excursion, by the Emperor Charles IV., to whom a statue has been erected in the market-place. The resident inhabitants make many curious articles in iron, steel, tin, and wood, for which they find a ready market during the season.

CARLSBURG, a fortified town of Transylvania, capital of a county of the same name, situated on the north bank of the Maros, 54 miles south of Clausenburg. It consists of the upper town or citadel, and the lower town. It has a fine Roman Catholic cathedral, containing among other tombs that of John Hunniades; also an ecclesiastical seminary, gymnasium, observatory, public library, mint, &c. Pop. 12,000.

CARLSHAMN, a small seaport-town of Sweden, in the laen of Bleking, on the Baltic, 27 miles west of Carlskrona. It has manufactures of sailcloth, leather, and tobacco. The harbour is small but secure, and by means of it a considerable trade is carried on in corn, iron, timber, pitch, tar, and potash. Pop. 4500.

CARLSKRONA, or Bleking, a laen or province of Sweden, bounded on the north by Wexio, N.E. by Calmar, east and south by the Baltic, and west by Christianstadt. It has an area of 1135 square miles, and (1845) 102,342 inhabitants. Its principal towns are Carlskrona and Carlshamn.

Carlskrona, the capital of the above province, a seaport-town on the Baltic, in N. Lat. 56. 10., E. Long. 15. 33., 55 miles east of Christianstadt. It takes its name from its founder Charles XI., and is built upon five small islands connected with each other and with the mainland by bridges. The town is well built, consisting partly of brick and stone, but principally of wooden houses. The harbour is capacious and secure, with a sufficient depth of water for the largest vessels. It has three entrances; the principal, and the only one practicable for large vessels, is on the south side of the town, and is defended by two strong forts. The dry docks are of great extent, and have been cut out of the solid granite rock. The arsenal and other buildings connected with the docks are extensive, and separated from the town by a wall. The manufactures are, naval equipments, linen cloths, tobacco, and refined sugar; the exports, metals, potash, tar, pitch, &c. The town is very deficient in good water. Carlskrona is the principal station of the Swedish navy. Pop. about 12,000.

CARLSRUHE (*Charles' rest*), a city of western Germany, capital of the Grand Duchy of Baden and of the circle of Middle Rhine. It stands on an elevated plain of the Hardt Forest (which nearly surrounds it), 380 feet above the level of the sea, 5 miles from the Rhine, and 39 miles W.N.W. of Stuttgardt. The Mannheim and Basle railway passes the city. Carlsruhe takes its name from Charles William, Margrave of Baden, who in 1715 erected a hunting seat here, around which the town has since been built. From the palace the principal streets, 17 in number, radiate in the form of an extended fan, in a S.E., S., and S.W. direction. The palace, erected in 1751 on the site of the previous erection of 1715, is a plain building composed of a centre and two wings, presenting nothing remarkable except the tower *Bleythurm*, from the summit of which a splendid view of the city and surrounding country is obtained. In front of the palace is the Great Circle, a semicircular line of buildings, containing the government offices and the palace of the margraves of Baden. Carlsruhe has several fine public squares, the principal of which is the market-place. In the centre of it is a pyramid in honour of Charles William, the founder of the city, whose remains are interred there. Among the public buildings are the council-house, hall of representatives, mint, post-office, barracks, arsenal, theatre, museum, polytechnic school, cannon foundry, a synagogue, and several Protestant and Catholic churches. There are also several hospitals, a deaf-mute asylum, botanic gardens, lyceum; military, medical, and veterinary schools; academies of architecture, painting, and music; and numerous literary and scientific associations. The town is adorned with several public fountains, and is supplied with water by an aqueduct from Durlach. Carlsruhe carries on few manufactures, chiefly silks, cottons, carpets, woollens, jewellery, tobacco, and snuff. Pop. (1849) 23,217.

CARLSTAD, a province or laen of Sweden. It is

bounded W. and N.W. by Norway, N.E. by Falun, E. by Obevo, S. by Wernersborg and Lake Werner. Area 6945 square miles. Pop. (1845) 209,596. The surface is mountainous, interspersed with numerous lakes and rivers, and it has some rich iron mines. The principal towns are Carlstad, Cristenshamn, and Philipstad.

CARLSTAD, the capital of the above province, stands on the island of Tingvalla, at the mouth of the Clara, on the north shore of Lake Werner. It is regularly built, the streets wide and straight, and the houses of wood. It is the seat of a bishop, and has a handsome cathedral, a gymnasium, observatory, theatre, cabinet of natural history, and an agricultural society. The Gotha canal has considerably increased its commerce. Exports copper, iron, corn, salt, timber, &c. Pop. 3400. It was founded by Charles IX., from whom it takes its name.

CARLSTADT, a royal free city of Austrian Croatia, capital of a county of that name, stands on the Kulpa, which here receives the Korana and the Dobra, 32 miles S.W. of Agram. It consists of the fortress, which is surrounded by ramparts, trenches, and palisades; the inner town and suburb. Carlstadt is the seat of a bishop, and has one Greek and five Catholic churches, a Catholic gymnasium, and many handsome public buildings. It has a considerable transit trade, and manufactures the liqueur called *rosoglio*. Pop. 7000.

CARLUKE, a burgh of barony, in the county of Lanark, Scotland, pleasantly situated near the right bank of the Clyde, 5 miles N.W. of Lanark. Pop. (1851) 2845, principally engaged in cotton-spinning, and in the extensive coal, iron, and lime works in the vicinity. There are many fine orchards in the neighbourhood.

CARLYLE, JOSEPH DACRE, a celebrated orientalist, was born in 1759 at Carlisle, where his father was a physician. Having completed his education at the grammar-school, he went to Cambridge, where he took a master's degree, and was elected a fellow of Queen's College. During his stay at college, with the assistance of a native of Baghdad then resident at Cambridge, he had attained great proficiency in Arabic literature; and after succeeding Dr Paley in the chancellorship of Carlisle, he was appointed in 1794 professor of Arabic in the University of Cambridge. Two years before his appointment he published his translation of the *History of Egypt*, written by Maured Allatafet Jemalledin, known in the east as the historiographer of Egypt; and two years after his election to the professorship, a volume of *Specimens of Arabic Poetry*, from the earliest times to the extinction of the khalifs, with some account of the authors. Having been appointed chaplain by Lord Elgin to the Embassy at Constantinople, he prosecuted his researches into Eastern literature, and made a lengthened tour through Asia Minor, Palestine, Greece, and Italy, collecting in his travels several valuable Greek and Syriac MSS., for a projected critical edition of the New Testament, collated with the Syriac and other versions—a work, however, which he did not live to complete. On his return he was presented by the Bishop of Carlisle to the living of Newcastle-upon-Tyne, where he died in 1804. After his death there appeared a volume of poems, descriptive of the scenes of his travels, with prefaces extracted from his journal; and amongst other valuable works which he left unfinished was a half-corrected edition of the Bible in Arabic.

CARMAGNOLA, a town of Piedmont, near the Po, in the province and 16 miles south of the town of Turin. It is well built, and many of its streets and squares are ornamented with porticoes. It has a fine Gothic and several other churches, monasteries, hospital, and a considerable trade in silk, flax, hemp, corn, and cattle. Pop. about 12,000.

CARMAGNOLA, *Francesco Bussone di*, one of the most celebrated Condottieri of the early part of the fourteenth century, was born in Piedmont in 1390. He was captain-general of the Venetian army that several times defeated Visconti, Duke of Milan; but the Venetian state becoming jealous of him, he was recalled, imprisoned, tortured, and then beheaded in 1432, on accusations which are of doubtful character.

CARMEL, a range of hills in Palestine, extending N.W. from the plain of Esdraelon, and ending in a promontory which forms the Bay of Acre. The whole range extends about 18 miles, and its greatest elevation is about 15,000 feet. It is of limestone formation, and received its name from the luxuriant verdure with which it is clothed, especially in spring. In its sides are numerous caverns, to which the prophets used to retreat; but it is principally celebrated for the sacrifice which Elijah offered up there in antagonism to the priests of Baal. On the traditional site of Elijah's altar there appears to have been a temple, which was once the retreat of Pythagoras, and contained an oracle where Vespasian consulted the God of Carmel. The summit is now crowned by a convent belonging to the Carmelites, and in the cave of Elijah lower down is a Moslem sanctuary. There was another Carmel (Josh. xv. 55) near Hebron.

CARMELITES, one of the four orders of mendicant friars, who derive their appellation from Mount Carmel. Their annalists not only attribute the origin of their order to the prophet Elias, but enumerate among their members all the prophets and holy persons mentioned in the Scriptures from Elias to Christ, and likewise include Pythagoras and the ancient Druids. Phocos, a Greek monk, relates that in his time, A.D. 1185, Elias's cave was still extant on the mountain, and near it were the remains of an ancient monastery, at which some years previous a monk of Calabria, by revelation as he pretended from the prophet Elias, had fixed his abode with ten brethren. In 1209 Albert, the patriarch of Jerusalem, gave the solitaries a rigid rule, which was afterwards printed by the Jesuit Papebroch. This was confirmed in 1224 by Pope Honorius III. It contained sixteen articles, by which they were confined to their cells; enjoined to continue day and night in prayer; prohibited from holding property; enjoined fasting from the feast of the holy cross till Easter, except on Sundays, and abstinence at all times from flesh. They were also obliged to labour, and to observe a strict silence from vespers till tierce the next day.

On the peace concluded by the Emperor Frederic II. with the Saracens, the Carmelites were expelled from the Holy Land. Some took refuge in 1238 at Cyprus, and founded a monastery in the forest of Fortania: some of the Sicilian brothers returned to their own country, and founded a monastery at Messina. Several of the English brothers retired to England for the purpose of establishing monasteries: and those of Provence, in 1244, founded one in the desert of Aigualates, about a league from Marseilles. Thus the number of their monasteries rapidly increased, and they held their European general chapter in 1245 at their monastery at Aylesford in England. The order continued to flourish till it had thirty-eight provinces; besides the congregation of Mantua, in which were fifty-four monasteries, under a vicar-general; and the congregations of Barefooted Carmelites in Italy and Spain, which had their peculiar general.

After the establishment of the Carmelites in Europe, their rule was in some respects altered. Innocent IV. added to the first article a precept of chastity, and relaxed the 11th, which enjoins abstinence at all times from flesh, permitting them, when travelling, to eat boiled flesh. This pope likewise gave them leave to eat in a common refectory, and to keep asses or mules. Their rule was again mitigated by Eugenius IV. and Pius II. Hence the order became divided into two branches, viz. *the Carmelites of the ancient observance*, who wore shoes; and those *of the strict observance*, who are the *barefooted Carmelites*—a reform insti-

tuted in 1540 by Sta. Theresa, a nun of the convent of Avila in Castile. These last are divided into two congregations—that of Spain, and that of Italy.

The habit of the Carmelites was at first white, and the cloak was edged at the bottom with several lists; but Honorius IV. changed it for that of Minims. They wear a scapulary, of a brown colour, thrown over the shoulders.

CARMENTALIA, an ancient Roman festival, celebrated annually on the 11th and 15th of January in honour of Carmenta or Carmentis, a prophetess of Arcadia, and the mother of Evander, with whom she came into Italy sixty years before the Trojan war. This feast, which was chiefly celebrated by women, was established in commemoration of a great fecundity among the Roman matrons after a general reconciliation with their husbands, with whom they had been at variance on account of the use of coaches having been prohibited them by an edict of the senate.

CARMICHAEL, ARCHIBALD NISBET, an accomplished Greek scholar, born at Edinburgh, Sept. 26, 1794. He was elected in 1824 to one of the classical masterships in the Edinburgh Academy; and in this situation he died Jan. 8th, 1847. He published several classical text-books, but is best known by his able treatise on *Greek Verbs, their leading Formations, Defects, and Irregularities.*

CARMINATIVE (Latin *carmen*, a verse or charm), a term applied to medicines which relieve flatulencies by exciting gentle perspiration. Among the ancients their operation was accompanied by the singing of a stanza (*carmen*) —whence the term.

CARMINE, a very brilliant red colour, obtained by the aid of ammonia from the cochineal insect, *Coccus cacti.* For an excellent method of preparing this pigment, see Berzelius, *Traité de Chimie*, tom. vii. p. 676.

CARMONA, a town of Spain, province of Seville, situated on a gentle elevation overlooking a plain, one of the richest in Spain, being almost wholly covered for more than twenty miles with woods of olive trees. A castle, now in ruins, was formerly the principal fortress of Peter the Cruel, and contained a spacious palace within its defences. The principal entrance to the town is by an old Moorish archway; and part of the ancient college of San Teodomir is of Moorish architecture. The gate on the road to Cordova is partly of Roman construction; and the tower of the church of San Pedro is an imitation of the Giralda at Seville. The manufactures consist of woollen stuffs, hats, soap, glue, leather, &c.; but its principal trade is in corn and cattle. It was the Roman Carmo, a strongly fortified city; and its strength was greatly increased by the Moors, who surrounded it with a strong wall, now in ruins, and ornamented it with fountains and magnificent palaces. Pop. 15,121.

CARNAC, a village of France, department of Morbihan, in the arrondissement and 18 miles S.E. of L'Orient. About three-fourths of a mile from the village is the great Celtic monument of Carnac, consisting of 11 lines of rude granitic blocks set on end, forming 10 avenues with a curved row of 18 stones touching at its extremities the two outside rows. There are said to be several thousands of these stones, none exceeding 18 feet in height; and a very large proportion are cubical masses not more than 3 feet high. The object and the epoch of the construction of this extraordinary monument are alike unknown.

CARNAC, *Temple of.* See THEBES.

CARNATIC, a large province of Southern India, so denominated by Europeans. It extends along the eastern coast about 600 miles in length, and from 50 to 100 miles in breadth. It is bounded on the north by the Guntoor circar, the limit being the small river Gundezama, which falls into the sea at Muntapilly, and thence it stretches southward to Cape Comorin. It is divided into the Southern, Central, and Northern Carnatic. The region south of the river Coleroon, which passes the town of Trichinopoly, is called the Southern Carnatic. The principal towns of this division are Tanjore, Trichinopoly, Madura, Tranquebar, Negapatam, and Tinevelly. The Central Carnatic extends from the Coleroon river on the south to the river Pennar on the north: its chief towns are Madras, Pondicherry, Arcot, Vellore, Cuddalore, Pullicat, Nelloor, &c. The Northern Carnatic extends from the river Pennar to the northern limit of the country; and the chief towns are Ongole, Carwaree, and Samgaum. The soil is various: in a great part of the country it is deep and rich, whilst in other tracts it is sandy, and, as water is scarce, unproductive. This defect is, however, supplied by artificial means; an extensive system of canal irrigation having been established within the delta formed by the Coleroon and the Cauvery. In such parts as are at too great a distance to have water thus conveyed to them, tanks are constructed, some of them of great extent, and formed by inclosing the waters deposited in low situations with a strong mound of earth; while others are of a smaller size, and of a quadrangular form, lined with stone, and with a flight of steps descending to the bottom. In these reservoirs are collected supplies during the periodical rains, which are afterwards distributed over the rice fields, or reserved for the use of the cattle in the dry season. The climate, except on the sea-coast, where there are sea and land breezes, is liable to excessive heats, the thermometer standing in the coolest and shadiest parts at 115 degrees. Occasional showers fall in May, June, and July; but the S.W. monsoon which prevails during those months expends its violence chiefly on the opposite coast of Malabar. As the S.W. monsoon dies away, the N.E. sets in, and continues to blow during October and November, bringing with it an annual rainfall of about 30 inches. The principal rivers are the Kistnah on the northern frontier, the Cauvery and Coleroon, the Pennar and the Palar; all of which rise in the high lands among the Ghauts, and take an easterly course to the Bay of Bengal. The vegetable productions are numerous, and similar to those found in most other parts of Hindustan. Famines and scarcities, owing to drought, have been more frequent in the Carnatic than in the Bengal provinces. This country in former times was the scene of unintermitting violence and strife between the numerous chieftains and petty potentates among whom it was divided; and forts and fortresses accordingly crown almost all the elevated points. They are built of a square form; but from the long period of internal tranquillity which the country has enjoyed, are now rapidly falling into decay. Large temples and other public monuments of civilization abound in the Carnatic. The temples are commonly built in the middle of a square area, and inclosed by a wall fifteen or twenty feet high, which conceals them from the public view, as they are never raised above it. The Carnatic, as above defined, comprehends within its limits the maritime provinces of Nellore, Chingleput, South Arcot, Tanjore, Madura, and Tinevelly, besides the inland districts of North Arcot and Trichinopoly. The aggregate population has been returned at 10,142,319, which consists chiefly of Hindus of the Brahminical persuasion, the Mohammedans being but thinly scattered over the country. The Brahmins rent a great proportion of the land; and also fill different offices in the collection of the revenue and the administration of justice. Throughout the country they appropriate to themselves a particular quarter in every town, generally the strongest part of it.

Trade and manufactures are carried on to a considerable extent. The exports are piece goods, consisting mostly of blue cloths, coarse chintzes, and the like; also indigo, grain, and other commodities.

The Carnatic was first invaded by the Mohammedans in A.D. 1310, when they defeated the Hindu sovereign and conquered the country. After this period it was liable to

an occasional tribute to the Deccany sovereigns; and early in the eighteenth century it was overrun by the armies of Aurungzebe. It was dismembered from the Mogul empire in 1717, when Nizam ul Mulk obtained possession of the Deccan and the south of India. In 1743 he appointed Anwar ud Deen nabob of the Carnatic and Arcot; in 1754 a competition for the government arose; and after a long and tedious war, in which the English and the French took different sides, Mohammed Ali was left in possession of that portion of the Carnatic which was the fruit of the successes achieved by the British. The Carnatic was laid completely waste in its central parts by Hyder Ali, but was again reconquered by the British in 1783. In 1801 all the possessions of the nabob of the Carnatic were transferred to the British by treaty, the conditions of which were, that a revenue should be reserved to the nabob of several lacs of pagodas annually; and that the British should undertake to support a sufficient civil and military force for the protection of the country and the collection of the revenue. A liberal establishment was also provided for the other branches of the family of Mohammed Ali Khan.

The Southern Carnatic, when it came into the possession of the British, was occupied by military chieftains called polygars, who ruled over the country, and held lands by doubtful tenures. They were unquestionably a disorderly race; and the country, by their incessant feuds and plunderings, was one continued scene of strife and violence. They were transferred to the dominions of the British in the year 1792, in virtue of a treaty concluded by Lord Cornwallis with the nabob of Arcot. But the conditions of that treaty were variously understood; and it was found necessary, for the peace of the country, to reduce these refractory polygars to obedience. In 1801 an insurrection took place, which was crushed by a military force; after which their forts and military establishments were abolished, the country was searched for arms, and some severe examples being made, tranquillity was restored. (D. B—N.) (E. T.)

CARNATION (from *caro carnis*, flesh), in painting, denotes those parts of a picture that represent flesh, or which are naked and without drapery. Titian, Correggio, Rubens, and Vandyk, excelled in carnations.

Carnation is also the name given by gardeners to a cultivated species of Dianthus.

CARNAUL. See KURNOOL.

CARNEADES, a celebrated philosopher, and the founder of the Third or New Academy at Athens, was born at Cyrene in Africa, about B.C. 213. He was a strenuous opponent of the Stoics, and applied himself with great zeal to refute the works of Chrysippus, one of the most eminent philosophers of their sect. In B.C. 155 Carneades, accompanied by Diogenes and Critolaus, was sent on an embassy to Rome, to deprecate a fine of 500 talents which had been imposed on the Athenians for plundering the city of Oropus. Before obtaining an audience of the senate, these philosophers harangued the people in various parts of the city, and drew together great multitudes by their eloquence. The Athenian ambassadors, said many of the senators, "were sent rather to force us to comply with their demands, than to solicit them by persuasion;" meaning that it was impossible to resist the powerful eloquence of Carneades. His subtilty in argument was most conspicuously displayed in his two orations on justice. The first of these was in commendation of the virtue; and the second, which he delivered on the following day, was a refutation of the first, and showed that justice was but a mere matter of compact for the maintenance of civil society. This grieved the honest mind of Cato, who urged the senate to send Carneades back to Athens lest the Roman youth should be corrupted by his pernicious doctrines. Such indeed, according to Plutarch, was the enthusiasm excited by his discourses, that the young Romans were carried away with a kind of mania for philosophizing, and forsook their usual pursuits. Paradox was the element of Carneades: he delighted in demolishing his own work, because it served in the end to confirm his grand principle—that there are only probabilities or resemblances of truth in the mind of man; so that of two things directly opposite, either may be chosen indifferently. Quintilian remarks, that although Carneades might argue in favour of injustice, yet he was invariably actuated by the strictest sense of honour. He died in B.C. 129, at the age of 85. (See *Diog. Laert.* iv.)

CARNEDD, in *British Antiquity*, denotes a cairn or heap of stones, thrown together on occasion of confirming and commemorating a covenant. (See Gen. xxxi. 46.) They were also used as sepulchral monuments.

CARNEIA, in *Antiquity*, a festival in favour of Apollo surnamed Carneios, and celebrated in most of the cities of Greece, but especially at Sparta, where it was instituted. The reason of the name, as well as the origin of the institution, is controverted. It commenced on the seventh day of the month Carneios, and lasted nine days. The ceremonies were an imitation of the method of living and discipline used in camps.

CARNELIAN, a well-known variety of calcedony, the produce of India. See CALCEDONY, and AGATE.

CARNIFEX, among the Romans, the common executioner. By reason of the disgrace attached to his office, the carnifex was prohibited by law from residing within the city. In writers of the middle ages carnifex signifies a butcher.

CARNIOLA. See AUSTRIA.

CARNIVAL, a season of festivity, observed with much pomp and solemnity in the chief cities of the Catholic countries of Europe. It begins on the day of the Epiphany, and ends on Ash-Wednesday. The etymology of the word, like the origin of the fête itself, is uncertain. The most probable is that which derives it from the Latin words *carni vale*—farewell to flesh—inasmuch as a provision is in this particular made beforehand against the abstinence observed by all good Catholics during the season of Lent. From the earliest ages it has been celebrated in all Catholic countries with much pomp and show, more especially at Venice and Rome. The most widely diffused recreation is that of masquerades, which, though they have now declined considerably both in frequency and splendour, are still much in vogue in France and Italy, as well as in southern Germany. Great license, often degenerating into licentiousness, prevailed, and still continues to prevail in these countries during that season of the year.

CARNIVOROUS, an epithet applied to those animals which naturally seek and feed on flesh.

It has been disputed whether man is naturally carnivorous. Those who take the negative side of the question insist chiefly on the structure of our teeth, which are mostly incisores or molares; not such as carnivorous animals are furnished with, and which are proper to tear flesh in pieces; and to this it may be added, that, even when we do feed on flesh, it is not without a preparatory alteration by boiling, roasting, or the like. To these arguments Dr Wallis subjoins another, which is, that all quadrupeds which feed on herbs or plants have a long colon, with a cæcum or some equivalent at its upper end, which conveys the food by a long progress from the stomach downwards, in order to its slower passage and longer stay in the intestines; but that, in carnivorous animals, such cæcum is wanting, and instead of it there is a shorter and more slender gut, and a quicker passage through the intestines. Now, in man the cæcum is very visible; a strong presumption that nature did not intend him for a carnivorous animal. It is true the cæcum is but small in adults, and seems of little or no use; but in a fœtus it is much larger in proportion; and it is probable that our customary change of diet, as we grow up, may occasion this shrinking. But to these arguments Dr Tyson

replies, that if man had been designed by nature to be not carnivorous, there would doubtless have been found, somewhere on the globe, people who do not feed on flesh, which is not the case. Neither are carnivorous animals always without a colon and cæcum; nor are all animals carnivorous which have these parts. The opossum, for instance, has both a colon and cæcum, and yet feeds on poultry and other flesh; whereas the hedgehog, which has neither colon nor cæcum, and so ought to be only carnivorous, feeds on both. Hogs, too, which have both, will sometimes feed on flesh; and rats and mice, which have large cæcums, relish bacon as well as bread and cheese. Lastly, the human race are furnished with teeth necessary for the preparation of all kinds of food; from which it would seem that nature intended we should live on all. And as the alimentary duct in the human body is fitted for digesting all kinds of food, we may conclude that nature did not intend to deny us any.

CARNOT, Lazare Nicolas Marguerite, one of the most consistent but intemperate of the French republicans, of the bloody period of the first French revolution, was born at Nolay in Burgundy, May 13, 1758. After a good mathematical education in his native province he was admitted as an officer of the engineer corps under the patronage of the prince of Condé, and was a captain in that corps when the storms of the revolution thrust him forward in political life, as he was beginning to be known by some mathematical essays and poetic effusions of small merit. In 1791 he was returned a member of the National Assembly for the Pas de Calais, and was soon engaged in the most violent measures of the republican party. It would have been lucky for his memory had his zeal been less unscrupulous; but he soon leagued himself with the party of the Mountain, became a member of the committee of public safety under Robespierre, voted for arming with pikes 30,000 *sans culottes*, for the condemnation of the princes, and the execution of the king; in short, he was highly accountable for the indiscriminate bloodshed that characterized the Reign of Terror. His genius, however, was more military than political, and he laboured energetically in improving the discipline of the French army; is said to have been the proposer of the military conscription; cashiered on the field a general who had retreated before the enemy; and as commissary of the republic put himself at the head of the troops. It is certain that his activity and spirit produced great effects on the soldiery, and thus he contributed materially to the wonderful successes of the armies of France. In 1794 he was president of the convention; but in the following year his severities had rendered him unpopular; and when Legendre moved his arrest in the convention, he was saved by the exclamation of a member, "This is the man who organized victory in the French armies." Afterwards Carnot became one of the five directors of the republic, and was the author of the *Plan for the Invasion of England*, by landing two armies simultaneously on the coasts of Sussex and Yorkshire. In this tract he stated that walls and hedges, instead of being a defence, would aid the advance of a disciplined enemy; and maintained that open plains would give us greater advantages, by permitting the superiority of our cavalry and horse artillery to have full effect; while he greatly underrated the efforts of an irregular force, animated by a love of home, and of national independence. Soon afterwards Carnot was proscribed, and compelled to take refuge in Germany, where, though under the protection of a monarch, he published his *Mémoire Justificatif*, in which he declares himself the "irreconcilable enemy of kings." This memoir hastened the fall of the Directory, already shaken by its vices and its crimes. On its downfall he returned to France, and he was minister of war in 1800, but soon resigned his office; having, with a consistency then not common, opposed the consulship for life; and afterwards the imperial title to Bonaparte, when, as one of the tribunate, he persisted in refusing to affix his name to the registers.

Carnot now devoted himself to the peaceful pursuits of science. He was an active member of the Institute. His best production in this field, perhaps, is the *Réflexions sur la Métaphysique du Calcul Infinitésimal;* next to that we would place his *Principes Fondamentaux d'Equilibre et Mouvement*—works of great originality and power. His work *De la Défense des Places Fortes* is far less esteemed by competent judges. From the Institute he was twice expelled; first, through the influence of the Directory, and secondly, on the restoration of the Bourbons in 1814. On Napoleon's reverses in the Russian campaign, he offered his services to his country, and was made governor of Antwerp, which he defended till the abdication in 1814, when he retired to Germany. On Napoleon's return from Elba, he was minister of war; but on the overthrow of the emperor of the French, Carnot retired first to Warsaw, and finally to Magdeburg, where he died in 1823.

The republican principles of Carnot, and the stern severity of his temper, impressed the lines of his countenance, and indicated the cruelty of which he has too justly been accused; but he did not disgrace himself by the peculation of which his brother directors of the republic cannot be acquitted. (T. S. T.)

CARNUNTUM, an ancient Celtic town, afterwards a Roman colony or municipium in Pannonia, on the Danube. It was for three years the residence of Marcus Aurelius, during his wars with the Marcomanni and Quadi. It was taken and destroyed by German invaders in the fourth century, but was afterwards rebuilt. It was finally destroyed in the wars against the Magyars in the middle ages. Extensive ruins of this town are to be seen not far from Presburg.

CARO, Annibale, a celebrated Italian poet, born at Civita Nuova in 1507. He held successively the office of confidential secretary to the dukes of Parma, Pier-Lugio, and Ottavio Farnese, and to the cardinals Rameccio and Alexander. His works consist principally of Italian translations from the Greek of Gregory Nazianzen, Cyprian, and Aristotle, and from the Latin of Virgil. They are uniformly remarkable for the purity and elegance of their style. His fame has been greatly damaged by the virulence with which he attacked Ludovico Castelvetro in one of his canzoni, and his baseness in denouncing him to the holy office for having translated some of Melancthon's writings. He died at Rome about 1566.

CAROLAN, Turlogh (1670–1738), an eccentric musical genius, born at Nabber, in Westmeath, where his father was a poor farmer. Having lost the use of his eyes when a child, he resorted to playing on the harp, by which he maintained himself. (See Kitto's "*Lost Senses.*")

CAROLINA, North, one of the United States of North America, bounded N. by Virginia, W. by Tennessee, S. by Georgia and South Carolina, and E. by the Atlantic Ocean. It lies between 33. 50. and 36. 30. N. Lat., and 75. 25. and 84. 30. W. Long. Length 430, breadth 198 miles; area, 43,800 square miles, or 2,803,200 acres.

The entire coast is lined with low narrow belts of sand, broken through at intervals by channels, communicating between the ocean and the lakes or lagoons which lie between the sand-banks and the mainland. South of Cape Lookout, these inlets are numerous and the lagoons narrower; while north of that cape the converse is the case. Beyond these banks are extensive shoals; furious gales, too, are prevalent; so that, altogether, the navigation of this coast is highly dangerous. Ocracoke Inlet, the only navigable passage north of Cape Lookout, is full of shifting sand-banks, and at low tides even in the main channel has only six feet of water. Roanoke Inlet, opposite the island of that

name, is now obstructed; but operations have been commenced for re-opening it. To the northward, between the main land and the narrow beach stretching southward from Cape Henry, lies Currituck Sound, 50 miles in length by from two to ten in breadth. West of this, running inland, is Albemarle Sound, 60 miles in length from east to west, and from 5 to 15 in breadth. Its waters are fresh, and not subject to tidal influences, though they are affected by particular winds. These two sounds communicate with the Sound of Pamlico, which lies south of Currituck, and is 86 miles long by from 10 to 20 in breadth; its general depth is about 20 feet, but it abounds in shoals; it is somewhat influenced by the tides, and is connected with the ocean by Ocracoke Inlet. Cape Hatteras, the headland of the triangular island which separates Pamlico from the ocean, is one of the most dangerous projections on the American coast. Cape Fear and Cape Lookout are also, as their names indicate, dangerous points on this coast. The islands are barren, and only inhabited by a few fishermen and pilots.

From the coast, for 60 or 80 miles inland, the land is low, traversed by sluggish and muddy streams, and abounds in extensive marshes and swamps, which cover about one-tenth of the whole state. The soil, except along the banks of the streams, where it is often fertile, is sandy and barren. The natural production of this soil is the pitch pine, which attains a fuller development here than in the states further north, and yields vast quantities of tar, pitch, turpentine, and lumber. The swamps are usually overgrown with cedars and cypresses, intermingled with maples, poplars, and white oaks, and having an almost impervious under-growth of reeds, grasses, briers, &c. Some of these swamps have been drained, and produce good crops of rice and cotton.

Beyond this region the country begins to rise into small hills; stones appear and ripple the surface of the streams. For 40 miles beyond the flat region, as far as the lower fall of the rivers, extends a flat belt of land, moderately undulating, with a sandy soil, of which pitch pine is the principal natural production. West of the falls, the surface is more undulated, the streams flow more swiftly, and the land is more fertile, producing wheat, rye, barley, oats, flax. Farther west, beyond the Yadkin and the Catawba, is an elevated region forming part of the great table-land of the United States, and lying from 1000 to 1200 feet above the level of the sea. Towering above it are the peaks of the Blue Ridge, the chief of which are the Black Mountain, with an elevation of 6426 feet, the highest east of the Rocky Mountains; and Roan Mountain, the summit of which is a broad meadow, with an elevation of 6038 feet above the sea. Mount Ararat, or the Pilot Mountain, in Surrey county, situated in a comparatively level region, exhibits a striking symmetry of form, being nearly cylindrical, and from the summit, which is accessible by a path in some places nearly perpendicular, the view is grand and extensive. Between the mountain ranges in the western part of the state the soil is productive.

North Carolina is well watered by numerous streams, many of them very considerable, but offering few facilities for navigation. They are generally shallow near their mouths, or lost in lagoons, or broken by falls in the upper part of their courses. Cape Fear river is the principal one whose course lies entirely within the state, and is, moreover, the only large stream that flows directly into the ocean; its principal sources are the Haw and the Deep, which rise near the northern boundary of the state, and unite their waters at Haywood, in Chatham county; it flows in a S.E. direction, and has a course of about 280 miles. At Fayetteville it is navigable for large boats, and above Wilmington it forms two branches which re-unite below that town, flowing to the ocean in a broad, sluggish stream, obstructed by sand-banks, and difficult of navigation. By diminishing the breadth of the river, and by stopping up some of the smaller outlets, these defects have in some measure been removed, and the main channel, as far as Wilmington, has a depth of from 12 to 13 feet. The S.W. or main entrance has a depth of from 10 to 14½ feet on the bar. The Chowan and Roanoke flow into Albemarle Sound; the former, formed by the union of the Meherrin and Nottaway, is accessible for small vessels to Murfreeboro'; the latter is navigable for 30 miles for the small craft which ply on the sound. The Tar, which flows into the Pamlico Sound, is navigable for vessels drawing 8 feet of water to Washington; and the Neuse, also flowing into the Pamlico Sound, for large boats to Kingston. The Waccamaw, Lumber, Yadkin, and Catawba, pass into South Carolina. From the west of the Blue Ridge flow New River, Wataga, French Broad, Little Tennessee, and Hiwassee, the waters of which flow into the Ohio.

Professor Olmsted, in his report on the geology of North Carolina, has given a full and accurate account of its mineral resources, which are extensive and valuable. The low country consists of deposits of sand and clay, similar to, and belonging to the same age (the tertiary) as those of Eastern Virginia and Maryland. These beds contain few minerals, but abound in deposits of shell, marl, fossiliferous limestone, green vitriol, and bog-iron ore. A ledge of micaceous rocks, seen in the ravines and beds of rivers, forms the line which divides the low land from the upper country. Formations of mica slate, chlorite slate, gneiss, and granite, lie west of this line. Among the minerals of this section are hematitic iron ores, plumbago, and occasionally soapstone and serpentine. This strip is succeeded by a belt of sandstone, running south-westerly from Granville across the state. Freestone of different qualities is abundant in some parts of the formation, which also contains argillaceous iron ore, and some coal measures of great extent, including the best varieties of bituminous and anthracite coal. Next to this is the great slate formation, about 20 miles in breadth, running from N.E. to S.W., quite across the state. Within this district are found numerous beds of porphyry, soapstone, serpentine, greenstone, and very fine whetstone-slate. The slate formation is succeeded by another belt of primary rocks, reaching nearly to the Blue Ridge. This comprises the gold region of North Carolina. Iron ore is also abundant, chiefly in the form of magnetic oxide, and has been extensively wrought. The gold district is for the most part barren, and the inhabitants poor and ignorant. The principal mines are Anson's, Read's, and Parker's. The first is in Anson county, and was once productive; but operations have been retarded by a dispute as to the ownership of the land. Read's mine is in Cabarrass county, and was the first wrought. Large masses of metal, weighing 400, 500, or 600 pennyweights are occasionally met with, and one piece was found weighing 28 lb. avoirdupois. Parker's mine is situated on a small stream 4 miles south of the Yadkin. The metal exists chiefly in flakes and grains; but a mass weighing 4 lb. 11 oz. has been found.

No state in the Union possesses a greater variety of staple productions. All kinds of grain growing in the north are successfully cultivated. The striking diversity of climate and soil between the low lands of the east, the high lands of the west, and the moderately diversified interior, produces a corresponding diversity in its agricultural productions. The low lands yield cotton, rice, and indigo; and grapes, plums, &c. grow spontaneously. Further west, in the interior and valleys of the high lands, the soil is well adapted for wheat, tobacco, hemp, Indian corn, and the grains and fruits which flourish northward. The mountainous districts afford excellent pasturage for herds of cattle and horses.

By the census of 1850, the improved farm lands amounted to 5,453,975 acres, and 15,543,008 acres of unimproved land attached to the farms. The principal productions are wheat, rye, Indian corn, oats, rice, tobacco, cotton, pease, beans, potatoes, barley, buck-wheat, hay, hemp, flax, hops, &c. The value of home-made manufactures during the above year was $2,086,522. During the last few years several cotton and woollen manufactories have been established.

The progress of the population from 1790 to 1850 was as follows:—

	Whites.	Free Coloured.	Slaves.	Total.
1790	288,204	4975	100,572	393,751
1800	337,764	7043	133,296	478,103
1810	376,410	10,266	168,824	555,500
1820	419,200	14,612	205,017	638,829
1830	472,843	19,543	245,601	737,987
1840	484,870	22,732	245,817	753,419
1850 { Males	273,025	13,298	144,581	869,039
Females	280,003	14,165	143,967	

The number of males engaged in professions, trades, and other occupations in 1850 was 139,387; of these, 81,898 were farmers and 28,143 labourers. The births for the year ending 1st June 1850 were 16,648 whites and free coloured, and 8086 slaves; deaths, 6028 of the former and 4329 of the latter.

The militia is composed of 79,448 men, of whom 4267 are commissioned officers. Every white male citizen between the ages of 18 and 45 years, unless exempt by law, is liable to military duty. The revenue from all sources for the year ending 31st October 1852 was $366,728; the expenditure, $249,254.

The value of exports for year ending June 1851, was $431,095; imports $206,931. The total shipping owned in the state at 30th June 1850, was 45,218 tons, of which 14,932 tons were registered, 27,535 were enrolled and licensed, and 2751 licensed (under 20 tons). The enrolled and licensed shipping are all employed in the coasting trade, and of this 3226 tons were navigated by steam. The principal ports are Wilmington and Newbern. At 1st January 1853, 249 miles of railway were in operation.

The state in 1850 had 2657 public schools, with 2730 teachers, and 104,095 pupils; 272 academies and other schools, with 403 teachers and 7822 pupils; and 5 colleges with 29 teachers and 513 pupils. The number returned by families as attending school during the year was 100,591 whites and 217 free coloured; in the former case being equal to 5½ of the white population. Adults who could not read and write, 26,239 male, and 47,327 female whites, and 6857 free coloured. There were 4 public schools, 19 Sunday school, 5 college. and 9 church libraries, with 29,592 volumes, in the state. The total number of churches in the state was 1795, with 572,924 sittings. Of these churches 615 were Baptist, 784 Methodist, 151 Presbyterian, 50 Episcopal, 49 Lutheran, 54 Free, and 4 Roman Catholic.

The legislative body consists of a senate and house of representatives; the former composed of 50, and the latter of 120 members. The right of suffrage is vested in every free white man 21 years of age who has resided in the district for 12 months, and owned a freehold within the same for 6 months; but the freehold qualification is not required in voting for representatives. The senators and representatives are chosen biennially. The governor is elected for two years, by the persons qualified to elect members of the house. The supreme court consists of a chief justice and 2 associate justices, and holds three sessions annually, 2 in the city of Raleigh, and 1 in Morgantown. The superior or circuit courts, of which there are 7, consist of a judge and solicitor, who hold courts twice a-year in each county of the state. North Carolina sends 8 representatives to the American congress.

The first English settlement in North America was made on Roanoke island in the state. Queen Elizabeth in 1584 granted by patent to Sir Walter Raleigh such lands as he might discover in America "not possessed by any Christian people." He accordingly despatched two vessels, which anchored early in July in Ocracoke Inlet; and the accounts brought home were so favourable that Sir Walter at once sent out a colony. Discouraged, however, by their contests, and the scarcity of provisions, they returned home. A few days after their departure, a ship under Sir Richard Grenville arrived; and finding the colony gone, left 15 men with provisions for 2 years to keep up the settlement. Raleigh then sent out another colony, which landed on Roanoke in July 1587, but found no traces of Grenville's men except a few scattered human bones. About 100 persons were left at the settlement; but on account of the troubles consequent on the attempted Spanish invasion of England, Roanoke was not revisited till 1590, when none of the colonists were found. The first permanent settlement was made in 1650 by some whites from Virginia; and in 1667 the colony obtained a representative government. In 1717 it was brought under the direct control of the crown; and in 1720 was divided into North and South Carolina.

Carolina, *South*, one of the United States of North America, is situated between N. Lat. 32. 4. and 35. 12., and W. Long. 78. 25. and 83. 19. It is of an irregularly triangular form, and is bounded N. by North Carolina, S.E. by the ocean, and S.W. by Georgia, from which it is separated by the river Savannah. Area 28,000 square miles. Its coast is upwards of 200 miles in length, and is lined towards the south by a chain of fine islands, between which and the shore the navigation is convenient. The land is naturally divided into an upper, middle, and lower country. The lower country extends for about 100 miles from the coast, and is covered with pine forests, interspersed by swamps and marshes, and permeated by sluggish streams The middle country is an undulating district chiefly of sand, which extends about 50 or 60 miles westward. This tract occasionally presents an oasis of verdure or a field of maize, but otherwise offers little to attract the agriculturist. Westward of this is the "Ridge," where the country rises suddenly and somewhat precipitously, and afterwards continues gradually to ascend. Its surface is beautifully diversified with hills and dales, interspersed with extensive forests, and watered by fine streams. This part of the country gradually ascends to the mountainous region in the west, where the Blue Ridge passes through the state. One of the most conspicuous of the peaks here is the Table Mountain, which rises to the height of 4000 feet above the sea.

South Carolina is abundantly watered. One of its triangular sides is washed by the ocean, and another is watered by the river Savannah, accessible to vessels for more than half its length, and to small boats for 100 miles farther. Its principal rivers have their sources in the Blue Ridge. The great Pedee, 450 miles long, rises in North Carolina, where it has the name of Yadkin; and, after receiving the waters of Lynch's Creek and Black River from the right, and Little Pedee and Waccamaw from the left, it falls into Winyaw Bay. It is navigable for sloops for 130 miles. The Santee is formed by the junction of the Catawba and the Congaree. Steamboats ascend to Camden and Columbia; and by the aid of canals there is navigation for boats to the mountains. The Congaree is itself formed by the junction of two considerable navigable streams, the Saluda and Broad rivers. The Edisto, Cambahee, Ashley, Cooper, and Coosawatchie, are smaller streams in the southern part of the state, navigable for some distance by small vessels. The lower part of the courses of these rivers are generally shallow, and obstructed by bars. The coast presents no good harbour, but has numerous entrances, accessible to small vessels, and very advantageous to an extensive and active coasting trade. The harbour of Charleston, the largest and most commercial place in the state, is obstructed at its entrance by a dangerous sand-bar; and that of Georgetown—at the head of Winyaw Bay, 13 miles from the ocean—will admit only small vessels. The harbour of Beaufort, on the island of Port Royal, is the best in the state, but little frequented. St Helena Sound is the most spacious opening for a great distance along the coast; but, although about 3 miles wide and 10 miles long, it is too much beset by shoals to be of any great commercial value. The range of islands on the southern coast are separated from the mainland by narrow channels. These islands are low and flat, covered with forests of live oak, pine, and palmettoes, and yield the black seed or Sea Island cotton. Formerly these were the haunts of alligators, but they are now well peopled and cultivated.

Its geological character much resembles that of North Carolina. The western part of the state belongs to the auriferous belt of the Atlantic slope, and for a number of years the production of gold has been such as to induce the miner to continue his pursuit. The washings are the most productive; but in several cases large nuggets have been dug up. Iron of a very superior quality is abundant, but coal is not found. Granite, sienite, gneiss, mica slate, soapstone, porcelain-clay, limestone, chalk, red and yellow ochre, and precious stones, are found in various parts of the state.

A great similarity of surface and soil is observable in the

Carolina.

upper regions; and this is also true of the lower districts. Oak is the natural growth of the one, and pine of the other. Clay forms the soil of by far the largest portion of the state, and except in the immediate vicinity of the ocean is almost the universal substratum. The high lands above the falls of the rivers are naturally much superior to those of the pine-covered region; but the alluvial bottoms of the former are greatly surpassed in richness by the river swamps of the latter. The swamps, covering about 2000 square miles, are capable of thorough and economical draining, and may thus be converted into tracts of great fertility. The pine forests cover about 6,000,000 acres.

South Carolina is remarkable for the richness, variety, and abundance of its productions. Of articles of food it produces rice, wheat, Indian corn, oats, rye, barley, peas, beans, potatoes, &c., besides cotton, hemp, flax, indigo, tobacco, sugar-cane, olives, oranges and other fruits, and a variety of culinary and medicinal plants. Its woods abound in game, and the shores and rivers present almost every variety of fish.

The manufactures are chiefly such as are required in an agricultural country. The number of manufacturing establishments in operation in June 1850, and producing to the value of $500 and upwards annually, was 1473. Of these 18 were cotton factories, 91 tanneries, and 6 iron works. The value of exports for the year ending 3d June 1852, was $11,670,021, the whole being the produce of the state; imports $2,177,614. The number of ships which entered during the year ending 30th June 1850 was 305 vessels of 96,916 tons; the number that cleared was 375 vessels of 125,052 tons. The total amount of shipping owned in the state was 36,072 tons, of which 17,126 tons were registered, 18,926 enrolled and licensed, and 69 licensed (under 20 tons). Of the registered tonnage 1116, and of the enrolled and licensed 6339 were propelled by steam. South Carolina is said to have 2400 miles of inland navigation; and in 1852 had 447 miles of railway in operation, 203 in progress, and 98 projected.

The decennial population since 1790 was as follows:—

		Whites.	Free coloured.	Slaves.	Total.
1790		140,178	1801	107,094	249,073
1800		196,255	3185	146,151	345,591
1810		214,196	4554	196,365	415,115
1820		237,440	6826	258,475	502,741
1830		257,863	7921	315,401	581,185
1840		259,084	8276	327,038	594,398
1850	Males,	137,747	4131	187,756	668,507
	Females,	136,816	4829	197,228	

The births during the year ending 1st June 1850, and surviving at that date, were, of whites and free coloured 6607, and of slaves 9194; deaths—2879 of the former, and 5167 of the latter.

The number of public schools in the state in 1850 was 724, with 739 teachers, and 17,838 pupils; of academies and other schools, 202, with 333 teachers, and 7467 pupils; and of colleges 8, with 43 teachers, and 720 pupils. The number attending school during the year, as returned by families, was 40,293 whites, and 80 free coloured persons—being in the former 6·8 of the white population. Adults unable to read and write—whites 15,684, free coloured 880. There were 16 public, 3 school, and 7 college libraries, having in all 107,472 volumes. The number of places of worship was 1182, with 460,530 sittings; of these, 484 were Methodist, 413 Baptist, 136 Presbyterian, 72 Episcopal, 41 Lutheran, and 17 Roman Catholic.

South Carolina, according to last census, sends 6 representatives (formerly 7) to congress. The legislature consists of a house of representatives and senate. The representatives, 124 in number, are elected for two years, and must be free white men, 21 years of age, and citizens of the state for 3 years, with certain property qualifications. The senators, 45 in number, are chosen for 4 years, one-half going out every two years: they must be free white men of at least 30 years of age, citizens of the state for 5 years, and possessed of a certain value of property. The legislature assembles annually at Columbia. The governor is elected by the senate and house of representatives jointly for two years, and is not re-eligible until the expiry of 4 years. The judiciary consists of a law and an equity court of appeals, courts for correction of errors, of common pleas, and general sessions, &c. Courts of common pleas and general sessions are held in each district twice a-year.

Caroline Islands || Carpathian Mountains.

The militia force in 1850 consisted of 55,209 men, of whom 2591 were commissioned officers. The revenue for year ending 30th Sept. 1852 was $739,696, and the expenditure $359,913: the absolute debt was $1,914,438, and the contingent $1,051,422: total property of the state $5,240,467. (De Bows' *Industrial Resources of the South and West; Gazetteer of the United States; Statistics of the United States; American Almanac*, &c.)

CAROLINE ISLANDS, or NEW PHILIPPINES, are upwards of 400 small islands in the Pacific Ocean, arranged in numerous groups, between Lat. N. 6. and 11., and Long. E. 138. and 163. The principal groups are Yap, Hogol, Ualan, &c. The inhabitants belong to the Malay race, and subsist chiefly by fishing.

CAROLINE *Books*, the name of four books composed by order of Charlemagne, to refute the second council of Nice.

CAROLOSTADT, or CARLOSTADT (*Andrew Bodenstein*), one of the Reformers, was a canon and archdeacon at Wittemberg when he became acquainted with Luther, who converted Carlostadt to his opinions. He was associated with the great Reformer in his early struggles against the Romish Church; but differing from him in regard to the Eucharist, and afterwards being suspected of favouring the Anabaptists, his intimacy with Luther was broken, and a partial reconciliation was effected only a short while before his death. He was for some time minister at Orlamund in Thuringia, but afterwards professor at Zurich and Basle, at which latter place he died in 1541 or 1543. He was the first Reformer who entered into the matrimonial state.

CAROLUS, an old English broad piece of gold, struck under Charles I., and worth twenty shillings. Also a small copper coin, mixed with a little silver, struck under Charles VIII. of France, and worth twelve deniers.

CAROMEL, or CARAMEL, the name given to a dark-brown porous mass obtained from sugar by exposing it to a heat of from 400° to 430°. It is greatly used to colour various liquors, as brandy, beer, &c. See BREWING, p. 331.

CAROOR, a town of Hindustan, in the British district of Coimbetoor, presidency of Madras. It is situated on the north bank of the Ambrawati, or Caroor river, and contains above 1000 houses. The Caroor was the ancient boundary between the dominions of Mysore and Trichinopoly. It was taken by the British in 1760. It is 42 miles west from Trichinopoly. E. Long. 78. 9., N. Lat. 10. 58.

CARORA, a well-built town of Venezuela, in the province of Coro, 94 miles S.S.W. of the town of that name. Pop. probably about 6000. It has manufactures of leather, ropes, and hammocks; and carries on a considerable trade in aromatic balsams, gums, and agricultural productions.

CAROTIDS, two arteries of the neck, which convey the blood from the aorta to the brain.

CAROUGE, a town in the canton of Geneva, pleasantly situated on the Arve, and connected with the city of Geneva by a bridge. Pop. 4000.

CARP. See ICHTHYOLOGY, and ANGLING.

CARPÆA, in *Grecian Antiquity*, a kind of mimetic dance peculiar to the Ænianians and Magnesians. It was performed by two persons, the one representing a labourer, the other a robber. The labourer, laying by his arms, began to plough and sow, but looking warily around as if afraid of being surprised. The robber at length appears, and the labourer seizes his arms and fights in defence of his oxen. Sometimes the robber was overcome, sometimes the labourer—the victor's reward being the oxen and plough. The design of this exercise was to accustom the peasants to defend themselves against the attacks of ruffians. (Xen. *Anab.* vi.; Athen. i.; Maxim. Tyr. *Diss.* xxviii.)

CARPATHIAN MOUNTAINS, or KRAPACKS, a great central European chain, inclosing Transylvania and Hungary, in a curve 800 miles long, the eastern point of which

rests on the Danube at Orsova, the western on the same river at Presburg. It forms the main water-shed between the northern seas and the Black Sea, and varies in elevation from 200 to nearly 9000 feet. See HUNGARY and TRANSYLVANIA.

CARPATHUS, the ancient name of the island of Scarpanto, about 30 miles S.W. of Rhodes. The surrounding sea was called *Carpathium Mare* from this island.

CARPENTARIA, GULF OF, an extensive arm of the sea deeply indenting the north coast of Australia, between S. Lat. 10. 40. and 17. 30., and E. Long. 136. and 142. It averages 350 miles in length and breadth, and contains numerous islands.

CARPENTER, LANT, LL.D., was born at Stourbridge in 1780. He studied at Glasgow, and was for some time minister of a dissenting congregation in Exeter, but afterwards removed to Bristol. He was drowned during a voyage between Leghorn and Naples, in 1840. His works are principally controversial. He was joined with the Rev. Dr William Shepherd, and the Rev. Jeremiah Joyce, in a valuable work entitled *Systematic Education.*

CARPENTER (French *charpentier*, Lat. *carpentarius*), an artificer who works in timber.

CARPENTRAS, capital of an arrondissement of the same name, department of Vaucluse, France, on the Auzon, 15 miles N.E. of Avignon. It is well built, but the streets are mostly narrow and filthy. It is surrounded by old walls. Public buildings, the cathedral, rebuilt in 1405; a palace of justice, formerly the episcopal palace; an aqueduct of 48 arches, finished in 1734; a hospital; and the remains of a Roman triumphal arch. It has a theatre, public library, and museum; also distilleries, dye-works, tanneries, chemical works, and a considerable trade in silk, madder, honey, wax, olive oil, &c. It was anciently an important Roman city. Pop. (1851) of city 10,473, of arrondissement 57,034.

CARPENTRY.

WE must begin by informing our readers, that the bulk of the present article was written by the late Professor Robison, in order to form, with those on ROOF, and STRENGTH OF MATERIALS, also written by him for this Encyclopædia, a uniform system of the most useful departments of practical mechanics, deduced, in the same familiar and elementary manner, from the simple principles of the composition of forces. In here reprinting his contribution, we shall premise some introductory observations, which may be considered as a retrospective summary of the doctrine of Passive Strength, accompanied by some of the most useful propositions respecting the resistance of elastic substances, derived from the principles which have been already laid down in our article BRIDGE; and subjoining a few notes on such passages as may appear to require further illustration or correction. Some of the demonstrations will be partly borrowed from a work which has been published since the death of Professor Robison, but others will be more completely original; and of the remarks, the most important will probably be those which relate to the form and direction of the abutment of rafters; a subject which seems to have been very incorrectly treated by former writers on Carpentry.[1]

I.—ABSTRACT OF THE DOCTRINE OF PASSIVE STRENGTH.

The effects of forces of different kinds, on the materials employed in the mechanical arts, require to be minutely examined in the arrangement of every work dependent on them; and of these effects, as exhibited in a solid body at rest, we may distinguish seven different varieties; the extension of a substance acting simply as a tie; the compression of a block supporting a load above it; the detrusion of an axis resting on a support close to its wheel, and resisting by its lateral adhesion only; the flexure of a body bent by a force applied unequally to its different parts; the torsion or twisting, arising from a partial detrusion of the external parts in opposite directions, while the axis retains its place; the alteration or permanent change of a body which settles, so as to remain in a new form, when the force is withdrawn; and lastly, the fracture, which consists in a complete separation of parts before united, and which has been the only effect particularly examined by the generality of authors on the strength of materials.

The analogy of the laws of extension and compression has been demonstrated in a former article (BRIDGE), and their connection with flexure has been investigated; but it is not easy to compare them directly with the resistance opposed to a partial detrusion, the effects of which are only so far understood as they are exhibited in the phenomena of twisting; and these appear to justify us in considering the resistance of lateral adhesion as a primitive force, deduced from the rigidity or solidity of the substance, and proportional to the deviation from the natural situation of the particles. The resistance exhibited by steel wire, when twisted, bears a greater proportion to that of brass than the resistance to extension or compression, but the forces agree in being independent of the hardness produced by tempering.

Flexure may be occasioned either by a transverse or by a longitudinal force. When the force is transverse, the extent of the flexure is nearly proportional to its magnitude; but when it is longitudinal, there is a certain magnitude which it must exceed in order to produce, or rather to continue, the flexure, if the force be applied exactly at the axis. But it is equally true that the slightest possible force applied at a distance from the axis, however minute, or with an obliquity however small, or to a beam already a little curved, will produce a certain degree of flexure; and this observation will serve to explain some of the difficulties and irregularities which have occurred in making experiments on beams that are exposed to longitudinal pressure.

Stiffness, or the power of resisting flexure, is measured by the force required to produce a given minute change of form. For beams similarly fixed, it is directly proportional to the breadth and the cube of the depth, and inversely to the cube of the length. Thus a beam or bar two yards long will be equally stiff with a beam one yard, provided that it be either twice as deep or eight times as broad. If the ends of a beam can be firmly fixed, by continuing them to a sufficient distance, and keeping them down by a proper pressure, the stiffness will be four times as great as if the ends were simply supported. A hollow substance, of given weight and length, has its stiffness

[1] These introductory observations to Professor Robison's article, and the notes subjoined to it, were written by the late Dr Thomas Young.

nearly proportional to the square of the diameter; and hence arises the great utility of tubes when stiffness is required, this property being still more increased by the expansion of the substance than the ultimate strength. It is obvious that there are a multiplicity of cases in carpentry where stiffness is of more importance than any other property, since the utility as well as beauty of the fabric might often be destroyed by too great a flexibility of the materials.

If we wish to find how much a beam of fir will sink when it is loaded in the middle, we may multiply the cube of the length in inches by the given weight in pounds, and divide by the cube of the depth, and by ten million times the breadth; but, on account of the unequal texture of the wood, we must expect to find the bending somewhat greater than this in practice, besides that a large weight will often produce an alteration, or permanent settling, which will be added to it: a beam of oak will also sink a little more than a beam of fir with the same weight.

With respect to torsion, the stiffness of a cylindrical body varies directly as the fourth power of the diameter, and inversely in the simple proportion of the length: it does not appear to be changed by the action of any force tending to lengthen or to compress the cylinder; and it may very possibly bear some simple relation to the force of cohesion, which has not yet been fully ascertained; but it appears that, in an experiment of Mr Cavendish, the resistance of a cylinder of copper to a twisting force, acting at its surface, was about $\frac{1}{100}$ of the resistance that the same cylinder would have opposed to direct extension or compression.

Alteration is often an intermediate step between a temporary change and a complete fracture. There are many substances which, after bending to a certain extent, are no longer capable of resuming their original form; and in such cases it generally happens that the alteration may be increased without limit, until complete fracture takes place, by the continued operation of the same force which has begun it, or by a force a little greater. Those substances which are the most capable of this change are called ductile; and the most remarkable are gold, and a spider's web. When a substance has undergone an alteration by means of its ductility, its stiffness, in resisting small changes on either side, remains little or not at all altered. Thus, if the stiffness of a spider's web, in resisting torsion, were sufficient at the commencement of an experiment to cause it to recover itself, after being twisted in an angle of ten degrees, it would return ten degrees, and not more, after having been twisted round a thousand times. The ductility of all substances capable of being annealed is greatly modified by the effects of heat. Hard steel, for example, is incomparably less subject to alteration than soft, although in some cases more liable to fracture; so that the degree of hardness requires to be proportioned to the uses for which each instrument is intended; although it was proved by Coulomb, and has since been confirmed by other observers, that the primitive stiffness of steel, in resisting small flexures, is neither increased nor diminished by any variation in its temper.

The strength of a body is measured by the force required completely to overcome the corpuscular powers concerned in the aggregation of its particles, and it is jointly proportional to the primitive stiffness and to the toughness of the substance, that is, to the degree in which it is capable of a change of form without permanent alteration. It becomes, however, of importance in some cases to consider the measure of another kind of strength, which has sometimes been called resilience, or the power of resisting a body in motion, and which is proportional to the strength and the toughness conjointly, that is, to the stiffness and the square of the toughness. Thus, if we double the length of a given beam, we reduce its absolute strength to one half, and its stiffness to one eighth; but since the toughness, or the space through which it will continue to resist, is quadrupled, the resilience will be doubled, and it would require a double weight to fall from the same height, or the same weight to fall from a double height, in order to overcome its whole resistance. If we wish to determine the resilience of a body from an experiment on its strength, we must measure the distance through which it recedes or is bent previously to its fracture; and it may be shown that a weight which is capable of breaking it by pressure, would also break it by impulse if it moved with the velocity acquired by falling from a height equal to half the deflection. Thus, if a beam or bar were broken by a weight of 100 pounds, after being bent six inches without alteration, it would also be broken by a weight of 100 pounds falling from a height of three inches, or moving in a horizontal direction with a velocity of four feet in a second, or by a weight of one pound falling from a height of 300 inches. This substitution of velocity for quantity of matter has, however, one limit, beyond which the velocity must prevail over the resistance, without regard to the quantity of matter; and this limit is derived from the time required for the successive propagation of the pressure through the different parts of the substance, in order that they may participate in the resistance. Thus, if a weight fell on the end of a bar or column with a velocity of 100 feet in a second, and the substance could only be compressed $\frac{1}{200}$ of its length, without being crushed, it is obvious that the pressure must be propagated through the substance with a velocity of 20,000 feet in a second, in order that it might resist the stroke; and, in general, a substance will be crushed or penetrated by any velocity exceeding that which is acquired by a body falling from a height, which is to half that of the modulus of elasticity of the substance, as the square of the greatest possible change of length is to the whole length. From the consideration of the effect of rigidity in lessening the resilience of bodies, we may understand how a diamond, which is capable of resisting an enormous pressure, may be crushed with a blow of a small hammer, moving with a moderate velocity. It is remarkable that, for the same substance in different forms, the resilience is in most cases simply proportional to the bulk or weight, while almost every other kind of resistance is capable of infinite variation by change of form only.

The elaborate investigations of M. Lagrange, respecting the strength and the strongest forms of columns, appear to have been conducted upon principles not altogether unexceptionable; but it is much easier to confute the results than to follow the steps of the computations. One great error is the supposition that columns are to be considered as elastic beams, bent by a longitudinal force; while, in reality, a stone column is never slender enough to be bent by a force which it can bear without being crushed and even for such columns as are capable of being bent by a longitudinal force, M. Lagrange's determinations are in several instances inadmissible. He asserts, for example, that a cylinder is the strongest of all possible forms, and that a cone is stronger than any conoid of the same bulk; but it appears to be demonstrable in a very simple manner, and upon incontestable principles, that a conoidal form may be determined, which shall be stronger than either a cone or a cylinder of the same bulk.

When a column is crushed, its resistance to compression seems to depend in great measure on the force of lateral adhesion, assisted by a kind of internal friction, dependent on the magnitude of the pressure; and it commonly gives way by the separation of a wedge in an

oblique direction. If the adhesion were simply proportional to the section, it may be shown that a square column would be most easily crushed when the angle of the wedge is equal to half of a right angle; but if the adhesion is increased by pressure, this angle will be diminished by half the angle of repose appropriate to the substance. In a wedge separated by a direct force from a prism of cast iron, the angle was found equal to $32\frac{1}{2}°$, consequently the angle of repose was $2 \times 12\frac{1}{2}° = 25°$, and the internal friction to the pressure as 1 to ·466, the tangent of this angle; there was, however, a little bubble in the course of the fracture, which may have changed its direction in a slight degree. The magnitude of the lateral adhesion is measured by twice the height of the wedge, whatever its angle may be. In this instance the height was to the depth as 1·57 to 1, consequently the surface, affording an adhesion equal to the force, was somewhat more than three times as great as the transverse section, and the lateral adhesion of a square inch of cast iron would be equal to about 46,000 pounds; the direct cohesive force of the same iron was found by experiment equal to about 20,000 pounds for a square inch. It is obvious that experiments on the strength of a substance in resisting compression ought to be tried on pieces rather longer than cubes, since a cube would not allow of the free separation of a single wedge so acute as was observed in this experiment; although, indeed, the force required to separate a shorter wedge on each side would be little or no greater than for a single wedge. The same consideration of the oblique direction of the plane of easiest fracture would induce us to make the outline of a column a little convex externally, as the common practice has been; for a circle cut out of a plank possesses the advantage of resisting equally in every section, and consequently of exhibiting the strongest form, when there is no lateral adhesion; and in the case of an additional resistance proportional to the pressure, the strongest form is afforded by an oval consisting of two circular segments, each containing twice the angle formed by the plane of fracture with the horizon. If we wish to obtain a direct measure of the lateral adhesion, we must take care to apply the forces concerned at a distance from each other not greater than one sixth of the depth of the substance, otherwise the fracture will probably be rather the consequence of flexure than of detrusion. Professor Robison found this force in some instances twice as great as the direct cohesion, or nearly in the same proportion as it appears to have been in the experiment on the strength of cast iron; Mr Coulomb thinks it most commonly equal only to the cohesion; and in fibrous substances, especially where the fibres are not perfectly straight, the repulsive strength is generally much less than would be inferred from this equality, and sometimes even less than the cohesive strength.

It is well known that the transverse strength of a beam is directly as the breadth and as the square of the depth, and inversely as the length; and the variation of the results of some experiments from this law can only have depended on accidental circumstances. If we wish to find the number of hundredweights that will break a beam of oak supported at both ends, supposing them to be placed exactly on the middle, we may multiply the square of the depth in inches by 100 times the breadth, and divide by the length; and we may venture in practice to load a beam with at least an eighth as much as this, or, in case of necessity, even a fourth. And if the load be distributed equally throughout the length of the beam, it will support twice as much; but for a beam of fir the strength is somewhat less than for oak. A cylinder will bear the same curvature as the circumscribing prism, and it may be shown that its strength, as well as its stiffness, is to that of the prism as one fourth of its bulk is to one third of the bulk of the prism. The strength of a beam supported at its extremities may be doubled by firmly fixing the ends where it is practicable; and we have already seen that the stiffness is quadrupled: but the resilience remains unaltered, since the resistance is doubled, and the space through which it acts is reduced to a half. It is therefore obviously of importance to consider the nature of the resistance that is required from the fabric which we are constructing. A floor, considered alone, requires to be strong; but in connection with a ceiling, its stiffness requires more particular attention, in order that the ceiling may remain free from cracks. A coach-spring requires resilience for resisting the relative motions of the carriage, and we obtain this kind of strength as effectually by combining a number of separate plates, as if we united them into a single mass, while we avoid the stiffness, which would render the changes of motion inconveniently abrupt.

In all calculations respecting stiffness, it is necessary to be acquainted with the modulus of elasticity, which may be found for a variety of substances in the annexed table.

Height of the Modulus of Elasticity in Thousands of Feet.

Iron and steel	10,000	Fir wood	10,000
Copper	5,700	Elm	8,000
Brass	5,000	Beech	8,000
Silver	3,240	Oak	5,060
Tin	2,250	Box	5,050
Crown glass	9,800	Ice	850

II.—PROPOSITIONS RELATING TO FLEXURE.

A. *The stiffness of a cylinder is to that of its circumscribing rectangular prism, as three times the bulk of the cylinder is to four times that of the prism.*

We may consider the different strata of the substance as acting on levers equal in length to the distance of each from the axis; for although there is no fixed fulcrum at the axis, yet the whole force is the same as if such a fulcrum existed, since the opposite actions of the opposite parts would relieve the fulcrum from all pressure. Then the tension of each stratum being also as the same distance x, and the breadth of the stratum being called $2y$, the fluxion of the force on either side of the axis will be $2x^2ydx$, while that of the force of the prism, the radius being r, is $2rx^2dx$. Now z being the area of half the portion included between the stratum and the axis, of which the fluxion is ydx, the fluxion of $z - \frac{y^3x}{rr}$ will be

$$ydx - \frac{y^3dx}{r^2} - \frac{3y^2xdy}{r^2}$$

$$= ydx\left(1 - \frac{y^2}{r^2}\right) - \frac{3yx}{r^2}\,ydy.$$

But $1 - \frac{y^2}{r^2} = \frac{x^2}{r^2}$, and $-ydy = xdx$,

therefore the fluxion is

$$\frac{x^2ydx}{r^2} + \frac{3x^2ydx}{r^2} = \frac{4x^2ydx}{r^2};$$

consequently the fluent of $2x^2ydx$ is $\frac{1}{2}r^2z - \frac{1}{2}y^3x$, which, when $y = 0$, becomes $\frac{1}{2}r^2z$, or one fourth of the product of the square of the radius by the area of the section, while the fluent of $2rx^2dx$, that is, $\frac{2}{3}rx^3$, the force of the prism, becomes $\frac{2}{3}r^4$ or $\frac{1}{3}r^2 \times 2r^2$, one third of the product of the same square into the area of the section of the prism.

Hence the radius of curvature of a cylindrical column, instead of $\frac{Maa}{12fy}$ (Art. BRIDGE, Prop. G), will be $\frac{Maa}{16fy}$, the weight of the modulus M decreasing in the same propor-

tion as the bulk when the prism is reduced to a cylinder. The force is supposed in this proposition to be either transverse or applied at a considerable distance from the axis; but the error will not be material in any other case.

B. *When a longitudinal force f is applied to the extremities of a straight prismatic beam, at the distance b from the axis, the deflection of the middle of the beam will be* $b\left(\text{SECANT}\left[\sqrt{\left(\frac{3f}{M}\right)}\cdot\frac{e}{a}\right]-1\right)$; M *being the weight of the modulus, e the length of the beam, and a its depth.*

The curvature being proportional to the distance from the line of direction of the force, or to the ordinate, when that line is considered as the absciss, the elastic curve must in this case initially coincide with a portion of the harmonic curve, well known for its utility in the resolution of a variety of problems of this kind. Now if the half length of the complete curve be called k, corresponding to a quadrant of the generating circle, and the greatest ordinate y, c being the quadrant of a circle of which the radius is unity, the radius of curvature r corresponding to y will be $\frac{kk}{ccy}$, that is, a third proportional to y and $\frac{k}{c}$ the radius of the generating circle; consequently $\frac{\text{M}aa}{12fy} = \frac{kk}{ccy}$, $kk = \frac{\text{M}aacc}{12f}$, and $k = \frac{1}{2}\sqrt{\frac{\text{M}}{3f}}\cdot ac$; but by the nature of the curve, $y : b = 1 : \cos.\frac{ec}{2k} = \sec.\frac{ec}{2k} : 1$, and $y = b\sec.\frac{ec}{2k} = b\sec.\sqrt{\frac{3f}{\text{M}}}\cdot\frac{e}{a}$, which is the ordinate at the middle; and the deflection from the natural situation is $y - b$.

It follows that, since the secant of the quadrant is infinite, when $\sqrt{\frac{3f}{\text{M}}}\cdot\frac{e}{a}$ becomes equal to c, the deflection will be infinite, and the resistance of the column will be overcome, however small the distance b may be taken, provided that it be of finite magnitude; and since in this case $\frac{3fee}{\text{M}aa} = cc$, $f = \frac{\text{M}aacc}{3ee} = \cdot 8225\ \text{M}\frac{aa}{ee}$, which is the utmost force that the column will bear: and for a cylinder we find, by the same reasoning, $f = \frac{\text{M}aacc}{4ee} = \cdot 6169\ \text{M}\frac{aa}{ee}$. If b be supposed to vanish, we shall have in theory an equilibrium without flexure; but since it will be tottering, it cannot exist in nature.

By applying this determination to the strength of wood and iron, compared with the modulus of elasticity, it appears that a round column or a square pillar of either of these substances cannot be bent by any longitudinal force applied to the axis, which it can withstand without being crushed, unless its length be greater than twelve or thirteen times its thickness respectively; nor a column or pillar of stone, unless it be forty or forty-five times as long as it is thick. Hence we may infer, as a practical rule, that every piece of timber or iron intended to withstand any considerable compressing force, should be at least as many inches in thickness as it is feet in length, in order to avoid the loss of force which necessarily arises from curvature.

C. *When a beam, fixed at one end, is pressed by a force in a direction deviating from the original position of the axis in a small angle, of which the tangent is t, the deflection becomes* $d = at\frac{\text{M}}{12f}\ \text{TANG.}\left(\sqrt{\frac{12f}{\text{M}}}\cdot\frac{e}{a}\right)$.

The inclination of the curve to the absciss being inconsiderable, it will not differ sensibly from a portion of a harmonic curve; and supposing the quadrantal length of this curve k, we have again, as in the last proposition, $k = \frac{1}{2}\sqrt{\frac{\text{M}}{3f}}\cdot ac$, or, for a cylinder, $k = \frac{1}{4}\sqrt{\frac{\text{M}}{f}}\cdot ac$. Now, the tangent of the inclination of the harmonic curve varies as the sine of the angular distance from the middle; consequently, as $\text{SIN.}\frac{k-e}{k}\cdot c$, or $\cos.\frac{ec}{k}$, is to the radius, so is the tangent t, expressing the difference of inclination of the end of the beam and the direction of the force, which is also that of the middle of the supposed curve, to the tangent of the extreme inclination of the curve to its absciss, which will therefore be $t\ \text{SEC.}\frac{ec}{k}$; consequently the greatest ordinate will be $\frac{kt}{c}\ \text{SEC.}\frac{ec}{k}$, and since the ordinates are as the sines of the angular distances from the origin of the curve, the ordinate at the fixed end of the beam, corresponding to the angle $\frac{ec}{k}$, that is, the deflection, will be $\frac{kt}{c}\ \text{SEC.}\frac{ec}{k}.\ \text{SIN.}\frac{ec}{k} = \frac{kt}{c}\ \text{TANG.}\frac{ec}{k} = \frac{1}{2}\sqrt{\frac{\text{M}}{3f}}\cdot at\ \text{TANG.}\frac{2e}{a}\sqrt{\frac{3f}{\text{M}}}$, or, for a cylinder, $\frac{1}{4}\sqrt{\frac{\text{M}}{f}}\cdot at\ \text{TANG.}\frac{4e}{a}\sqrt{\frac{f}{\text{M}}}$.

By means of this proposition we may determine the effect of a small lateral force in weakening a beam or pillar which is at the same time compressed longitudinally by a much greater force, considering the parts on each side of the point to which the lateral force is applied, as portions of two beams, bent in the manner here described, by a single force slightly inclined to the axis.

D. *A bar fixed at one end, and bent by a transverse force applied to the other end, assumes initially the form of a cubic parabola, and the deflection at the end is* $d = \frac{4e^3f}{\text{M}aa}$.

The ordinate of a cubic parabola varying as x^3, its second fluxion varies as $6x\,(dx)^2$, or since the first fluxion of the absciss is constant, simply as the absciss x, measured from the vertex of the parabola, which must therefore be situated at the end to which the force is applied, and the absciss must coincide with the tangent of the bar. But if we begin from the other end, we must substitute $e-x$ for x, and the second fluxion of the ordinate will be as $6\,(e-x)\,(dx)^2$, the first as $6exdx - 3x^2dx$, and the fluent as $3ex^2 - x^3$, which, when $x = e$, becomes $2e^3$, while it would have been $3e^3$ if the curvature had been uniform, and the second fluxion had been everywhere $6e(dx)^2$. Now the radius of curvature at the fixed end being $r = \frac{\text{M}aa}{12ef}$, and the versed sine of a small portion of a circle being equal to $\frac{ee}{2r}$, this versed sine will be expressed by $\frac{6e^3f}{\text{M}aa}$; and two thirds of this, or $\frac{4e^3f}{\text{M}aa}$, will be the actual deflection.

E. *The depression of a bar, fixed horizontally at one end, and supporting only its own weight, is* $d = \frac{3e^4}{2maa}$; *m being the height of the modulus of elasticity.*

The curvature here varies as the square of the distance from the end, because the strain is proportional to the weight of the portion of the bar beyond any given point, and to the distance of its centre of gravity conjointly, that is, to $(e-x)\ \frac{1}{2}\,(e-x)$, so that if the second fluxion

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at the fixed end be as $e^2(dx)^2$, it will elsewhere be as $(e-x)^2(dx)^2$; and the corresponding first fluxions being e^2xdx and $e^2xdx - ex^2dx + \frac{1}{3}x^3dx$, the fluents will be $\frac{1}{2}e^2x^2$, and $\frac{1}{2}e^2x^2 - \frac{1}{3}ex^3 + \frac{1}{12}x^4$, or, when $x = e$, $\frac{1}{12}e^4$, and $(\frac{1}{2} - \frac{1}{3} + \frac{1}{12})e^4 = \frac{1}{4}e^4$; consequently the depression must be half the versed sine in the circle of greatest curvature. Now the radius of curvature $\frac{Maa}{12fy}$ becomes here $\frac{Maa}{6ef}$, the force being applied at the distance $\frac{1}{2}e$; and since the weight of the bar is to that of the modulus of elasticity in the proportion of the respective lengths, we have $\frac{f}{M} = \frac{e}{m}$, and $r = \frac{maa}{6ee}$, and the versed sine for the ordinate e will be $\frac{3e^4}{maa}$, half of which is the actual depression.

F. *The depression of the middle of a horizontal bar, fixed at both ends, and supporting its own weight only, is* $d = \frac{5e^4}{32maa}$.

The transverse force at each point of such a bar, resisted by the lateral adhesion, is as the distance x from the middle (*Art.* BRIDGE, under Prop. L); but this force is proportional to the first fluxion of the strain or curvature, consequently the curvature itself must vary as the corrected fluent of $\pm xdx$, taking here the negative sign, because the curvature diminishes as x increases; and the corrected fluent will be $\frac{1}{4}e^2 - x^2$, since it must vanish when $x = \frac{1}{2}e$; the first fluxion of the ordinate will then be $\frac{1}{4}e^2xdx - \frac{1}{3}x^3dx$, and the fluent $\frac{1}{8}e^2x^2 - \frac{1}{12}x^4$, or for the whole length $\frac{1}{2}e$, $\frac{1}{192}e^4$, instead of $\frac{1}{32}$, or $\frac{6}{192}$, which would have been its value if the curvature had been equal throughout. Now the strain at the middle is the difference of the opposite strains produced by the forces acting on either side; and these are the half weight acting at the mean distance $\frac{1}{4}e$, and the resistance of the support, which is equal to the same half weight, but acts at the distance $\frac{1}{2}e$, the difference being equivalent to the half weight, acting at the distance $\frac{1}{4}e$, so that the curvature at the middle is the same as if the bar were fixed there, and loose at the ends; that is, as in the last proposition, substituting $\frac{1}{2}e$ for e, $r = \frac{2maa}{3ee}$; and the versed sine at the distance $\frac{1}{2}e$ being $\frac{e^2}{8r}$, or $\frac{3e^4}{16maa}$, $\frac{5}{6}$ of this will be $\frac{5e^4}{32maa}$. This demonstration may serve as an illustration of two modes of considering the effect of a strain, which have not been generally known, and which are capable of a very extensive application.

It follows that where a bar is equally loaded throughout its length, the curvature at the middle is half as great as if the whole weight were collected there, the strain derived from the resistance of the support remaining in that case uncompensated. The depression produced by the divided weight will be $\frac{5}{8}$ as great as by the single weight, since $\frac{5}{6} \times \frac{1}{2}$ is to $\frac{2}{3}$ as 5 to 8. M. Dupin found the proposition, by many experiments, between $\frac{2}{3}$ and $\frac{3}{5}$; and $\frac{5}{8}$ is a very good mean for representing these results.

III.—ELEMENTS OF CARPENTRY.

Definition.

"Carpentry is the art of framing timber for the purposes of architecture, machinery, and, in general, for all considerable structures."

It is not intended in this article to give a full account of carpentry as a mechanical art, or to describe the various ways of executing its different works, suited to the variety of materials employed, the processes which must be followed for fashioning and framing them for our purposes, and the tools which must be used, and the manner in which they must be handled. This would be an occupation for volumes, and, though of great importance, must be entirely omitted here. Our only aim at present will be to deduce, from the principles and laws of mechanics, and the knowledge which experience, and judicious inferences from it, have given us concerning the strength of timber, in relation to the strain laid on it, such maxims of construction as will unite economy with strength and efficacy.

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This object is to be attained by a knowledge, 1*st*, of the strength of our materials, and of the absolute strain that is to be laid on them; 2*dly*, of the modifications of this strain, by the place and direction in which it is exerted, and the changes that can be made by a proper disposition of the parts of our structure; and, 3*dly*, having disposed every piece in such a manner as to derive the utmost advantage from its relative strength, we must know how to form the joints and other connections in such a manner as to secure the advantages derived from this disposition.

An important branch of mechanical science.

This is evidently a branch of mechanical science which makes carpentry a *liberal* art, constitutes part of the learning of the ENGINEER, and distinguishes him from the workman. Its importance in all times and states of civil society is manifest and great. In the present condition of these kingdoms, raised by the active ingenuity and energy of our countrymen to a pitch of prosperity and influence unequalled in the history of the world, a condition which consists chiefly in the superiority of our manufactures, attained by prodigious multiplication of engines of every description, and for every species of labour, the Science (so to term it) of carpentry is of immense consequence. We regret therefore exceedingly that none of our celebrated artists have done honour to themselves and their country, by digesting into a body of consecutive doctrines the results of their experience, so as to form a system from which their pupils might derive the first principles of their education. The many volumes called Complete Instructors, Manuals, &c. take a much humbler flight, and content themselves with instructing the mere workman; or sometimes give the master builder a few approved forms of roofs and other framings, with the rules for drawing them on paper, and from thence forming the working draughts which must guide the saw and the chisel of the workman. Hardly any of them offer any thing that can be called a principle, applicable to many particular cases, with the rules for this adaptation. We are indebted for the greatest part of our knowledge of this subject to the labours of literary men, chiefly foreigners, who have published in the memoirs of the learned academies dissertations on different parts of what may be termed the *Science of Carpentry*. It is singular that the members of the Royal Society of London, and even of that established and supported for the encouragement of the arts, have contributed so little to the public instruction in this respect. We have observed some beginnings of this kind, such as the last part of Nicholson's *Carpenter's and Joiner's Assistant*; and it is with pleasure we can say, that we were told by the editor this work was prompted in a great measure by what has been delivered in our articles ROOF and STRENGTH OF MATERIALS. It abounds more in important and new observations than any book of the kind that we are acquainted with. We again call on such as have given a scientific attention to this subject, and pray that they would render a meritorious service to their country by imparting the result of their researches. The very limited nature of this work does not allow us to treat the subject in de-

Principally indebted to foreigners for a knowledge of this subject.

Carpentry. tail; and we must confine our observations to the fundamental and leading propositions.

Theory founded on what.

The theory, so to term it, of carpentry is founded on two distinct portions of mechanical science, namely, a knowledge of the strains to which framings of timber are exposed, and a knowledge of their *relative* strength.

We shall therefore attempt to bring into one point of view the propositions of mechanical science that are more immediately applicable to the art of carpentry, and are to be found in various articles of our work, particularly Roof and Strength of Materials. From these propositions we hope to deduce such principles as shall enable an attentive reader to comprehend distinctly what is to be aimed at in framing timber, and how to attain this object with certainty; and we shall illustrate and confirm our principles by examples of pieces of carpentry which are acknowledged to be excellent in their kind.

Composition and resolution of forces.

The most important proposition of general mechanics to the carpenter is that which exhibits the composition and resolution of forces; and we beg our practical readers to endeavour to form very distinct conceptions of it, and to make it very familiar to their minds. When accommodated to their chief purposes, it may be thus expressed:

1. If a body, or any part of a body, be at once pressed in the two directions AB, AC (fig. 1, Plate CLIX.), and if the intensity or force of those pressures be in the proportion of these two lines, the body is affected in the same manner as if it were pressed by a single force acting in the direction AD, which is the diagonal of the parallelogram ABDC formed by the two lines, and whose intensity has the same proportion to the intensity of each of the other two that AD has to AB or AC.

Such of our readers as have *studied* the laws of motion, know that this is fully demonstrated. Such as wish for a very accurate view of this proposition will do well to read the demonstration given by D. Bernoulli, in the first volume of the *Comment. Petropol.*, and the improvement of this demonstration by D'Alembert in his *Opuscules* and in the *Comment. Taurinens.* The practitioner in carpentry will get more useful confidence in the doctrine, if he will shut his book, and verify the theoretical demonstrations by actual experiments. They are remarkably easy and convincing. Therefore it is our request that the artist, who is not so habitually acquainted with the subject, do not proceed further till he has made it quite familiar to his thoughts. Nothing is so conducive to this as the actual experiment; and since this only requires the trifling expense of two small pulleys and a few yards of whipcord, we hope that none of our practical readers will omit it: they will thank us for this injunction.

Illustrated by experiment.

2. Let the threads A*d*, AF*b*, and AE*c* (fig. 2), have the weights *d*, *b*, and *c*, appended to them, and let two of the threads be laid over the pulleys F and E. By this apparatus the knot A will be drawn in the directions AB, AC, and AK. If the sum of the weights *b* and *c* be greater than the single weight *d*, the assemblage will of itself settle in a certain determined form: if you pull the knot A out of its place, it will always return to it again, and will rest in no other position. For example, if the three weights are equal, the threads will always make equal angles, of 120 degrees each, round the knot. If one of the weights be three pounds, another four, and the third five, the angle opposite to the thread stretched by five pounds will always be square, &c. When the knot A is thus in equilibrio, we must infer that the action of the weight *d*, in the direction A*d*, is in direct opposition to the combined action of *b* in the direction AB, and of *c* in the direction AC. Therefore, if we produce *d*A to any point D, and take AD to represent the magnitude of the force, or pressure exerted by the weight *d*, the pressures exerted on A by the weights *b* and *c*, in the directions AB, AC, are in fact equivalent to a pressure acting in the direction AD, whose intensity we have represented by AD. If we now measure off by a scale on AF and AE the lines AB and AC, having the same proportions to AD that the weights *b* and *c* have to the weight *d*, and if we draw DB and DC, we shall find DC to be equal and parallel to AB, and DB equal and parallel to AC; so that AD is the diagonal of a parallelogram ABDC. We shall find this always to be the case, whatever are the weights made use of; only we must take care that the weight which we cause to act without the intervention of a pulley be less than the sum of the other two; if any one of the weights exceeds the sum of the other two, it will prevail, and drag them along with it.

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Now since we know that the weight *d* would just balance an equal weight *g*, pulling directly upwards by the intervention of the pulley G; and since we see that it just balances the weights *b* and *c*, acting in the directions AB, AC; we must infer that the knot A is affected in the same manner by those two weights, or by the single weight *g*; and therefore that *two pressures, acting in the directions and with the intensities* AB, AC, *are equivalent to a single pressure having the direction and proportion of* AD. In like manner, the pressures AB, AK, are equivalent to AH, which is equal and opposite to AC. Also AK and AC are equivalent to AI, which is equal and opposite to AB.

We shall consider this combination of pressures a little more particularly.

Suppose an upright beam BA (fig. 3), pushed in the direction of its length by a load B, and abutting on the ends of two beams AC, AD, which are firmly resisted at their extreme points C and D, which rest on two blocks, but are nowise joined to them; these two beams can resist no way but in the directions CA, DA, and therefore the pressures which they sustain from the beam BA are in the directions AC, AD. We wish to know how much each sustains: Produce BA to E, taking AE from a scale of equal parts, to represent the number of tons or pounds by which BA is pressed. Draw EF and EG parallel to AD and AC; then AF, measured on the same scale, will give us the number of pounds by which AC is strained or crushed, and AG will give the strain on AD.

It deserves particular remark here, that the length of AC or AD has no influence on the strain arising from the thrust BA, while the directions remain the same. The effects, however, of this strain are modified by the length of the piece on which it is exerted. This strain compresses the beam, and will therefore compress a beam of double length twice as much. This may change the form of the assemblage. If AC, for example, be very much shorter than AD, it will be much less compressed: the line CA will turn about the centre C, while DA will hardly change its position; and the angle CAD will grow more open, the point A sinking down. The artist will find it of great consequence to pay a very minute attention to this circumstance, and to be able to see clearly the change of shape which necessarily results from these mutual strains. He will see in this the cause of failure in many very great works. By thus changing shape, strains are often produced in places where there were none before, and frequently of the very worst kind, tending to break the beams across.

The dotted lines of this figure show another position of the beam AD'. This makes a prodigious change, not only in the strain on AD', but also in that on AC. Both of them are much increased; AG is almost doubled, and AF is four times greater than before. This addition was

made to the figure to show what enormous strains may be produced by a very moderate force, AE, when it is exerted on a very obtuse angle.[1]

The fourth and fifth figures will assist the most uninstructed reader in conceiving how the very same strains, AF, AG, are laid on these beams, by a weight simply hanging from a billet resting on A, pressing hard on AD, and also leaning a little on AC; or by an upright piece, AE, joggled on the two beams AC, AD, and performing the office of an ordinary king-post. The reader will thus learn to call off his attention from the means by which the strains are produced, and learn to consider them abstractedly merely as strains, in whatever situation he finds them, and from whatever cause they arise.

We presume that every reader will perceive, that the proportions of these strains will be precisely the same if every thing be inverted, and each beam be drawn or pulled in the opposite direction. In the same way that we have substituted a rope and weight in fig. 4, or a king-post in fig. 5, for the loaded beam BA of fig. 3, we might have substituted the framing of fig. 6, which is a very usual practice. In this framing, the batten DA is stretched by a force AG, and the piece AC is compressed by a force AF. It is evident that we may employ a rope or an iron rod hooked on at D, in place of the batten DA, and the strains will be the same as before.

This seemingly simple matter is still full of instruction; and we hope that the well-informed reader will pardon us, though we dwell a little longer on it for the sake of the young artist.

By changing the form of this framing, as in fig. 7, we produce the same strains as in the disposition represented by the dotted lines in fig. 3. The strains on both the battens AD, AC, are now greatly increased.

The same consequences result from an improper change of the position of AC. If it is placed as in fig. 8, the strains on both are vastly increased. In short, the rule is general, that the more open we make the angle against which the push is exerted, the greater are the strains which are brought on the struts or ties which form the sides of the angle.

The reader may not readily conceive the piece AC of fig. 8 as sustaining a compression; for the weight B appears to hang from AC as much as from AD. But his doubts will be removed by considering whether he could employ a rope in place of AC. He cannot; but AD may be exchanged for a rope. AC is therefore a strut, and not a tie.

In fig. 9, Plate CLX., AD is again a strut, butting on the block D, and AC is a tie; and the batten AC may be replaced by a rope. While AD is compressed by the force AG, AC is stretched by the force AF.

If we give AC the position represented by the dotted lines, the compression of AD is now AG′, and the force stretching AC′ is now AF′; both much greater than they were before. This disposition is analogous to fig. 8, and to the dotted lines in fig. 3. Nor will the young artist have any doubts of AC′ being on the stretch, if he consider whether AD can be replaced by a rope. It cannot, but AC′ may; and it is therefore not compressed, but stretched.

In fig. 10 all the three pieces, AC, AD, and AB, are ties, on the stretch. This is the complete inversion of fig. 3; and the dotted position of AC induces the same changes in the forces AF, AG′, as in fig. 3.

Thus have we gone over all the varieties which can happen in the bearings of three pieces on one point. All calculations about the strength of carpentry are reduced to this case; for when more ties or braces meet in a point (a thing that rarely happens), we reduce them to three, by substituting for any two the force which results from their combination, and then combining this with another: and so on.

The young artist must be particularly careful not to mistake the kind of strain that is exerted on any piece of the framing, and suppose a piece to be a brace which is really a tie. It is very easy to avoid all mistakes in this matter by the following rule, which has no exception: (See Note AA.)

Rule for distinguishing the cases of compression and extension.

Take notice of the direction in which the piece acts from which the strain proceeds. Draw a line in that direction *from* the point on which the strain is exerted, and let its length (measured on some scale of equal parts) express the magnitude of this action in pounds, hundreds, or tons. From its *remote* extremity draw lines parallel to the pieces on which the strain is exerted. The line parallel to one piece will necessarily cut the other, or its direction produced. If it cut the piece itself, that piece is compressed by the strain, and it is performing the office of a strut or brace; if it cut its direction produced, the piece is stretched, and it is a tie. In short, the strains on the pieces AC, AD, are to be estimated in the direction of the points F and G *from* the strained point A. Thus, in fig. 3, the upright piece BA, loaded with the weight B, presses the point A in the direction AE; so does the rope AB in the other figures, or the batten AB in fig. 5.

In general, if the straining piece is within the angle formed by the pieces which are strained, the strains which they sustain are of the opposite kind to that which it exerts. If it be pushing, they are drawing; but if it be within the angle formed by their directions produced, the strains which they sustain are of the same kind. All the three are either drawing or pressing. If the straining piece lie within the angle formed by one piece and the produced direction of the other, its own strain, whether compression or extension, is of the same kind with that of the most remote of the other two, and opposite to that of the nearest. Thus, in fig. 9, where AB is drawing, the remote piece AC is also drawing, while AD is pushing or resisting compression.

In all that has been said on this subject, we have not spoken of any joints. In the calculations with which we are occupied at present, the resistance of joints has no share; and we must not suppose that they exert any force which tends to prevent the angles from changing. The joints are supposed perfectly flexible, or to be like compass joints, the pin of which only keeps the pieces together when one or more of the pieces draws or pulls. The carpenter must always suppose them all compass joints when he calculates the thrusts and draughts of the different pieces of his frames. The strains on joints, and their power to produce or balance them, are of a different kind, and require a very different examination.

General expression of the magnitude of the strain.

Seeing that the angles which the pieces make with each other are of such importance to the magnitude and the proportion of the excited strains, it is proper to find out some way of readily and compendiously conceiving and expressing this analogy.

In general the strain on any piece is proportional to the straining force. This is evident.

[1] The reader is requested to add accents to the extreme letters D and F of fig. 3, which correspond to the position of the beam AGD indicated by the dotted lines. Accents are also wanted to the upper F and the lower C and G in fig. 9; also to the upper F and lower G in fig. 10; and in this *b* should be C. In fig. 11, the *i* towards the left should be *t*, and an accent is wanting over the upper *f*. In fig. 12, the dotted line CK should be continued upward and marked I. In fig. 16. the letters should stand thus, A C E *e* D *f* F B.

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Secondly, the strain on any piece AC is proportional to the sine of the angle which the straining force makes with the other piece directly, and to the sine of the angle which the pieces make with each other inversely.

For it is plain that the three pressures AE, AF, and AG, which are exerted at the point A, are in the proportion of the lines AE, AF, and FE (because FE is equal to AG). But because the sides of a triangle are proportional to the sines of the opposite angles, the strains are proportional to the sines of the angles AFE, AEF, and FAE. But the sine of AFE is the same with the sine of the angle CAD, which the two pieces AC and AD make with each other; and the sine of AEF is the same with the sine of EAD, which the straining piece BA makes with the piece AC. Therefore we have this analogy, Sin. CAD : Sin. $\text{EAD} = \text{AE} : \text{AF}$, and $\text{AF} = \text{AE} \times \frac{\text{Sin. EAD}}{\text{Sin. CAD}}$. Now the sines of angles are most conveniently conceived as decimal fractions of the radius, which is considered as unity. Thus. *Sin.* 30° is the same thing with 0·5, or $\frac{1}{2}$; and so of others. Therefore, to have the strain on AC, arising from any load AE acting in the direction AE, multiply AE by the sine of EAD, and divide the product by the sine of CAD.

This rule shows how great the strains must be when the angle CAD becomes very open, approaching to 180 degrees. But when the angle CAD becomes very small, its sine (which is our divisor) is also very small; and we should expect a very great quotient in this case also. But we must observe, that in this case the sine of EAD is also very small; and this is our multiplier. In such a case, the quotient cannot exceed unity.

But it is unnecessary to consider the calculation by the tables of sines more particularly. The angles are seldom known any otherwise but by drawing the figure of the frame of carpentry. In this case, we can always obtain the measures of the strains from the same scale, with equal accuracy, by drawing the parallelogram AFCG.

Strains propagated to the points of support.

Hitherto we have considered the strains excited at A only as they affect the pieces on which they are exerted. But the pieces, in order to sustain, or be subject to, any strain, must be supported at their ends C and D; and we may consider them as mere intermediums, by which these strains are made to act on those points of support: Therefore AF and AG are also measures of the forces which press or pull at C and D. Thus we learn the supports which must be found for these points. These may be infinitely various. We shall attend only to such as somehow depend on the framing itself.

Action of a straining beam.

Such a structure as fig. 11 very frequently occurs, where a beam BA is strongly pressed to the end of another beam AD, which is prevented from yielding, both because it lies on another beam HD, and because its end D is hindered from sliding backwards. It is indifferent from what this pressure arises: we have represented it as owing to a weight hung on at B, while B is withheld from yielding by a rod or rope hooked to the wall. The beam AD may be supposed at full liberty to exert all its pressure on D, as if it were supported on rollers lodged in the beam HD; but the loaded beam BA presses both on the beam AD and on HD. We wish only to know what strain is borne by AD.

All bodies act on each other in the direction perpendicular to their touching surfaces; therefore the support given by HD is in a direction perpendicular to it. We may therefore supply its place at A by a beam AC, perpendicular to HD, and firmly supported at C. In this case, therefore, we may take AE, as before, to represent the pressure exerted by the loaded beam, and draw EG perpendicular to AD, and EF parallel to it, meeting the perpendicular AC in F. Then AG is the strain compressing AD, and AF is the pressure on the beam HD.

The form of the abutting joint of no great importance.

It may be thought, that since we assume as a principle that the mutual pressures of solid bodies are exerted perpendicular to their touching surfaces, this balance of pressures, in framings of timbers, depends on the directions of their butting joints; but it does not, as will readily appear by considering the present case. Let the joint or abutment of the two pieces BA, AD, be mitred in the usual manner, in the direction *f*A*f'*. Therefore, if A*c* be drawn perpendicular to A*f*, it will be the direction of the actual pressure exerted by the loaded beam BA on the beam AD. But the re-action of AD, in the opposite direction A*t*, will not balance the pressure of BA; because it is not in the direction precisely opposite. BA will therefore slide along the joint, and press on the beam HD. AE represents the load on the mitre joint A. Draw E*c* perpendicular to A*c*, and E*f* parallel to it. The pressure AE will be balanced by the re-actions *c*A and *f*A; or, the pressure AE produces the pressures A*c* and A*f*, of which A*f* must be resisted by the beam HD, and A*c* by the beam AD. The pressure A*f* not being perpendicular to HD, cannot be fully resisted by it; because (by our assumed principle) it re-acts only in a direction perpendicular to its surface. Therefore draw *fp*, *fi*, parallel to HD, and perpendicular to it. The pressure A*f* will be resisted by HD with the force *p*A; but there is required another force *i*A, to prevent the beam BA from slipping outwards. This must be furnished by the re-action of the beam DA. (See Note BB.) In like manner, the other force A*c* cannot be fully resisted by the beam AD, or rather by the prop D, acting by the intervention of the beam; for the action of that prop is exerted through the beam in the direction DA. The beam AD, therefore, is pressed to the beam HD by the force A*c*, as well as by A*f*. To find what this pressure on HD is, draw *cg* perpendicular to HD, and *co* parallel to it, cutting EG in *r*. The forces *g*A and *o*A will resist, and balance A*c*.

Thus we see that the two forces A*c* and A*f*, which are equivalent to AE, are equivalent also to A*p*, A*i*, A*o*, and A*g*. But because A*f* and *c*E are equal and parallel, and E*r* and *fi* are also parallel, as also *cr* and *fp*, it is evident, that *if* is equal to *r*E, or to *o*F, and *i*A is equal to *rc*, or to G*g*. Therefore the four forces A*g*, A*o*, A*p*, A*i*, are equal to AG and AF. Therefore AG is the compression of the beam AD, or the force pressing it on D, and AF is the force pressing it on the beam HD. The proportion of these pressures, therefore, is not affected by the form of the joint.

This remark is important; for many carpenters think the form and direction of the butting joint of great importance; and even the theorist, by not prosecuting the general principle through *all* its consequences, may be led into an error. The form of the joint is of no importance, in as far as it affects the strains in the direction of the beams; but it is often of great consequence, in respect to its own firmness, and the effect it may have in bruising the piece on which it acts, or being crippled by it.

Origin of the strain on a tie-beam.

The same compression of AB, and the same thrust on the point D by the intervention of AD, will obtain, in whatever way the original pressure on the end A is produced. Thus, supposing that a cord is made fast at A, and pulled in the direction AE, and with the same force, the beam AD will be equally compressed, and the prop D must re-act with the same force.

But it often happens that the obliquity of the pressure on AD, instead of compressing it, stretches it; and we desire to know what tension it sustains. Of this we have a familiar example in a common roof. Let the two rafters AC, AD (fig. 12), press on the tie-beam DC. We may

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suppose the whole weight to press vertically on the ridge A, as if a weight B were hung on there. (See Note CC.) We may represent this weight by the portion A*b* of the vertical or plumb line, intercepted between the ridge and the beam. Then drawing *bf* and *bg* parallel to AD and AC, A*g* and A*f* will represent the pressures on AC and AD. Produce AC till CH be equal to A*f*. The point C is forced out in this direction, and with a force represented by this line. As this force is not perpendicularly across the beam, it evidently stretches it; and this extending force must be withstood by an equal force pulling it in the opposite direction. This must arise from a similar oblique thrust of the opposite rafter on the other end D. We concern ourselves only with this extension at present; but we see that the cohesion of the beam does nothing but supply the balance to the extending forces. It must still be supported externally, that it *may resist*, and by resisting obliquely, be stretched. The points C and D are supported on the walls, which they press in the directions CK and DO, parallel to A*b*. If we draw HK parallel to DC, and HI parallel to CK (that is to A*b*), meeting DC produced in I, it follows from the composition of forces, that the point C would be supported by the two forces KC and IC. In like manner, making DN = A*g*, and completing the parallelogram DMNO, the point D would be supported by the forces OD and MD. If we draw *go* and *fk* parallel to DC, it is plain that they are equal to NO and CI, while A*o* and A*k* are equal to DO and CK, and A*b* is equal to the sum of DO and CK (because it is equal to A*o* + A*k*). The weight of the roof is equal to its vertical pressure on the walls.

Thus we see, that while a pressure on A, in the direction A*b*, produces the strains A*f* and A*g*, on the pieces AC and AD, it also excites a strain CI or DM in the piece DC. And this completes the mechanism of a frame; for all derive their efficacy from the triangles of which they are composed, as will appear more clearly as we proceed.

External action of a frame.

But there is more to be learned from this. The consideration of the strains on the two pieces AD and AC, by the action of a force at A, only showed them as the means of propagating the same strains in their own direction to the points of support. But, by adding the strains exerted in DC, we see that the frame becomes an intermedium, by which exertions may be made on other bodies in certain directions and proportions, so that this frame may become part of a more complicated one, and, as it were, an element of its constitution. It is worth while to ascertain the proportion of the pressures CK and DO, which are thus exerted on the walls. The similarity of triangles gives the following analogies:

$$\mathrm{DO} : \mathrm{DM} = \mathrm{A}b : b\mathrm{D}$$
$$\mathrm{CI, or\ DM} : \mathrm{CK} = \mathrm{C}b : \mathrm{A}b$$
$$\mathrm{Therefore\ DO} : \mathrm{CK} = \mathrm{C}b : b\mathrm{D}.$$

Or, *the pressures on the points* C *and* D, *in the direction of the straining force* A*b*, *are reciprocally proportional to the portions of* DC *intercepted by* A*b*.

Also, since A*b* is = DO + CK, we have

$$\mathrm{A}b : \mathrm{CK} = \mathrm{C}b + b\mathrm{D}\ (\mathrm{or\ CD}) : b\mathrm{D}, \text{ and}$$
$$\mathrm{A}b : \mathrm{DO} = \mathrm{CD} : b\mathrm{C}.$$

In general, any two of the three parallel forces A*b*, DO, CK, are to each other in the reciprocal proportion of the parts of CD, intercepted between their directions and the direction of the third.

And this explains a still more important office of the frame ADC. If one of the points, such as D, be supported, an external power acting at A, in the direction A*b*, and with an intensity which may be measured by A*b*, may be set in equilibrio with another acting at C, in the direction CL, opposite to CK or A*b*, and with an intensity represented by CK; for since the pressure CH is partly withstood by the force IC, or the firmness of the beam DC supported at D, the force KC will complete the balance. When we do not attend to the support at D, we conceive the force A*b* to be balanced by KC, or KC to be balanced by A*b*. And, in like manner, we may neglect the support or force acting at A, and consider the force DO as balanced by CK.

Thus our frame becomes a lever, and we are able to trace the interior mechanical procedure which gives it its efficacy: it is by the intervention of the forces of cohesion, which connect the points to which the external forces are applied with the supported point or fulcrum and with each other.

It becomes a lever.

These strains or pressures A*b*, DO, and CK, not being in the directions of the beams, may be called *transverse*. We see that by their means a frame of carpentry may be considered as a solid body: but the example which brought this to our view is too limited for explaining the efficacy which may be given to such constructions. We shall therefore give a general proposition, which will more distinctly explain the procedure of nature, and enable us to trace the strains as they are propagated through all the parts of the most complicated framing, finally producing the exertion of its most distant points.

General proposition.

We presume that the reader is now pretty well habituated to the conception of the strains as they are propagated along the lines joining the points of a frame, and we shall therefore employ a very simple figure.

Let the strong lines ACBD (fig. 13) represent a frame of carpentry. Suppose that it is pulled at the point A by a force acting in the direction AE, but that it rests on a fixed point C, and that the other extreme point B is held back by a power which resists in the direction BF: It is required to determine the proportion of the strains excited in its different parts, the proportion of the external pressures at A and B, and the pressure which is produced on the obstacle or fulcrum C.

It is evident that each of the external forces at A and B tend one way, or to one side of the frame, and that each would cause it to turn round C if the other did not prevent it; and that if, notwithstanding their action, it is turned neither way, the forces in actual exertion are in equilibrio by the intervention of the frame. It is no less evident that these forces concur in pressing the frame on the prop C. Therefore, if the piece CD were away, and if the joints C and D be perfectly flexible, the pieces CA, CB, would be turned round the prop C, and the pieces AD, DB, would also turn with them, and the whole frame change its form. This shows, by the way, and we desire it to be carefully kept in mind, that the firmness or stiffness of framing depends entirely on the triangles bounded by beams which are contained in it. An open quadrilateral may always change its shape, the sides revolving round the angles. A quadrilateral may have an infinity of forms, without any change of its sides, by merely pushing two opposite angles towards each other, or drawing them asunder. But when the three sides of a triangle are determined, its shape is also invariably determined; and if two angles be held fast, the third cannot be moved It is thus that, by inserting the bar CD, the figure becomes unchangeable; and any attempt to change it by applying a force to an angle A, immediately excites forces of attraction or repulsion between the particles of the stuff which form its sides. Thus it happens, in the present instance, that a change of shape is prevented by the bar CD. The power at A presses its end against the prop; and in doing this it puts the bar AD on the stretch, and also the bar DB. Their places might therefore be supplied by cords or metal wires. Hence it is evident that

DC is compressed, as is also AC; and, for the same reason, CB is also in a state of compression; for either A or B may be considered as the point that is impelled or withheld. Therefore DA and DB are stretched, and are resisting with attractive forces. DC and CB are compressed, and are resisting with repulsive forces; and thus the support of the prop, combined with the firmness of DC, puts the frame ADBC into the condition of the two frames in fig. 8 and fig. 9. Therefore the external force at A is really in equilibrio with an attracting force acting in the direction AD, and a repulsive force acting in the direction AK. And since all the connecting forces are mutual and equal, the point D is pulled or drawn in the direction DA. The condition of the point B is similar to that of A, and D is also drawn in the direction DB. Thus the point D, being urged by the forces in the directions DA and DB, presses the beam DC on the prop, and the prop resists in the opposite direction. Therefore the line DC is the diagonal of the parallelogram, whose sides have the proportion of the forces which connect D with A and B. This is the principle on which the rest of our investigation proceeds. We may take DC as the representation and measure of their joint effect. Therefore draw CH, CG, parallel to DA, DB. Draw HL, GO, parallel to CA, CB, cutting AE, BF, in L and O, and cutting DA, DB, in I and M. Complete the parallelograms ILKA, MONB. Then DG and AI are the equal and opposite forces which connect A and D; for GD = CH = AI. In like manner DH and BM are the forces which connect D and B.

The external force at A is in immediate equilibrio with the combined forces, connecting A with D and with C. AI is one of them, therefore AK is the other; and AL is the compound force with which the external force at A is in immediate equilibrium. This external force is therefore equal and opposite to AL. In like manner, the external force at B is equal and opposite to BO; and AL is to BO as the external force at A to the external force at B. The prop C resists with forces equal to those which are propagated to it from the points D, A, and C. Therefore it resists with forces CH, CG, equal and opposite to DG, DH; and it resists the compressions KA, NB, with equal and opposite forces C*k*, C*n*. Draw *kl*, *no*, parallel to AD, BD, and draw C*l*Q, C*o*P: It is plain that *k*CH*l* is a parallelogram equal to KAIL, and that C*l* is equal to AL. In like manner C*o* is equal to BO. Now the forces C*k*, CH, exerted by the prop, compose the force C*l*; and C*n*, CG, compose the force C*o*. These two forces C*l*, C*o*, are equal and parallel to AL and BO; and therefore they are equal and opposite to the external forces acting at A and B. But they are, primitively, equal and opposite to the pressures, or at least the compounds of the pressures, exerted on the prop, by the forces propagated to C from A, D, and B. Therefore the pressures exerted on the prop are the same as if the external forces were applied there in the same directions as they are applied to A and B. Now if we make C*v*, C*z*, equal to C*l* and C*o*, and complete the parallelogram C*vyz*, it is plain that the force *y*C is in equilibrio with *l*C and *o*C. Therefore the pressures at A, C, and B are such as would balance if applied to one point.

Lastly, in order to determine their proportions, draw CS and CR perpendicular to DA and DB. Also draw A*d*, B*f*, perpendicular to CQ and CP; and draw C*g*, C*i*, perpendicular to AE, BF.

The triangles CPR and BP*f* are similar, having a common angle P, and a right angle at R and *f*.

In like manner, the triangles CQS and AQ*d* are similar. Also the triangles CHR, CGS, are similar, by reason of the equal angles at H and G, and the right angles at R and S. Hence we obtain the following analogies:

$$\begin{aligned} Co : CP &= on : PB, = CG : PB \\ CP : CR &= \qquad PB : fB \\ CR : CS &= \qquad CH : CG \\ CS : CQ &= \qquad Ad : AQ \\ CQ : Cl &= AQ : hl, = AQ : CH. \end{aligned}$$

Therefore, by equality,

$$\begin{aligned} Co : Cl &= \qquad Ad : fB \\ \text{or } BO : AL &= \qquad Cg : Ci. \end{aligned}$$

That is, the external forces are reciprocally proportional to the perpendiculars drawn from the prop on the lines of their direction.[1]

Extensive consequences.

This proposition, sufficiently general for our purpose, is fertile in consequences, and furnishes many useful instructions to the artist. The strains LA, OB, CY, that are excited, occur in many, we may say in all, framings of carpentry, whether for edifices or engines, and are the sources of their efficacy. It is also evident that the doctrine of the transverse strength of timber is contained in this proposition; for every piece of timber may be considered as an assemblage of parts, connected by forces which act in the direction of the lines which joined the strained points on the matter which lies between those points, and also act on the rest of the matter, exciting those lateral forces which produce the inflexibility of the whole. See Strength of Materials.

Thus it appears that this proposition contains the principles which direct the artist to frame the most powerful levers; to secure uprights by shores or braces, or by tiers and ropes; to secure scaffoldings for the erection of spires; and many other more delicate problems of his art. He also learns from this proposition how to ascertain the strains that are produced, without his intention, by pieces which he intended for other offices, and which, by their transverse action, puts his work in hazard. In short, this proposition is the key to the science of this art.

We would now counsel the artist, after he has made the tracing of the strains and thrusts through the various parts of a frame familiar to his mind, and even amused himself with some complicated fancy framings, to read over with care the articles Strength of Materials and Roof. He will now conceive its doctrine much more clearly than when he was considering them as abstract theories. The mutual action of the woody fibres will now

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[1] "The learned reader will perceive that this analogy is precisely the same with that of forces which are in equilibrio by the intervention of a lever. In fact, this whole frame of carpentry is nothing else than a *built* or *framed lever* in equilibrio. It is acting in the same manner as a solid, which occupies the whole figure compressed in the frame, or as a body of any size and shape whatever that will admit the three points of application A, C, and B. It is always in equilibrio in the case first stated; because the pressure *produced* at B by a force applied to A is always such as balances it. The reader may also perceive, in this proposition, the analysis or tracing of those internal mechanical forces which are indispensably requisite for the functions of a lever. The mechanicians have been extremely puzzled to find a legitimate demonstration of the equilibrium of a lever ever since the days of Archimedes. Mr Vince has the honour of first demonstrating, most ingeniously, the principle assumed by Archimedes, but without sufficient ground for *his* demonstration; but Mr Vince's demonstration is only a putting the mind into that perplexed state which makes it acknowledge the proposition, but without a clear perception of its truth. The difficulty has proceeded from the abstract notion of a lever, conceiving it as a mathematical line—inflexible, without reflecting how it is inflexible; for the very source of this indispensable quality furnishes the mechanical connection between the remote pressures and the fulcrum; and this supplies the demonstration (without the least difficulty) of the desperate case of a straight lever urged by parallel forces." See the article Rotation.

Carpentry. be easily comprehended, and his confidence in the results will be greatly increased.

Decision of a disputed and very important question. There is a proposition (see article Roof) which has been called in question by several very intelligent persons; and they say that Belidor has demonstrated, in his *Science des Ingenieurs*, that a beam firmly fixed at both ends is not twice as strong as when simply lying on the props; and that its strength is increased only in the proportion of two to three; and they support this determination by a list of experiments recited by Belidor, which agree *precisely* with it. Belidor also says that Pitot had the same result in his experiments. These are respectable authorities, but Belidor's reasoning is any thing but demonstration, and his experiments are described in such an imperfect manner that we cannot build much on them. It is not said in what manner the battens were secured at the ends, any further than that it was by *chevalets*. If by this word is meant a trestle, we cannot conceive how they were employed; but we see it sometimes used for a wedge or key. If the battens were wedged in the holes, their resistance to fracture may be made what we please; they may be made loose, and therefore resist little more than when simply laid on props. They may be (and probably were) wedged very fast, and bruised or crippled.

Our proposition mentioned distinctly the security given to the ends of the beams. They were mortised into remote posts. Our *precise* meaning was, that they were simply kept from rising by these mortises, but at full liberty to bend up at E and I, and between G and K. Our assertion was not made from theory alone (although we think the reasoning incontrovertible), but was agreeable to numerous experiments made in those precise circumstances. Had we mortised the beams firmly into two very stout posts which could not be drawn nearer to each other by bending, the beam would have borne a *much* greater weight, as we have verified by experiments. We hope that the following mode of conceiving this case will remove all doubts.

Let LM be a long beam (fig. 14) divided into six equal parts, in the points D, B, A, C, E. Let it be firmly supported at L, B, C, M. Let it be cut through at A, and have compass joints at B and C. Let FB, GC, be two equal uprights, resting on B and C, but without any connection. Let AH be a similar and equal piece, to be occasionally applied at the seam A. Now let a thread or wire AGE be extended over the piece GC, and made fast at A, G, and E. Let the same thing be done on the other side of A. If a weight be now laid on at A, the wires AFD, AGE, will be strained, and may be broken. In the instant of fracture we may suppose their strains to be represented by Af and Ag. Complete the parallelogram, and Aa is the magnitude of the weight. It is plain that nothing is concerned here but the cohesion of the wires; for the beam is sawed through at A, and its parts are perfectly movable round B and C.

Instead of this process, apply the piece AH below A, and keep it there by straining the same wire BHC over it. Now lay on a weight. It must press down the ends of BA and CA, and cause the piece AH to strain the wire BHC. In the instant of fracture of *the same* wire, its resistances Hb and Hc must be equal to Af and Ag, and the weight hH which breaks them must be equal to Aa.

Lastly, employ all the three pieces FB, AH, GC, with the same wire attached as before. There can be no doubt but that the weight which breaks all the four wires must be $= a\text{A} + h\text{H}$, or twice Aa.

The reader cannot but see that the wires perform the very same office with the fibres of an entire beam LM held fast in the four holes D, B, C, and E, of some upright posts.

In the experiments for verifying this, by breaking slender bars of fine deal, we get complete demonstration, by measuring the curvatures produced in the parts of the beam thus held down, and comparing them with the curvature of a beam simply laid on the props B and C; and there are many curious inferences to be made from these observations, but we have not room for them in this place.

The best manner of framing purlins. We may observe by the way, that we learn from this case that purlins are able to carry twice the load when notched into the rafters that they carry when mortised into them, which is the most usual manner of framing them. So would the bending joists of floors; but this would double the thickness of the flooring. But this method should be followed in every possible case, such as brest summers, lintels over several pillars, &c. These should never be cut off and mortised into the sides of every upright; numberless cases will occur which show the importance of the maxim.

We must here remark, that the proportion of the spaces BC and CM, or BC and LB, has a very sensible effect on the strength of the beam BC; but we have not yet satisfied our minds as to the *rationale* of this effect. It is undoubtedly connected with the serpentine form of the curve of the beam before fracture. This should be attended to in the construction of the springs of carriages. These are frequently supported at the middle point (and it is an excellent practice); and there is a certain proportion which will give the easiest motion to the body of the carriage. We also think that it is connected with that deviation from the best theory observable in Buffon's experiments on various lengths of the same scantling. The force of the beams diminished much more than in the inverse proportion of their lengths.

In what case ties are better than struts. We have seen that it depends entirely on the position of the pieces in respect of their points of ultimate support, and of the direction of the external force which produces the strains, whether any particular piece is in a state of extension or of compression. The knowledge of this circumstance may greatly influence us in the choice of the construction. In many cases we may substitute slender iron rods for massive beams, when the piece is to act the part of a tie. But we must not invert this disposition; for when a piece of timber acts as a strut, and is in a state of compression, it is next to certain that it is not equally compressible in its opposite sides through the whole length of the piece, and that the compressing force on the abutting joint is not acting in the most equable manner all over the joint. A very trifling inequality in either of these circumstances (especially in the first) will compress the beam more on one side than on the other. This cannot be without the beam's bending, and becoming concave on that side on which it is most compressed. When this happens, the frame is in danger of being crushed, and soon going to ruin. It is, therefore, indispensably necessary to make use of beams in all cases where struts are required of considerable length, rather than of metal rods of slender dimensions, unless in situations where we can effectually prevent their bending, as in trussing a girder internally, where a cast-iron strut may be firmly cased in it, so as not to bend in the smallest degree. In cases where the pressures are enormous, as in the very oblique struts of a centre or arch frame, we must be particularly cautious to do nothing which can facilitate the compression of either side. No mortises should be cut near to one side; no lateral pressures, even the slightest, should be allowed to touch it. We have seen a pillar of fir twelve inches long, and one inch in section, when loaded with three tons, snap in an instant when pressed on one side by sixteen pounds, while another bore four and a half tons without hurt, because it was inclosed (loosely) in a stout pipe of iron. (See Note DD.)

In such cases of enormous compression it is of great importance that the compressing force bear equally on the whole abutting surface. The German carpenters are accustomed to put a plate of lead over the joint. This prevents, in some measure, the penetration of the end fibres. M. Perronet, the celebrated French architect, formed his abutments into arches of circles, the centre of which was the remote end of the strut. By this contrivance the unavoidable change of form of the triangle made no partial bearing of either angle of the abutment. This always has a tendency to splinter off the heel of the beam where it presses strongest. It is a very judicious practice. (See Note EE.)

When circumstances allow it, we must rather employ ties than struts for securing a beam against lateral strains. When an upright pillar, such as a flag-staff, a mast, or the uprights of a very tall scaffolding, are to be shoared up, the dependence is more certain on those braces that are stretched by the strain than on those which are compressed. The scaffolding of the iron bridge near Sunderland had some ties very judiciously disposed, and others with less judgment.

We should proceed to consider the transverse strains as they affect the various parts of a frame of carpentry; but we have very little to say here in addition to what will be found in the articles Strength of Materials and Roof. What we shall add in this article will find a place in our occasional remarks on different works. It may, however, be of use to recal to the reader's memory the following propositions.

General theorems concerning the relative strength of beams.

1. When a beam AB (fig. 15) is firmly fixed at the end A, and a straining force acts perpendicularly to its length at any point B, the strain occasioned at any section C between B and A is proportional to CB, and may therefore be represented by the product $w \times$ CB; that is, by the product of the number of tons, pounds, &c. which measure the straining force, and the number of feet, inches, &c. contained in CB. As the loads on a beam are easily conceived, we shall substitute this for any other straining force.

2. If the strain or load is uniformly distributed along any part of the beam lying beyond C (that is, farther from A), the strain at C is the same as if the load were all collected at the middle point of that part; for that point is the centre of gravity of the load.

3. The strain on any section D of a beam AB (fig. 16) resting freely on two props A and B, is $w \times \frac{\text{AD} \times \text{DB}}{\text{AB}}$. (See Roof, No. 19, and Strength of Materials, No. 92, &c.) Therefore,

4. The strain on the middle point, by a force applied there, is one fourth of the strain which the same force would produce if applied to one end of a beam of the same length having the other end fixed.

5. The strain on any section C of a beam, resting on two props A and B, occasioned by a force applied perpendicularly to another point D, is proportional to the rectangle of the exterior segments, or is equal to $w \times \frac{\text{AC} \times \text{DB}}{\text{AB}}$. Therefore,

The strain at C occasioned by the pressure on D is the same with the strain at D occasioned by the same pressure on C.

6. The strain on any section D, occasioned by a load uniformly diffused over any part EF, is the same as if the two parts ED, DF, of the load were collected at their middle points e and f. Therefore,

The strain on any part D, occasioned by a load uniformly distributed over the whole beam, is one half of the strain that is produced when the same load is laid on at D; and

The strain on the middle point C, occasioned by a load uniformly distributed over the whole beam, is the same which half that load would produce if laid on at C.

7. A beam supported at both ends on two props B and C (fig. 14), will carry twice as much when the ends beyond the props are kept from rising, as it will carry when it rests loosely on the props.

8. Lastly, the transverse strain on any section, occasioned by a force applied obliquely, is diminished in the proportion of the sine of the angle which the direction of the force makes with the beam. Thus, if it be inclined to it in an angle of thirty degrees, the strain is one half of the strain occasioned by the same force acting perpendicularly.

On the other hand, the relative strength of a beam, or its power in any particular section to resist any transverse strain, is proportional to the absolute cohesion to the section directly, to the distance of its centre of effort from the axis of fracture directly, and to the distance from the strained point inversely.

Thus, in a rectangular section of the beam, of which b is the breadth, d the depth (that is, the dimension in the direction of the straining force), measured in inches, and f the number of pounds which one square inch will just support without being torn asunder, we must have $f \times b \times d^2$, proportional to $w \times$ CB (fig. 15). Or, $f \times b \times d^2$, multiplied by some number m, depending on the nature of the timber, must be equal to $w \times$ CB. Or, in the case of the section C of fig. 16, that is strained by the force w applied at D, we must have $m \times fbd^2 = w \times \frac{\text{AC} \times \text{DB}}{\text{AB}}$. Thus, if the beam is of sound oak, m is very nearly $= \frac{1}{9}$ (see Strength of Materials, No. 116.) Therefore we have $\frac{fbd^2}{9} = w \times \frac{\text{AC} \times \text{CB}}{\text{AB}}$. (See Note FF.)

Hence we can tell the precise force w which any section C can just resist when that force is applied in any way whatever; for the above-mentioned formula gives $w = \frac{fbd^2}{9\text{CB}}$ for the case represented by fig. 15. But the case represented in fig. 16, having the straining force applied at D, gives the strain at C $(= w) = f \times \frac{bd^2 \times \text{AB}}{9\text{AC} \times \text{CB}}$.

Example. Let an oak beam, four inches square, rest freely on the props A and B, seven feet apart, or eighty-four inches. What weight will it just support at its middle point C, on the supposition that a square inch rod will just carry 16,000 pounds, pulling it asunder?

The formula becomes $w = \frac{16000 \times 4 \times 16 \times 84}{9 \times 42 \times 42}$, or $w = \frac{86016000}{15876}$, $= 5418$ pounds. This is very near what was employed in Buffon's experiment, which was 5312.

Had the straining force acted on a point D, half way between C and B, the force sufficient to break the beam at C would be $= \frac{16000 \times 4 \times 16 \times 84}{9 \times 42 \times 21} = 10836$ lbs.

Had the beam been sound red fir, we must have taken $f = 10{,}000$ nearly, and m nearly 8; for although fir be less cohesive than oak in the proportion of five to eight nearly, it is less compressible, and its axis of fracture is therefore nearer to the concave side.

Of joints.

Having considered at sufficient length the strains of different kinds which arise from the form of the parts of a frame of carpentry, and the direction of the external forces which act on it, whether considered as impelling or as supporting its different parts, we must now proceed to con-

sider the means by which this form is to be secured, and the connections by which those strains are excited and communicated.

The joinings practised in carpentry are almost infinitely various, and each has advantages which make it preferable in some circumstances. Many varieties are employed merely to please the eye. We do not concern ourselves with these: nor shall we consider those which are only employed in connecting small works, and can never appear on a great scale; yet even in some of these, the skill of the carpenter may be discovered by his choice; for in all cases, it is wise to make every, even the smallest, part of his work as strong as the materials will admit. He will be particularly attentive to the changes which will necessarily happen by the shrinking of timber as it dries, and will consider what dimensions of his framings will be affected by this, and what will not; and will then dispose the pieces which are less essential to the strength of the whole, in such a manner that their tendency to shrink shall be in the same direction with the shrinking of the whole framing. If he do otherwise, the seams will widen, and parts will be split asunder. He will dispose his boardings in such a manner as to contribute to the stiffness of the whole, avoiding at the same time the giving them positions which will produce lateral strains on truss beams which bear great pressures; recollecting, that although a single board has little force, yet many united have a great deal, and may frequently perform the office of very powerful struts.

Our limits confine us to the joinings which are most essential for connecting the parts of a single piece of a frame when it cannot be formed of one beam, either for want of the necessary thickness or length; and the joints for connecting the different sides of a trussed frame.

Of building up beams.

Much ingenuity and contrivance has been bestowed on the manner of building up a great beam of many thicknesses, and many singular methods are practised as great nostrums by different artists; but when we consider the manner in which the cohesion of the fibres performs its office, we will clearly see that the simplest are equally effected with the most refined, and that they are less apt to lead us into false notions of the strength of the assemblage.

Building up a girder or lever.

Joggling preferable to scarfing.

Thus, were it required to build up a beam for a great lever or a girder, so that it may act nearly as a beam of the same size of one log, it may either be done by plain joggling, as in Plate CLXI. fig. 17, A, or by scarfing, as in fig. 17, B or C. If it is to act as a lever, having the gudgeon on the lower side at C, we believe that most artists will prefer the form B and C; at least this has been the case with nine tenths of those to whom we have proposed the question. The best informed only hesitated; but the ordinary artists were all confident in its superiority, and we found their views of the matter very coincident. They considered the upper piece as grasping the lower in its hooks; and several imagined, that by driving the one very tight on the other, the beam would be stronger than an entire log; but if we attend carefully to the internal procedure in the loaded lever, we shall find the upper one clearly the strongest. If they are formed of equal logs, the upper one is thicker than the other by the depth of the joggling or scarfing, which we suppose to be the same in both; consequently, if the cohesion of the fibres in the intervals is able to bring the uppermost filaments into full action, the form A is stronger than B, in the proportion of the greater distance of the upper filaments from the axis of the fracture. This may be greater than the difference of the thickness if the wood is very compressible. If the gudgeon be in the middle, the effect, both of the joggles and the scarfings, is considerably diminished; and if it is on the upper side the scarfings act in a very different way. In this situation, if the loads on the arms are also applied to the upper side, the joggled beam is still more superior to the scarfed one. This will be best understood by resolving it in imagination into a trussed frame. But when a gudgeon is thus put on that side of the lever which grows convex by the strain, it is usual to connect it with the rest by a powerful strap, which embraces the beam, and causes the opposite point to become the resisting point. This greatly changes the internal actions of the filaments, and in some measure brings it into the same state as the first, with the gudgeon below. Were it possible to have the gudgeon on the upper side, and to bring the whole into action without a strap, it would be the strongest of all; because in general the resistance to compression is greater than to extension. In every situation the joggled beam has the advantage, and it is the easiest executed. (See Note GG.)

We may frequently gain a considerable accession of strength by this building up of a beam, especially if the part which is stretched by the strain be of oak, and the other part be fir. Fir being so much superior to oak as a pillar (if Muschenbroeck's experiments may be confided in), and oak so much preferable as a tie, this construction seems to unite both advantages. But we shall see much better methods of making powerful levers, girders, &c. by trussing.

Observe that the efficacy of both methods depends entirely on the difficulty of causing the piece between the cross joints to slide along the timber to which it adheres. Therefore, if this be moderate, it is wrong to make the notches deep; for as soon as they are so deep that their ends have a force sufficient to push the slice along the line of junction, nothing is gained by making them deeper; and this requires a greater expenditure of timber.

Scarfings are frequently made oblique, as in fig. 18; but we imagine that this is a bad practice. It begins to yield at a point where the wood is crippled and splintered off, or at least bruised out a little. As the pressure increases, this part, by squeezing broader, causes the solid parts to rise a little upwards, and gives them some tendency, not only to push their antagonists along the base, but even to tear them up a little. For similar reasons, we disapprove of the favourite practice of many artists to make the angles of their scarfings acute, as in fig. 19. This often causes the two pieces to tear each other up The abutments should always be perpendicular to the directions of the pressures. Lest it should be forgotten in its proper place, we may extend this injunction also to the abutments of different pieces of a frame, and recommend it to the artist even to attend to the shrinking of the timbers by drying. When two timbers abut obliquely, the joint should be most full at the obtuse angle of the end; because, by drying, that angle grows more obtuse, and the beam would then be in danger of splintering off at the acute angle.

We must not wedge too hard.

It is evident that the nicest work is indispensably necessary in building up a beam. The parts must abut on each other completely, and the smallest play or void takes away the whole efficacy. It is usual to give the butting joints a small taper to one side of the beam, so that they may require moderate blows of a maul to force them in; and the joints may be perfectly close when the external surfaces are even on each side of the beam. But we must not exceed in the least degree, for a very taper wedge has great force; and if we have driven the pieces together by very heavy blows, we leave the whole in a state of violent strain, and the abutments are perhaps ready to splinter off by a small addition of pressure. This is like too severe a proof for artillery; which, though not sufficient to burst the pieces, has weakened them to such a

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degree, that the strain of ordinary service is sufficient to complete the fracture. The *workman* is tempted to exceed in this, because it smooths off and conceals all uneven seams; but he must be watched. It is not unusual to leave some abutments open enough to admit a thin wedge reaching through the beam. Nor is this a bad practice, if the wedge is of material which is not compressed by the driving or the strain of service. Iron would be preferable for this purpose, and for the joggles, were it not that, by its too great hardness, it cripples the fibres of timber to some distance. In consequence of this it often happens, that in beams which are subjected to desultory and sudden strains (as in the levers of reciprocating engines), the joggles or wedges widen the holes, and work themselves loose; therefore skilful engineers never admit them, and indeed as few bolts as possible, for the same reason; but when resisting a steady or dead pull, they are not so improper, and are frequently used.

Beams are built up, not only to increase their dimensions in the direction of the strain (which we have hitherto called their depth), but also to increase their breadth, or the dimensions perpendicular to the strain. We sometimes double the breadth of a girder which is thought too weak for its load, and where we must not increase the thickness of the flooring.

Building of masts.

The mast of a great ship of war must be made bigger athwartship, as well as fore and aft. This is one of the nicest problems of the art; and professional men are by no means agreed in their opinions about it. We do not presume to decide, and shall content ourselves with exhibiting the different methods.

The most obvious and natural method is that shown in fig. 20. It is plain that (independent of the connection of cross bolts, which are used in them all when the beams are square) the piece C cannot bend in the direction of the plane of the figure without bending the piece D along with it. This method is much used in the French navy; but it is undoubtedly imperfect. Hardly any two great trees are of equal quality, and swell or shrink alike. If C shrinks more than D, the feather of C becomes loose in the groove wrought in D to receive it; and when the beam bends, the parts can slide on each other like the plates of a coach-spring; and if the bending is in the direction *cf*, there is nothing to hinder this sliding but the bolts, which soon work themselves loose in the bolt-holes.

Method used in the French navy.

Another method.

Fig. 21 exhibits another method. The two halves of the beam are tabled into each other in the same manner as in fig. 17. It is plain that this will not be affected by the unequal swelling or shrinking, because this is insensible in the direction of the fibres; but when bent in the direction *ab*, the beam is weaker than fig. 20 bent in the direction *cf*. Each half of fig. 20 has, in every part of its length, a thickness greater than half the thickness of the beam. It is the contrary in the alternate portions of the halves of fig. 21. When one of them is bent in the direction AB, it is plain that it drags the other with it by means of the cross butments of its tables, and there can be no longitudinal sliding. But unless the work is accurately executed, and each hollow completely filled up by the table of the other piece, there will be a lateral slide along the cross joints sufficient to compensate for the curvature; and this will hinder the one from compressing or stretching the other in conformity to this curvature.

Its imperfection.

The imperfection of this method is so obvious that it has seldom been practised; but it has been combined with the other, as is represented in fig. 22, where the beams are divided along the middle, and the tables in each half are alternate, and alternate also with the tables of the other half. Thus 1, 3, 4, are prominent, and 5, 2, 6, are depressed. This construction evidently puts a stop to both slides, and obliges every part of both pieces to move together. *ab* and *cd* show sections of the built-up beam corresponding to AB and CD.

No more is intended in this practice by any intelligent artist, than the causing the two pieces to act together in all their parts, although the strains may be unequally distributed on them. Thus, in a built-up girder, the binding joists are frequently mortised into very different parts of the two sides. But many seem to aim at making the beam stronger than if it were of one piece; and this inconsiderate project has given rise to many whimsical modes of tabling and scarfing, which we need not regard.

British method.

The practice in the British dock-yards is somewhat different from any of these methods. The pieces are tabled as in fig. 22, but the tables are not thin parallelopipeds, but thin prisms. The two outward joints or visible seams are straight lines, and the table No. 1 rises gradually to its greatest thickness in the axis. In like manner, the hollow, 5, for receiving the opposite table, sinks gradually from the edge to its greatest depth in the axis. Fig. 23, No. 1, represents a section of a round piece of timber built up in this way, where the full line EFGH is the section corresponding to AB of fig. 22, and the dotted line EGFH is the section corresponding to CD.

This construction, by making the external seam straight, leaves no lodgment for water, and looks much fairer to the eye; but it appears to us that it does not give so firm a hold when the mast is bent in the direction EH. The exterior parts are most stretched and most compressed by this bending; but there is hardly any abutment in the exterior parts of these tables. In the very axis, where the abutment is the firmest, there is little or no difference of extension and compression.

But this construction has an advantage, which, we imagine, much more than compensates for these imperfections, at least in the particular case of a round mast; it will draw together by hooping incomparably better than any of the others. If the cavity be made somewhat too shallow for the prominence of the tables, and if this be done uniformly along the whole length, it will make a somewhat open seam; and this opening can be regulated with the utmost exactness from end to end by the plane. The heart of those vast trunks is very sensibly softer than the exterior circles; therefore, when the whole is hooped, and the hoops hard driven, and at considerable intervals between each spell, we are confident that all may be compressed till the seam disappears; and then the whole makes one piece, *much* stronger than if it were an original log of that size, because the middle has become, by compression, as solid as the crust, which was naturally firmer, and resisted farther compression. We verified this beyond a doubt by hooping a built stick of a timber which has this inequality of firmness in a remarkable degree, and it was nearly twice as strong as another of the same size.

Our mast-makers are not without their fancies and whims; and the manner in which our masts and yards are generally built up is not near so simple as fig. 23; but it consists of the same essential parts, acting in the very same manner, and derives all its efficacy from the principles which are here employed.

Attended with peculiar advantages.

This construction is particularly suited to the situation and office of a ship's mast. It has no bolts; or, at least, none of any magnitude, or that make very important parts of its construction. The most violent strains perhaps that it is exposed to, is that of twisting, when the lower yards are close braced up by the force of many men acting by a long lever. This form resists a twist with peculiar energy; it is therefore an excellent method for building up a great shaft for a mill. The way in which they are usually built up is by reducing a central log to a poly-

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The most general reason for piecing a beam is to increase its length. This is frequently necessary, in order to procure tie-beams for very wide roofs. Two pieces must be scarfed together. Numberless are the modes of doing this, and almost every master carpenter has his favourite nostrum. Some of them are very ingenious; but here, as in other cases, the most simple are commonly the strongest. We do not imagine that any, the most ingenious, is equally strong with a tie consisting of two pieces of the same scantling laid over each other for a certain length, and firmly bolted together. We acknowledge that this will appear an artless and clumsy tie-beam, but we only say that it will be stronger than any that is more artificially made up of the same thickness of timber. This, we imagine, will appear sufficiently certain.

Various methods of scarfing.

The simplest and most obvious scarfing, after the one now mentioned, is that represented in fig. 24, No. 1 and 2. If considered merely as two pieces of wood joined, it is plain that, as a tie, it has but half the strength of an entire piece, supposing that the bolts (which are the only connections) are fast in their holes. No. 2 requires a bolt in the middle of the scarf to give it that strength, and in every other part is weaker on one side or the other. (See Note HH.)

But the bolts are very apt to bend by the violent strain, and require to be strengthened by uniting their ends by iron plates; in which case it is no longer a wooden tie. The form of No. 1 is better adapted to the office of a pillar than No. 2, especially if its ends be formed in the manner shown in the elevation No. 3. By the sally given to the ends, the scarf resists an effort to bend it in that direction. Besides, the form of No. 2 is unsuitable for a post; because the pieces, by sliding on each other by the pressure, are apt to splinter off the tongue which confines their extremity.

Fig. 25 and 26 exhibit the most approved form of a scarf, whether for a tie or for a post. The key represented in the middle is not essentially necessary; the two pieces might simply meet square there. This form, without a key, needs no bolts (although they strengthen it greatly); but, if worked very true and close, and with square abutments, will hold together, and will resist bending in any direction. But the key is an ingenious and a very great improvement, and will force the parts together with perfect tightness. The same precaution must be observed that we mentioned on another occasion, not to produce a constant internal strain on the parts by overdriving the key. The form of fig. 25 is by far the best; because the triangle of 26 is much easier splintered off by the strain, or by the key, than the square wood of 25. It is far preferable for a post, for the reason given when speaking of fig. 24, No. 1 and No. 2. Both may be formed with a sally at the ends equal to the breadth of the key. In this shape fig. 25 is vastly well suited for joining the parts of the long corner posts of spires and other wooden towers. Fig. 25, No. 2, differs from No. 1 only by having three keys. The principal and the longitudinal strength are the same. The long scarf of No. 2, tightened by the three keys, enables it to resist a bending much better.

None of these scarfed tie-beams can have more than one third of the strength of an entire piece, unless with the assistance of iron plates; for if the key be made thinner than one third, it has less than one third of the fibres to pull by. Carpentry.

We are confident, therefore, that when the heads of the bolts are connected by plates, the simple form of fig. 24, No. 1, is stronger than those more ingenious scarfings. It may be strengthened against lateral bending by a little tongue, or by a sally, but cannot have both.

The strongest of all methods of piecing a tie-beam would be to set the parts end to end, and grasp them between other pieces on each side, as in fig. 27, Plate CLXII. This is what the ship-carpenter calls *fishing* a beam, and is a frequent practice for occasional repairs. M. Perronet used it for the tie-beams or stretchers, by which he connected the opposite feet of a centre, which was yielding to its load, and had pushed aside one of the piers above four inches. Six of these not only withstood a strain of 1800 tons, but, by wedging behind them, he brought the feet of the truss 2½ inches nearer. The stretchers were 14 inches by 11 of sound oak, and could have withstood three times that strain. M. Perronet, fearing that the great length of the bolts employed to connect the beams of these stretchers would expose them to the risk of bending, scarfed the two side pieces into the middle piece. The scarfing was of the triangular kind (*Trait de Jupiter*), and only an inch deep, each face being two feet long, and the bolt passed through close to the angle.

Fishing a beam.

In piecing the pump-rods and other wooden stretchers of great engines, no dependence is had on scarfing; and the engineer connects every thing by iron straps. We doubt the propriety of this, at least in cases where the bulk of the wooden connection is not inconvenient. These observations must suffice for the methods employed for connecting the parts of a beam; and we now proceed to consider what are more usually called the joints of a piece of carpentry.

Square joints.

Where the beams stand square with each other, and the strains are also square with the beams, and in the plane of the frame, the common mortise and tenon is the most perfect junction. A pin is generally put through both, in order to keep the pieces united, in opposition to any force which tends to part them. Every carpenter knows how to bore the hole for this pin, so that it shall draw the tenon tight into the mortise, and cause the shoulder to butt close, and make neat work; and he knows the risk of tearing out the bit of the tenon beyond the pin, if he draw it too much. We may just observe, that square holes and pins are much preferable to round ones for this purpose, bringing more of the wood into action, with less tendency to split it. The ship-carpenters have an ingenious method of making long wooden bolts, which do not pass completely through, take a very fast hold, though not nicely fitted to their holes, which they must not be, lest they should be crippled in driving. They call it *fox-tail wedging*. They stick into the point of the bolt a very thin wedge of hard wood, so as to project a proper distance; when this reaches the bottom of the hole by driving the bolt, it splits the end of it, and squeezes it hard to the side. This may be practised with advantage in carpentry. If the ends of the mortise are widened inwards, and a thin wedge be put into the end of the tenon, it will have the same effect, and make the joint equal to a dove-tail. But this risks the splitting the piece beyond the shoulder of the tenon, which would be unsightly. This may be avoided as follows: Let the tenon T, fig. 28, have two *very* thin wedges *a* and *c* struck in near its angles, projecting equally; at a very small distance within these, put in two shorter ones *b*, *d*, and more within these if necessary. In driving this tenon,

Fox-tail wedging.

the wedges *a* and *c* will take first, and split off a thin slice, which will easily bend without breaking. The wedges *b*, *d*, will act next, and have a similar effect, and the others in succession. The thickness of all the wedges taken together must be equal to the enlargement of the mortise towards the bottom.

When the strain is transverse to the plane of the two beams, the principles laid down in No. 85, 86, of the article STRENGTH OF MATERIALS, will direct the artist in placing his mortise. Thus the mortise in a girder for receiving the tenon of a binding joist of a floor should be as near the upper side as possible, because the girder becomes concave on that side by the strain. But as this exposes the tenon of the binding-joist to the risk of being torn off, we are obliged to mortise farther down. The form (fig. 29) generally given to this joint is extremely judicious. The sloping part *a b* gives a very firm support to the additional bearing *e d*, without much weakening of the girder. This form should be copied in every case where the strain has a similar direction.

Oblique mortise and tenon.

The joint that most of all demands the careful attention of the artist, is that which connects the ends of beams, one of which pushes the other very obliquely, putting it into a state of extension. The most familiar instance of this is the foot of a rafter pressing on the tie-beam, and thereby *drawing* it away from the other wall. When the direction is very oblique (in which case the extending strain is the greatest), it is difficult to give the foot of the rafter such a hold of the tie-beam as to bring many of its fibres into the proper action. There would be little difficulty if we could allow the end of the tie-beam to project to a small distance beyond the foot of the rafter; but, indeed, the dimensions which are given to tie-beams for other reasons, are always sufficient to give enough of abutment when judiciously employed. Unfortunately this joint is much exposed to failure by the effects of the weather. It is much exposed, and frequently perishes by rot, or becomes so soft and friable that a very small force is sufficient either for pulling the filaments out of the tie-beam, or for crushing them together. We are therefore obliged to secure it with particular attention, and to avail ourselves of every circumstance of construction.

One is naturally disposed to give the rafter a deep hold by a long tenon; but it has been frequently observed in old roofs that such tenons break off. Frequently they are observed to tear up the wood that is above them, and push their way through the end of the tie-beam. This in all probability arises from the first sagging of the roof, by the compression of the rafters and of the head of the king-post. The head of the rafter descends; the angle with the tie-beam is diminished by the rafter revolving round its step in the tie-beam. By this motion the heel or inner angle of the rafter becomes a fulcrum to a very long and powerful lever much loaded. The tenon is the other arm, very short; and being still fresh, it is therefore very powerful. It therefore forces up the wood that is above it, tearing it out from between the cheeks of the mortise, and then pushes it along. Carpenters have therefore given up long tenons, and give to the toe of the tenon a shape which abuts firmly, in the direction of the thrust, on the solid bottom of the mortise, which is well supported on the under side by the wall-plate. This form has the further advantage of having no tendency to tear up the end of the mortise. This form is represented in fig. 30. The tenon has a small portion *ab* cut perpendicular to the surface of the tie-beam, and the rest *bc* is perpendicular to the rafter. (See Note CC.)

But if the tenon is not sufficiently strong (and it is not so strong as the rafter, which is thought not to be stronger than is necessary), it will be crushed, and then the rafter will shade out along the surface of the beam. It is therefore necessary to call in the assistance of the whole rafter. It is in this distribution of the strain among the various abutting parts that the varieties of joints and their merits chiefly consist. It would be endless to describe every nostrum, and we shall only mention a few that are most generally approved of.

Most approved forms

The aim in fig. 31 is to make the abutments exactly perpendicular to the thrusts. (See Note CC.) It does this very precisely; and the share which the tenon and the shoulder have of the whole may be what we please, by the portion of the beam that we notch down. If the wall-plate lie duly before the heel of the rafter, there is no risk of straining the tie across or breaking it, because the thrust is made to direct to that point where the beam is supported. The action is the same as against the joggle on the head or foot of a king-post. We have no doubt but that this is a very effectual joint. It is not, however, much practised. It is said that the sloping seam at the shoulder lodges water; but the great reason seems to be a secret notion that it weakens the tie-beam. If we consider the direction in which it acts as a tie, we must acknowledge that this form takes the best method for bringing the whole of it into action.

Fig. 32 exhibits a form that is more general, but certainly worse. Such part of the thrust as is not borne by the tenon acts obliquely on the joint of the shoulder, and gives the whole a tendency to rise up and slide outward.

The shoulder joint is sometimes formed like the dotted line *abedcfg* of fig. 32. This is much more agreeable to the true principle, and would be a very perfect method, were it not that the intervals *bd* and *df* are so short that the little wooden triangles *bed*, *dcf*, will be easily pushed off their bases *bd*, *df*.

Fig. 33, No. 1, seems to have the most general approbation. It is the joint recommended by Price, and copied into all books of carpentry as the *true joint* for a rafter foot. The visible shoulder-joint is flush with the upper surface of the tie-beam. The angle of the tenon at the tie nearly bisects the obtuse angle formed by the rafter and the beam, and is therefore somewhat oblique to the thrust. The inner shoulder *ac* is nearly perpendicular to *bd*. The lower angle of the tenon is cut off horizontally, as at *ed*. Fig. 34 is a section of the beam and rafter foot, showing the different shoulders.

We do not perceive the peculiar merit of this joint. The effect of the three oblique abutments, *ab*, *ac*, *ed*, is undoubtedly to make the whole bear on the outer end of the mortise, and there is no other part of the tie-beam that makes immediate resistance. Its only advantage over a tenon extending in the direction of the thrust is, that it will not tear up the wood above it. Had the inner shoulder had the form *eci*, having its face *ic* perpendicular, it would certainly have acted more powerfully in stretching many filaments of the tie-beam, and would have had much less tendency to force out the end of the mortise. The little bit *ci* would have prevented the sliding upwards along *ec*. At any rate, the joint *ab* being flush with the beam, prevents any sensible abutment on the shoulder *ac*.

Fig. 33, No. 2, is a simpler, and in our opinion a preferable, joint. We observe it practised by the most eminent carpenters for all oblique thrusts; but it surely employs less of the cohesion of the tie-beam than might be used without weakening it, at least when it is supported on the other side by the wall-plate.

Fig. 33, No. 3, is also much practised by the first carpenters.

Fig. 35, No. 1, is proposed by Mr Nicholson as preferable to fig. 33, No. 3, because the abutment of the inner

Carpentry. part is better supported. This is certainly the case; but it supposes the whole rafter to go to the bottom of the socket, and the beam to be thicker than the rafter. Some may think that this will weaken the beam too much, when it is no broader than the rafter is thick; in which case they think that it requires a deeper socket than Nicholson has given it. Perhaps the advantages of Nicholson's construction may be had by a joint like fig. 35, No. 2.

Circumstance to be attended to.

Whatever is the form of these butting joints, great care should be taken that all parts bear alike; and the artist will attend to the magnitude of the different surfaces. In the general compression, the greater surfaces will be less compressed, and the smaller will therefore change most. When all has settled, every part should be *equally* close. Because great logs are moved with difficulty, it is very troublesome to try the joint frequently to see how the parts fit; therefore we must expect less accuracy in the interior parts. This should make us prefer those joints whose efficacy depends chiefly on the visible joint.

It appears from all that we have said on this subject, that a very small part of the cohesion of the tie-beam is sufficient for withstanding the horizontal thrust of a roof, even though very low pitched. If therefore no other use is made of the tie-beam, one much slenderer may be used, and blocks may be firmly fixed to the ends, on which the rafters might abut, as they do on the joggles on the head and foot of a king-post. Although a tie-beam has commonly floors or ceilings to carry, and sometimes the workshops and store-rooms of a theatre, and therefore requires a great scantling, yet there frequently occur in machines and engines very oblique stretchers, which have no other office, and are generally made of dimensions quite inadequate to their situation, often containing ten times the necessary quantity of timber. It is therefore of importance to ascertain the most perfect manner of executing such a joint. We have directed the attention to the principles that are really concerned in the effect. In all hazardous cases, the carpenter calls in the assistance of iron straps; and they are frequently necessary, even in roofs, notwithstanding this superabundant strength of the tie-beam. But this is generally owing to bad construction of the wooden joint, or to the failure of it by time. Straps will be considered in their place.

There needs but little to be said of the joints at a joggle worked out of solid timber; they are not near so difficult as the last. When the size of a log will allow the joggle to receive the whole breadth of the abutting brace, it ought certainly to be made with a square shoulder; or, which is still better, an arch of a circle, having the other end of the brace for its centre. (See Note EE.) Indeed this in general will not sensibly differ from a straight line perpendicular to the brace. By this circular form, the settling of the roof makes no change in the abutment; but when there is not sufficient stuff for this, we must avoid bevel joints at the shoulders, because these always tend to make the brace slide off. The brace in fig. 36, No. 1, must not be joined as at *b*, but as at *a*, or in some equivalent manner. Observe the joints at the head of the main posts of Drury Lane theatre, fig. 44, Plate CLXIV.

Butting joints.

When the very oblique action of one side of a frame of carpentry does not extend, but compress, the piece on which it abuts (as in fig. 11), there is no difficulty in the joint. Indeed a joining is unnecessary, and it is enough that the pieces abut on each other; and we have only to take care that the mutual pressure be equally borne by all the parts, and that it do not produce lateral pressures, which may cause one of the pieces to slide on the butting joint. A very slight mortise and tenon is sufficient at the joggle of a king-post with a rafter or straining beam. It is best, in general, to make the butting plain, bisecting the angle formed by the sides, or else perpendicular to one of the pieces. In fig. 36, No. 2, where the straining beam, *ab*, cannot slip away from the pressure, the joint *a* is preferable to *b*, or indeed to any uneven joint, which never fails to produce very unequal pressures on the different parts, by which some are crippled, others are splintered off, &c. Carpentry.

Directions for placing iron straps.

When it is necessary to employ iron straps for strengthening a joint, considerable attention is necessary, that we may place them properly. The first thing to be determined is the direction of the strain. This is learned by the observations in the beginning of this article. We must then resolve this strain into a strain parallel to each piece, and another perpendicular to it. Then the strap which is to be made fast to any of the pieces must be so fixed that it shall resist in the direction parallel to the piece. Frequently this cannot be done; but we must come as near to it as we can. In such cases we must suppose that the assemblage yields a little to the pressures which act on it. We must examine what change of shape a small yielding will produce. We must now see how this will affect the iron strap which we have already supposed attached to the joint in some manner that we thought suitable. This settling will perhaps draw the pieces away from it, leaving it loose and unserviceable (this frequently happens to the plates which are put to secure the obtuse angles of butting timbers, when their bolts are at some distance from the angles, especially when these plates are laid on the inside of the angles); or it may cause it to compress the pieces harder than before, in which case it is answering our intention. But it may be producing cross strains, which may break them, or it may be crippling them. We can hardly give any general rules; but the reader will do well to read what is written in No. 36 and 41 of the article ROOF. In No. 36 he will see the nature of the strap or stirrup, by which the king-post carries the tie-beam. The strap that we observe most generally ill placed is that which connects the foot of the rafter with the beam. It only binds down the rafter, but does not act against its horizontal thrust. It should be placed farther back on the beam, with a bolt through it, which will allow it to turn round. It should embrace the rafter almost horizontally near the foot, and should be notched square with the back of the rafter. Such a construction is represented in fig. 37. By moving round the eye-bolt, it follows the rafter, and cannot pinch and cripple it, which it always does in its ordinary form. We are of opinion that straps which have eye-bolts in the very angles, and allow all motion round them, are of all the most perfect. A branched strap, such as may at once bind the king-post and the two braces which butt on its foot, will be more serviceable if it have a joint. When a roof warps, those branched straps frequently break the tenons, by affording a fulcrum in one of their bolts. An attentive and judicious artist will consider how the beams will act on such occasions, and will avoid giving rise to these great strains by levers. A skilful carpenter never employs many straps, considering them as auxiliaries foreign to his art, and subject to imperfections in workmanship which he cannot discern or amend. We must refer the reader to Nicholson's *Carpenter and Joiner's Assistant* for a more particular account of the various forms of stirrups, screwed rods, and other iron work for carrying tie-beams, &c.

As for those that are necessary for the turning joints of great engines constructed of timber, they make no part of the art of carpentry. (See Note II.)

Examples of different pieces of carpentry.

After having attempted to give a systematic view of the principles of framing carpentry, we shall conclude by giving some examples which will illustrate and confirm the foregoing principles.

Carpentry.

Roof of Greenwich chapel.

Fig. 38, Plate CLXIII. is the roof of the chapel of the Royal Hospital at Greenwich, constructed by Mr S. Wyatt.

	Inches Scantling.
AA is the tie-beam, 57 feet long, spanning 51 feet clear	14 by 12
CC, queen-posts	9 × 12
D, braces	9 × 7
E, straining beam	10 × 7
F, straining piece	6 × 7
G, principal rafters	10 × 7
H, a cambered beam for the platform	9 × 7
B, an iron string, supporting the tie-beam	2 × 2

The trusses are seven feet apart, and the whole is covered with lead, the boarding being supported by horizontal ledgers *h*, *h*, of six by four inches.

This is a beautiful roof, and contains less timber than most of its dimensions. The parts are all disposed with great judgment. Perhaps the iron rod is unnecessary, but it adds great stiffness to the whole.

The iron straps at the rafter feet would have had more effect if not so oblique. Those at the head of the post are very effective.

We may observe, however, that the joints between the straining beam and its braces are not of the best kind, and tend to bruise both the straining beam and the truss beam above it.

St Paul's, Covent Garden.

Fig. 39, the roof of St Paul's, Covent Garden, designed by Mr Hardwick, and constructed by Mr Wapshot in 1796.

AA, tie-beam spanning fifty feet two inches	16 × 12
BB, queen-posts	9 × 8
C, straining beam	10 × 8
D, king-post (fourteen at the joggle)	9 × 8
EE, struts	8 × 7½
FF, auxiliary rafters (at bottom)	10 × 8½
HH, principal rafter (at bottom)	10 × 8½
gg, studs supporting the rafter	8 × 8

The trusses are about ten feet six inches apart, and the dotted lines in the middle compartment show the manner in which the roof is framed under the cupola.

This roof far excels the original one put up by Inigo Jones. One of its trusses contains 198 feet of timber. One of the old roof had 273, but had many inactive timbers, and others ill disposed. The internal truss FCF is admirably contrived for supporting the exterior rafters, without any pressure on the far projecting ends of the tie-beam. The former roof had bent them greatly, so as to appear ungraceful. (See Note KK.)

We think that the camber (six inches) of the tie-beam is rather hurtful, because, by settling, the beam lengthens; and this must be accompanied by a *considerable* sinking of the roof. This will appear by calculation. (See Note LL.)

Birmingham theatre.

Fig. 43, Plate CLXIV., the roof of Birmingham theatre, constructed by Mr George Saunders. The span is eighty feet clear, and the trusses are ten feet apart.

A is an oak corbel	9 × 5
B, inner plate	9 × 9
C, wall-plate	8 × 5½
D, pole-plate	7 × 5
E, tie-beam	15 × 15
F, straining beam	12 × 9
G, oak king-post (in the shaft)	9 × 9
H, oak queen-post (in the shaft)	7 × 9
I, principal rafters	9 × 9
K, common ditto	4 × 2½
L, principal braces	9 and 6 × 9
M, common ditto	6 × 9
N, purlins	7 × 5
Q, straining sill	5½ × 9
S, ridge piece	

This roof is a fine specimen of British carpentry, and is one of the boldest and lightest roofs in Europe. The straining sill, Q, gives a firm abutment to the principal braces, and the space between the posts is 19½ feet wide, affording roomy workshops for the carpenters and other workmen connected with a theatre. The contrivance for taking double hold of the wall, which is very thin, is excellent. There is also added a beam (marked R), bolted down to the tie-beams. The intention of this was to prevent the total failure of so bold a trussing, if any of the tie-beams should fail at the end by rot.

Drury-Lane theatre.

Akin to this roof is fig. 44, Plate CLXIV., the roof of Drury Lane theatre, eighty feet three inches in the clear, and the trusses fifteen feet apart, constructed by Edward Grey Saunders.

A, beams	10 by 7
B, rafters	7 × 7
C, king-posts	12 × 7
D, struts	5 × 7
E, purlins	9 × 5
G, pole-plates	5 × 5
H, gutter plates framed into the beams	12 × 6
I, common rafters	5 × 4
K, tie-beam to the main truss	15 × 12
L, posts to ditto	15 × 12
M, principal braces to ditto	14 and 12 × 12
N, struts	8 × 12
P, straining beams	12 × 12

The main beams are trussed in the middle space with oak trusses five inches square. This was necessary for its width of thirty-two feet, occupied by the carpenters, painters, &c. The great space between the trusses afford good store-rooms, dressing-rooms, &c.

It is probable that this roof has not its equal in the world for lightness, stiffness, and strength. The main truss is so judiciously framed, that each of them will safely bear a load of three hundred tons; so it is not likely that they will ever be quarter loaded. The division of the whole into three parts makes the exterior roofings very light. The strains are admirably kept from the walls, and the walls are even firmly bound together by the roof. They also take off the dead weight from the main truss one third.

Remarks.

The intelligent reader will perceive that all these roofs are on one principle, depending on a truss of three pieces and a straight tie-beam. This is indeed the great principle of a truss, and is a step beyond the roof with two rafters and a king-post. It admits of much greater variety of forms, and of greater extent. We may see that even the middle part may be carried to any space, and yet be flat at top; for the truss-beam may be supported in the middle by an inverted king-post (of timber, not iron), carried by iron or wooden ties from its extremities; and the same ties may carry the horizontal tie-beam K; for till K be torn asunder, or M, M, and P be crippled, nothing can fail.

The roof of St Martin's church in the Fields is constructed on good principles, and every piece properly disposed. But although its span does not exceed forty feet from column to column, it contains more timber in a truss than there is in one of Drury-Lane theatre. The roof of the chapel at Greenwich, that of St Paul's, Covent-Garden, those of Birmingham and Drury-Lane theatres, form a series gradually more perfect. Such specimens afford excellent lessons to the artist. We therefore account them a useful present to the public.

Project by Mr Nicholson.

There is a very ingenious project offered to the public by Mr P. Nicholson. (*Carpenter's Assistant*, p. 68.) He proposes iron rods for king-posts, queen-posts, and all

Carpentry. other situations where beams perform the office of ties. He receives the feet of the braces and struts in a socket very well connected with the foot of his iron king-post; and he secures the feet of his queen-posts from being pushed inwards, by interposing a straining sill. He does not even mortise the foot of his principal rafter into the end of the tie-beam, but sets it in a socket like a shoe, at the end of an iron bar, which is bolted into the tie-beam a good way back.[1] All the parts are formed and disposed with the precision of a person thoroughly acquainted with the subject; and we have not the smallest doubt of the success of the project, and the complete security and durability of his roofs. We abound in iron; but we must send abroad for building timber. This is therefore a valuable project; at the same time, however, let us not overrate its value. Iron is about twelve times stronger than red fir, and is more than twelve times heavier; nor is it cheaper, weight for weight, or strength for strength.

Our illustrations and examples have been chiefly taken from roofs, because they are the most familiar instances of the difficult problems of the art. We could have wished for more room even on this subject. The construction of dome roofs has been, we think, mistaken, and the difficulty is much less than is imagined; we mean in respect of strength; for we grant that the obliquity of the joints, and a general intricacy, increases the trouble of workmanship exceedingly. Wooden bridges form another class equally difficult and important; but our limits are already overpassed, and will not admit them. The principle on which they should all be constructed, without exception, is that of a truss, avoiding all lateral bearings on any of the timbers. In the application of this principle we must further remark, that the angles of our truss should be as acute as possible; therefore we should make it of as few and of as long pieces as we can, taking care to prevent the bending of the truss beams by bridles, which embrace them, but without pressing them to either side. When the truss consists of many pieces, the angles are very obtuse, and the thrusts increase nearly in the duplicate proportion of the number of angles.

Wooden bridges.

Framing of great levers.

With respect to the frames of carpentry which occur in engines and great machines, the varieties are such that it would require a volume to treat of them properly. The principles are already laid down; and if the reader be really interested in the study, he will engage in it with seriousness, and cannot fail of being instructed. We recommend to his consideration, as a specimen of what may be done in this way, the working beam of Hornblower's steam-engine. (See STEAM-ENGINE.) When the beam must act by chains hung from the upper end of arch-heads, the framing there given seems very scientifically constructed; at the same time we think that a strap of wrought iron reaching the whole length of the upper bar (see the figure) would be vastly preferable to those partial plates which the engineer has put there, for the bolts will soon work loose.

But when arches are not necessary, the form employed by Mr Watt is vastly preferable, both for simplicity and for strength. It consists of a simple beam, AB (fig. 45, Plate CLXIV.), having the gudgeon C, on the upper side. The two piston rods are attached to wrought-iron joints, A and B. Two strong struts, DC, EC, rest on the upper side of the gudgeon, and carry an iron string, ADEB, consisting of three pieces, connected with the struts by proper joints of wrought iron. A more minute description is not needed for a clear conception of the principle. No part of this is exposed to a cross strain; even the beam AB might be sawed through at the middle. The iron string is the only part which is stretched; for AC, DC, EC, BC, are all in a state of compression. We have made the angles equal, that all may be as great as possible, and the pressure on the struts and strings a minimum. Mr Watt makes them much lower, as *AdeB*, or *AδεB*. But this is for economy, because the strength is almost insuperable. It might be made with wooden strings; but the workmanship of the joints would more than compensate the cheapness of the materials.

We offer this article to the public with deference, and we hope for an indulgent reception of our essay on a subject which is in a manner new, and would require much study. We have bestowed our chief attention on the strength of the construction, because it is here that persons of the profession have the most scanty information. We beg them not to consider our observations as too refined, and that they will study them with care. One principle runs through the whole; and when that is clearly conceived and familiar to the mind, we venture to say that the practitioner will find it of easy application, and that he will improve every performance by a continual reference to it.

IV.—NOTES.

AA, p. 255. This rule may be somewhat more accurately expressed in these words: From the point at which any three forces meet and balance each other, draw a line in the actual direction of any one of them, and from the extremity of this line draw two others, parallel to the directions of the other two forces respectively; then supposing the pieces affording these two forces to be produced indefinitely at their remoter ends, either of them which is cut by one of the two lines will be compressed, and act as a brace, and either of them which is not cut will be stretched, and act as a tie.

BB, p. 256. It is, however, difficult to imagine how the beam DA can furnish a force iA, to prevent the force Af from carrying the beam BA towards H, when DA only affords a repulsive abutment. The true resolution of the force AE is found by considering the intersection of GE with Ae, which are the directions of the separate forces composing it: these lines meeting in a point a little above r, we may call their intersection r^*: then in the triangle AEr^*, the side Ar^* will represent the pressure on the mitred joint, and r^*E the pressure on the beam HD; and the former being again resolved into AG and Gr^*, we have ultimately AG and $Gr^* + r^*E = GE = AF$, for the horizontal and vertical forces, however they may be modified by intermediate combinations.

CC, p. 257. The reasoning contained in this and some of the subsequent articles may serve as an approximation to the truth in many cases of common occurrence; but the supposition on which it is founded is by no means generally admissible as affording a result mathematically accurate; for, in reality, the distribution of the weight of a roof over the whole extent of the rafters, or the concentration of the whole weight in the point where they meet, is far from being an indifferent alternative, either with respect to the magnitude of the thrusts, or to the proper directions of the abutments or joints. In the case here discussed, where there is no king-post, it is clear that the centre of gravity of the whole roof must be much nearer to the middle of the figure than the angular point, and that consequently the weights supported by the two walls will be very different from those which would be support-

[1] See figures 40, 41, 42, Plate CLXIII., and Mr Nicholson's work, p. 68, where these figures are particularly described.

ed if the whole load were placed at the summit; although, where there is a heavy king-post, supporting also, as it ought to do, about half the weight of the tie-beam, with its floors or ceiling, the case will approach much nearer to the supposition here assumed.

For a common light roof, without a king-post, the calculation or construction is very simple. When two rafters only meet at the summit, they must support each other by a horizontal thrust (see Art. BRIDGE, Prop. Y); and this thrust, acting on each rafter as a lever, of which the lower end is the fulcrum, must be equivalent to the weight, acting at the horizontal distance of the centre of gravity from the fulcrum, which is a quarter of the whole span; consequently the thrust must be to the weight as a quarter of the span to the height, and the compound oblique thrust on the abutment will be represented by the hypotenuse of the triangle of which those lines are the sides; so that if we had a roof of the same height, and of half the breadth, the direction of its rafters would exactly represent the actual direction of the compound thrust on the end of the tie-beam, and would consequently indicate the proper form for the abutment of the given structure.

But in the case of the unequal rafters represented in the figure, the determination becomes more complicated, and we must first find the direction of the mutual thrust of the rafters, which must evidently be such, that the perpendiculars falling on it from each end of the tie-beam may be in the inverse proportion of the motive powers of the weights of the rafters, that is, of the products of those weights into the horizontal distances of the centres of gravity from the respective fulcrums, or into the segments of the tie-beam made by a vertical line passing through the summit, which are proportional to these distances; and if we produce the base of the triangle, and find in it a point, of which the distance is to the length of the tie-beam as the smaller product to the difference of the products, a line drawn from the summit to this point will show the true direction of the thrust; and its magnitude may then be readily determined by dividing either of the products by the respective perpendicular falling on this line.

Where, however, there is a king-post supporting a heavy tie-beam, it is necessary to determine the centre of gravity of the half roof, together with this addition; and the distance of the centre of gravity from the middle will then be to the half span, as the weight of one of the rafters with its load is to the weight of the whole roof, including the tie-beam and ceiling; and if we erect a perpendicular passing through the centre of gravity thus found, and equal to the height, the oblique thrust on the abutment will be in the direction of the line joining the upper end of this perpendicular and the end of the tie-beam.

DD, p. 259. In order to obtain a distinct idea of the operation of the forces concerned in this experiment, we must have recourse to proposition C of this article, and substitute in the formula for the deflection

$$d = a\,t\sqrt{\frac{M}{16f}}\ \text{TANG.}\left(\sqrt{\frac{16f}{M}}\cdot\frac{e}{a}\right),$$

$a = 1$, $t = \frac{8}{6720} = \frac{1}{840}$, $M = 1{,}900{,}000$ pounds, the specific gravity of fir being ·56, $f = 6720$, and $e = 6$, the middle of the pillar being considered as the fixed point: we then find $\sqrt{\frac{16f}{M}}\cdot\frac{e}{a} = 1{\cdot}427$, which is the length of an arc of 81° 45′, and the tangent becomes 6·9, whence we have $d = \frac{1}{840} \times 4{\cdot}2 \times 6{\cdot}9 = {\cdot}0345$, or somewhat more than the thirtieth of an inch; consequently the strength must have been reduced in the proportion of 1·207 to 1. (Art. BRIDGE, Prop. E.) But considering how near the arc thus determined approaches to a quadrant, it is obvious that any slight variations of the quantities concerned in the calculation must have greatly affected the magnitude of the tangent; so that the loss of strength may easily have been considerably greater than this, as it appears to have been found in the experiment. It would, however, scarcely have been expected that such a pillar, however supported, could withstand the pressure of ninety hundredweight, since Emerson informs us that the cohesive strength of a pillar of fir an inch in diameter is only about thirty-five: but supposing the facts correct, the coincidence tends to show the near approach to equality of the forces of cohesion and lateral adhesion, as explained in the introduction to this article.

EE, p. 260. A similar remark of the author has already been noticed in the article BRIDGE, at the end of the fifth section. In the form in which it is here expressed, it becomes still more objectionable; for with whatever part of a circular abutment a rafter equal to the radius may be brought into contact, it is very plain that its opposite end can never be either higher or lower than the original centre of curvature: and even if the curvature were made twice as great, so that the rafter might be equal to the diameter of the circle, it would be necessary that the lower end should slide upwards on the abutment as much as the upper end fell, in order to preserve the contact; and there would obviously be no force in the structure capable of producing such a change as this. Any general curvature of the joint must therefore be totally useless; but a judicious workman will make it somewhat looser below than above, when there is any probability that the rafters will sink, taking care, however, to avoid all bearing too near the surface, lest it should splinter, and, for these reasons combined, making the end a little prominent somewhat above the middle of the surface which rests on the abutment.

With this precaution, the direction of the joint between a rafter and a tie-beam ought to be made precisely perpendicular to the true thrust of the rafter, determined as already explained (Note CC); for, in the first place, unless we trust either to the friction, or to straps, the bearing cannot be more nearly horizontal than this, without danger of the rafters sliding outwards; and, in the second place, if we made it more nearly vertical, we should lessen the vertical pressure on the end of the tie-beam, immediately beyond the joint; a pressure which gives firmness to the wood, by pressing its fibres more closely together, and increasing their lateral adhesion, or rather internal friction. If, however, the tie-beam were not deep enough to receive the whole of the rafter so terminated, without too great a reduction of its depth, it would be proper to make the joint a little flatter, or more horizontal, and to restrain the end from sliding upwards by an iron strap fixed in a proper direction. We should preserve the end of the rafter as little diminished in breadth as possible, when the tie-beam is wide enough to receive it; a moderate thickness, left on each side of the mortise in the tie-beam, being sufficient to assist in securing the connection of the ends of the beam with the intermediate parts.

FF, p. 260. The doctrine of the initial equality of the resistances to compression and extension, as stated in the article BRIDGE, enables us to demonstrate that the transverse strength can never exceed one sixth of that which would be derived from the resistance of all the fibres, co-operating at the distance of the whole depth from a fixed fulcrum, and acting with the weaker of the two powers appropriate to the body. It is true that the results of some direct experiments seem to favour the opinion that

the cohesive power is the weaker; but where the flexure is already considerable, it is probable that this circumstance materially diminishes the primitive power of resisting compression, so that the principles on which the calculation proceeds are by no means strictly applicable to the case of a bar so broken.

GG, p. 261. There seems to be a little confusion in the idea of the possibility of altering the nature of the action of the fibres of a beam by altering the place of the gudgeon in this manner; but the author has very properly abstained from making any practical application of the supposed modification thus introduced. With respect to the strength required for scarfing or joggling, it may be observed, that the whole of the compressed fibres of the concave side may be considered as abutting against the whole of the extended fibres on the convex side; and this abutment is equally divided throughout the length of the beam; so that if the scarfings or joggles in the whole length of the arm of a lever, taken together, are as strong as one half of the depth of the lever, exerting half its powers, from the inequality of tension, there will be no danger of the failing of these joints; and from this principle it will be easy to determine the depth to which the joints ought to extend in any particular case. Hence also we may understand how a beam may become so short as to be incapable of transverse fracture in its whole extent; for the lateral adhesion between the different fibres of wood is generally far inferior to the longitudinal strength of the fibres: and if, for example, it were only one fourth as great, a beam less than twice as long as it is deep would separate, if urged in the middle by a transverse force, into two strata, from its incapacity of affording sufficient abutment, before its longitudinal fibres would give way.

HH, p. 263. If the bolts were sufficiently numerous and sufficiently firm, so as to produce a great degree of adhesion or of friction between the parts, this joint might be made almost as strong as the entire beam, since there is nothing to prevent the co-operation of each side with the other throughout its extent; but much of the strength would be lost if the bolts became loose, even in an inconsiderable degree.

II, p. 265. The author has reasoned upon the direction of straps, as if it were universally necessary to economize their immediate strength only, without regard to the effect produced on the tightness of the joint; but it may happen that the principal purpose of the strap will be answered by its pressing the rafter firmly upon the beam, and this effect may be produced by a certain deviation from the horizontal position, with but little diminution of the strength of the strap; a deviation which has also the advantage of allowing the strap to embrace the whole of the beam, without weakening it by driving a bolt through it. We must not, however, run the risk of crippling the end of the beam, and the straps represented in fig. 38 may be allowed to be somewhat too erect.

KK, p. 266. It does not appear to be desirable that the ends of the rafters should be supported without any pressure on the ends of the beams, since these ends would bear a small weight without any danger of bending, and would thus lessen the pressure on the king-post.

LL, p. 266. The half length being 25 feet, and the camber 6 inches, the excess of the oblique length will be $\sqrt{625 \cdot 25} - 25$, or $\frac{1}{200}$ of a foot, that is, $\frac{1}{16}$ of an inch, which is all that the beam would appear to lengthen in sinking; nor would the settling of the roof be more "considerable" than about a quarter of an inch. But there seems to be no advantage in this deviation of the tie-beam from the rectilinear direction; and the idea, which appears to be entertained by some workmen, that a bent beam partakes of the nature of an arch, is one of the many mischievous fallacies which it is the business of the mathematical theory of carpentry to dispel. (T. Y.)

CARPENTUM, in *Antiquity*, a name common to different kinds of vehicles, including coaches, waggons, and carts. The carriage generally used by the Roman matrons was called carpentum, and usually had two wheels and an arched covering The name is said to be derived by a slight literal conversion from *Carmenta*, the mother of Evander. In the second Punic war, women were prohibited the use of the carpentum by the Oppian law, which, however, was soon afterwards repealed. Carpenta or covered carts were much employed by the Britons, Gauls, and other northern nations, in their military expeditions. These, together with the commoner kind of waggons, were included under the general term *carri* or *carra*, from the Celtic *carr*. (See Cæsar's *Commentaries*).

CARPET. This term is supposed to be derived from Cairo (whence also the French *Cairan*, a Turkey carpet), and from the Latin *tapes*, tapestry, corresponding to the Italian *carpetta*, and the Dutch *karpet*. It is legitimately applied to an article of manufacture used for covering the floors of chambers, or spreading on the ground, although, while it was a novelty in Europe, tables also were covered with it.

Carpets and rugs were manufactured at a very remote period in Egypt, India, and China; but those of Persia and Turkey are the most celebrated. They were originally used for sitting and reclining upon, as may still be observed in Eastern countries, where they constitute the entire furniture of the people. In Egypt they were first applied to religious purposes by the priests of Heliopolis, and were also used to garnish the palaces of the Pharaohs. It was also a custom of antiquity to place them under the couches of guests at banquets. Sardinian carpets are mentioned by Plato the comic poet, as being disposed in this manner—"beneath the ivory feet of purple-cushioned couches." The carpets of the Homeric age were generally white or plain cloths; but they were also sometimes produced with various colours and embroidered designs. At the supper of Iphicrates, purple carpets were spread on the floor; and at the magnificent banquet of Ptolemy Philadelphus (an account of which is given by Callixenus of Rhodes) we learn that underneath 200 golden couches "were strewed purple carpets of the finest wool, with the carpet pattern on both sides; and there were handsomely embroidered rugs, very beautifully elaborated with figures. Besides this," he adds, "thin Persian cloths covered all the centre space where the guests walked, having most accurate representations of animals embroidered on them;" (*Athenæus*, v. 26.) The Babylonians, who were very skilful in weaving cloths of divers colours (Pliny, viii. 48), delineated upon their carpets entire groups of human figures, together with such fabulous animals as the dragon, the sphynx, and the griffin. These were numbered among the luxuries of Heliogabalus. On the tomb of Cyrus was spread a purple Babylonian carpet, and another covered the bed whereon his body was placed (Arrian, vi. 29). These carpets were exported in considerable quantities to Greece and Rome, where they were highly esteemed. Carthage was also noted by Hermippus, Antiphanes, and others, for its magnificent carpets.

Sir J. Gardiner Wilkinson gives us an account of an ancient carpet-rug of Egyptian manufacture. "This rug," he tells us, "is made like many cloths of the present day,

with woollen threads, on linen strings. In the centre is the figure of a boy in white, with a goose above, the hieroglyphic of a 'child,' upon a green ground, around which is a border composed of red and blue lines," &c. (*Manners and Customs of the Ancient Egyptians*, vol. iii., pp. 141-2.) He further informs us that there are in the Turin Museum some specimens of worked worsted upon linen, "in which the linen threads of the weft had been picked out, and coloured worsted sewed on the warp." In these two examples we have evidence of the existence, at a very early time, of a system of tapestry-weaving. The ancient carpet manufacture of the Asiatic countries may resolve itself under the appellation of needle-work. Of this, the present process of carpet-weaving in Persia and Turkey, and the tapestry manufacture of France, may be considered as fitting examples. The tapestry, as is well known, consists of woollen or other threads sewed on the strings of the warp, by means of small shuttle-needles. The Persian carpet is formed by knotting into the warp tuft after tuft of woollen yarn, over each row of which a woof shot is passed, the fingers being here employed instead of the shuttle-needles, as the fabric is of a coarser description. In both methods the principle is the same. Both are formed in looms of very simple construction, the warp threads are arranged in parallel order, whether upright or horizontal, and the fabric and pattern are produced by coloured threads, hand-wrought upon the warp. This may be designated the hand-wrought or needle-work method, which only makes one stitch or loop at a time, in contradistinction to the machine-wrought process, the result of mechanical appliances, whereby a thousand stitches are effected at once. Herein lies the essential difference between the ancient and modern, the simple and complex carpet-manufacture.

In Persia there are entire tribes and families whose only occupation is that of carpet-weaving. These dispose of their productions at the bazaars to native merchants, who remove them to Smyrna or Constantinople, where they meet with European purchasers. The trade in real Persian carpets is, however, very limited, owing to their small size. They are seldom larger than hearth-rugs, long and narrow. Very many of them, moreover, are considerably tarnished by exposure in bazaars, if they have not indeed been already used. To render them more saleable they are cleaned. This is done by cropping the surface, which in some cases is shaved quite close to the knot, hence a great proportion of those brought to this country have not their original richness and depth of pile. Felted carpets or *nurmuds* are also made in Persia, but do not constitute an export commodity. Sir Henry Bethune, late Persian ambassador, had in his possession a very singular specimen of this felt carpeting, in which coloured tufts of worsted had been inserted during the process of manufacture, producing a regular pattern when finished.

The greater part of those Turkey carpets imported into England are manufactured at Ushak or Ouchak, in the province of Aïdin, about six days' journey from Smyrna, and rugs principally at Kulah or Koula, an adjacent village. In the provinces of Hoodavendigniar, Adana, and Nish, numerous households are employed in their production, as also in the districts of Bozah, the city of Aleppo, and the villages of Trebizond. Here and there, throughout Caramania, such carpets are also made. The Turcomans of Tripoli, the women of Candia, and the peasantry of Tunis and Algiers, are likewise engaged in their fabrication. In none of these places, however, does any large manufactory exist; the carpets are the work of families and households. These carpets are woven in one piece, and there is this notable peculiarity in their manufacture, that the same pattern is never again exactly reproduced; no two carpets are quite alike. The patterns are very remarkable, and their origin is unknown even to Mussulmans. The Turkey carpet pattern represents inlaid jewelled work, which accords with Eastern tales of jewels and diamonds. If this were rightly understood, it would prevent such speculations as those of Mr Redgrave in his Great Exhibition Report on Design, where he remarks, that "the Turkish carpets are generally designed with a *flat* border of flowers of the natural size, and with a centre of larger forms conventionalized in some cases even to the extent of obscuring the forms—a fault to be avoided." This is doubtless a very ingenious mode of accounting for the curious forms of a Turkey carpet; but these, however fantastic, are never obscured, nor are there any flowers, *flat* or otherwise, in the borders or elsewhere. The great beauty of these carpets lies in the equal balance of colour, of dull neutral shades, somewhat sombre in effect.

Generally throughout British India the carpet manufacture is carried on. At Benares and Moorshedabad are produced velvet carpets with gold embroidery. A very elaborate carpet, sent from Cashmere to the Great Exhibition by Maharajah Goolab Singh, was composed entirely of silk, and excited great admiration. In every square foot of this carpet, we are informed, there were at least 10,000 ties or knots. Silk embroidered hookah carpets are made at Lahore, Mooltan, Khyrpoor, Tanjore, and Bengal; cotton carpets, or *satrunjees*, at Rungpore, Agra, and Sasseram; printed cotton carpets at Ahmedabad; printed floorcloth at Mooltan. Woollen carpets are far more extensively manufactured; some of which come from Ellore, Mirzapore, and Goruckpore, but the principal manufacture is at Masulipatam, 292 miles north from Madras. There the capital and enterprise of this country have lent their aid to the rather tardy movements of the natives, and this article is now in general demand. Of late years linen warp has been introduced instead of cotton, and the fabric is thereby much improved. The designs of the Indian carpets have more regularity than those of Turkey, and the colours are mostly warm negatives, enlivened with brilliant hues interspersed. For the introduction of Masulipatam carpets, as of many others into the trade of this country, we are indebted to the firm of Watson, Bell, & Co., whose Indian connection is our sole means of obtaining these beautiful fabrics.

The total value of Persian, Turkey, and Indian carpets imported into England, may be computed at about L.20,000 per annum.

Oriental carpets were first introduced into Spain by the Moors; and at a later date the Venetians imported them into Italy, and supplied western Europe with this luxurious manufacture. We have frequent mention of them during the middle ages, and their costliness and magnificence are celebrated in the illuminated pages of fabliaux and romances. They were spread in the presence-chambers of royalty, before the high altars of chapels and cathedrals, in the bowers of "ladyes faire," and on the summer grass. Many articles of furniture were also covered with them—beds, couches, tables, and regal faldestols; but here it becomes difficult to distinguish between carpet and tapestry, both being used promiscuously. Tapestry of Baldekine or Baldachine (from Baldak, ancient name of Baghdad), was a carpet inwrought with gold and silver threads. Such were carried on poles, and uplifted as a canopy over the host, and over great personages in procession. The troubadours had carpets of gold embroidery which they laid upon the grass beneath them. Hearth-rugs and throne carpets, gorgeously emblazoned with heraldic centre-pieces, were the handiwork of high-born dames during the romance period. To some of these were attached fringes, but such were more usually composed of the fag-ends of the warp, like those of Persia, India, and Turkey. A black velvet carpet, "fringed with silver and gold, and lined with taffeta," is enumerated in the inventory of Archbishop Parke's household furniture in 1577. Rushes were strewn on the floor of Queen Mary's presence-cham-

Carpet. ber, and that of Elizabeth had the additional covering of a Turkey carpet. Long prior to this, however, Eastern carpets had been introduced. In the reign of Edward VI. we read that before communion-tables were placed—

> " —— —— Carpets full gay,
> That wrought were in the Orient."

Chequered matting appears to have been very generally used about the fifteenth century.[1] In Lydgate's metrical life of St Edmund (MS. Harl. No. 2278), is a representation of the room wherein that saint was born; the floor is covered with chequered matting, and a fringed hearth-rug of Gothic design is before the fireplace. Carpets composed entirely of leather strips interlaced together may be seen in our antiquarian museums. A sample of this description was lately prepared for the inspection of the new houses of parliament, and offered as a covering for their halls and passages, but was rejected.

In the reign of Henry IV. the carpet manufacture appears to have been introduced from Persia into France. Colbert, the minister of Louis XIV., established the manufactory at Beauvais in 1664, which is now in the hands of the French government, and produces very artistic specimens. A variety of these, "in Turkish, Peruvian, and Chinese styles," was exhibited at London in 1851. The national manufactory of Gobelins, which likewise sent its beautiful carpets and tapestry to the Great Exhibition, was established shortly after that of Beauvais. It was purchased in 1677 by Colbert from the Gobelin family, whose progenitors, a century ago (Gilles and Jean Gobelin), brought their art, as was supposed, from Flanders. An attempt was made, in the time of Henry VIII., by William Sheldon, to start this manufacture in England; but under the patronage of James I. it was more successfully established, with the superintendence of Sir Francis Crane, at Mortlake in Surrey, where both carpets and tapestry were produced. Toward this object the sum of L.2676 sterling was contributed by its royal patron, and French weavers were brought over to assist. But it does not appear that anything considerable was effected, until after the revocation of the edict of Nantes, in 1685, when artizans of every trade fled to this country, among whom were tapestry and carpet weavers, who settled in various parts. About the year 1750, Mr Moore was awarded a premium by the Society of Arts for the best imitation Turkey carpets; and Parisot conducted an establishment for their manufacture at Paddington, under the patronage of the Duke of Cumberland. Subsequently, carpets were wrought on the same principle at Axminster, in Devonshire, whence the name; and afterwards at Wilton, where they are still manufactured by Messrs Blackmore. The Board of Trustees for the Encouragement of Arts and Manufactures in Scotland offered prizes for the best Persian and Turkey carpets, which were carried off by Gregory, Thomsons, & Co. of Kilmarnock, and Whytock & Co. of Edinburgh. About ninety years previously they had been made in the vicinity of Holyrood Palace. These expensive and magnificent carpets are now made in many parts of Europe, but more particularly at the Gobelins manufactory, at Aubusson and Fellitin, in the department of Creuse, at the Manufacture Royale de Tapis de Tournai in Belgium, and at Deventer in the Netherlands. They are also made in London and Kidderminster.

Hitherto we have been treating of the simple hand-wrought or needle-work process, which implies great expense and waste of time and labour, and is therefore not calculated to supply a general demand. The machine-wrought fabric now claims our attention; and first in order, the common ingrain, Kidderminster or Scotch carpet, which is made in many parts of Scotland, the north of England, and in the United States of America. This consists of worsted warp traversed by woollen weft, and is woven in pieces about a yard wide. It is composed of two distinct webs interlaced together at one operation, and is therefore a double or two-ply carpet, similar on either side. In this article only two colours can with propriety be introduced, as otherwise it has a striped or mixed appearance. A pure or plain colour can only be obtained where the weft traverses the warp of the same colour. Suppose a crimson figure on a maroon ground; the one web is maroon, the other is crimson, and the pattern is produced by these intersecting and decussating each other at points predetermined; thus what is crimson on one side is maroon on the other, and *vice versa.* One beam contains the warp of both plies, arranged in two tiers, which is passed through the *mails* or metallic eyes of the harness—two threads through each eye—and thence through the reed. The harness draws up certain warp threads, to admit of the passage of the shuttle with the weft, the pattern depending upon such warp threads as are so drawn up. This was formerly effected by means of a revolving barrel, whose surface was studded with pins, which by rotation acted upon the warp threads. These studs being arranged so as to produce one pattern, a separate barrel or a new arrangement of the studs was requisite for every other pattern. But this machine is now superseded by the more efficient Jacquard apparatus, which produces the pattern by means of an endless chain of perforated cards working against parallel rows of needles. This double fabric is also made in France, and sprigs of divers colours inserted. A detailed account of this process, with elaborate diagrams, is given by M. Roland de la Platière, in the *Encyclopédie Méthodique.*

An improvement upon the Kidderminster carpet is the triple or three-ply fabric, the invention of Mr Thomas Morton of Kilmarnock. This is composed of three distinct webs, which, by interchanging their threads, produce the pattern on both sides. A variety of colour is thus obtained, and the texture is of great thickness and durability.

Figured Venetian carpeting is of similar description; here the woof is completely covered by a heavy body of warp. Dutch carpeting is much inferior in quality, and was originally made of cow-hair, but now of the coarsest wool. Neither fabric has great capabilities of design; simple diced patterns are wrought in the Venetian, stripes and chequers in the Dutch.

The Brussels carpet is a very superior texture. It is composed of worsted and linen, and has a rich corded appearance. The figures are raised entirely from the warp, by inserting a series of wires between the linen foundation and the superficial yarn. These wires are afterwards withdrawn, leaving a looped surface. In this manufacture there is a great waste of material, and the colours are usually limited to five. Each colour has its continuous layer of thread, running from end to end of the web, which rises to the surface at intervals indicated by the design, and then sinks into the body of the fabric. Thus there are five layers or covers, only a fifth part of which is visible; and owing to the irregularity of their ascent to the surface, they cannot be placed upon one beam, but each thread is wound on a separate bobbin, with a weight attached to give a proper tension. These bobbins are arranged in five frames jutting out behind the loom—260 bobbins in each frame for the ordinary width. Additional frames are requisite for additional colours introduced; but where more than five are engaged the pattern is rather indistinct. The threads of all the bobbins are then drawn through the harness, heddles, and reed, to unite with the linen yarn in the compound fabric, the Jacquard machine being employed to

[1] The same article is produced in many parts of Asia from the grassy fibres of the ratan. A superior description is now made in this country from cocoa-nut fibre and Manillan flax.

produce the pattern. Brussels carpets were first introduced into Wilton about a century ago, from Tournai in Belgium. Kidderminster is now the chief seat of this manufacture, where upwards of 2000 looms are in operation.

Moquette or Wilton carpets are woven in the same manner, and differ only in this, that the loops are cut open into an elastic velvet pile. To effect this, the wires are not circular as in the Brussels fabric, but flat, and furnished with a groove in the upper edge, wherein the sharp point of a knife is inserted and drawn across the yarn, cutting the pile. These carpets, besides being manufactured in many parts of England and Scotland, are also made in France.

We now proceed to describe a very ingenious improvement in this branch of carpet manufacture—the invention of Mr Richard Whytock of Edinburgh. This is a combination of the arts of printing and weaving, at the same time simplifying both. These arts may be said to be combined when any *woven* fabric is *printed;* but here the process is reversed, the threads being printed before they are in cloth. This, to be sure, is the case when warps are printed and then woven; but the grand novelty of this invention is that the *threads* are printed before even the *warp* is formed. One thread, or two treated as one, in some cases miles in length, are coloured by steps of half an inch, faster than a swift runner would make the distance. When these threads have been all parti-coloured in this manner, they form the elements, as it were, of the intended design or fabric. Singly, they exhibit no regular figure or pattern; but when arranged in their proper order, ready for the weaver's beam, the figure comes into view, much elongated of course, inasmuch as 18 feet of the warp will sometimes be gathered into 4 feet of cloth, in order to secure the due proportions of the intended object. It has been said that the two combined arts of printing and weaving are simplified by this contrivance. With regard to the weaving: *First,* The loom occupies only one-third of the space in length that the Brussels loom requires. *Second,* The latter must have 1300 little beams or bobbins, from which the worsted pile has to be gathered; whereas this loom requires only one beam for the whole of the worsted threads. *Third,* While the Brussels or Wilton, on a web of 27 inches, requires for the best fabric 2860 threads, only 780 are here requisite—one layer instead of five—to produce as good or a better surface. *Lastly,* While the number of colours in succession lengthwise, on the old principle, must not exceed six or seven, upwards of twenty or thirty can be introduced by the new method. Then, again, as a simplification of the printing process: whereas formerly a change of blocks was required for every change of pattern, in this new process the same blocks serve for all patterns—as the pen serves for every form of type. Many of those manufacturers who are now availing themselves of this invention do not see wherein its true economy consists. If an object, say a rosebud, recurs a thousand times in the length of a web, at intervals of 4 feet, the block printer must apply his block a thousand times to point the opening bud; but here the buds are congregated, so that one stroke may dye them all. If it be desired to have a thousand buds in the length of the web, let a thread be wound round a hollow cylinder a thousand times, and a traversing wheel charged with colour be passed across the coil. The thread when uncoiled will be found to be marked in a thousand places, exactly where it is wanted to tip the opening bud with red from end to end of the web. Design-paper, whereon the pattern is indicated in small squares, serves as a guide to the printer; each square being one stroke of the colour-pulley. After the threads are thus streaked across with colour, they are removed from the cylinder or drum, and the dyes are fixed by the action of steam. The threads are then arranged in setting frames, according to the squares of the design-paper, to constitute the warp of the projected web. The Jacquard is now so far at a discount, and the loom restored to nearly the same simplicity as of old, when

"Between two trees the web was hung."

The principle here referred to is only in its infancy. The works of the first masters may yet be multiplied by this process, if they will condescend to furnish the cartoons. Already flowers are produced which the botanist can classify without mistake.

Like every other improvement, this invention met with considerable opposition, particularly on the part of manufacturers and dealers. During the first fourteen years, the number of looms employed gradually increased from one to fifty-six, the greatest number in operation at Lasswade in 1847. Now, so extensive is the manufacture in England, that one house produces to the extent of half a million sterling per annum, having upwards of 300 looms at work by steam-power. It is gratifying to learn that these power-looms, instead of throwing out of employment, engage more operatives with better wages and easier work.[1] Messrs Henderson and Widnell of Lasswade, John Crossley and Sons of Halifax, Pardoe, Hoomans, and Pardoe of Kidderminster, and Sutherland and Tod of Lanark, are the principal manufacturers engaged upon this patent. An extraordinary consequence upon the introduction of this article is that it has not interfered with other branches of the carpet manufacture, not one of which appears to have been diminished. There is, therefore, an addition to the trade of the country, to the whole amount of its produce, itself no mean result; the whole trade being at least doubled, as far as fine carpets are concerned. Whytock's carpets are known under the designation of Patent Tapestry and Velvet Pile Carpets. Rugs, table-covers, fine velvets, and tapestry hangings, are wrought on the same principle.

Another great improvement in carpet-making, which originated also in Scotland, was patented by Mr James Templeton of Glasgow. It is on the chenille principle, and consists of a process of double weaving. First a thin striped fabric is made; and this, when cut up, is again woven into a denser fabric for carpets, rugs, and table-covers. The chenille stripes, like the parti-coloured threads in Whytock's invention, form the elements of the second fabric, only those elements go to compose the woof instead of the warp, as in the former case. Extremely beautiful carpets have been made on this principle, and these being woven in large squares, have interfered much with the Tournai or Axminster carpets, having the same depth of pile, without being so expensive. Hitherto, however, the manufacture has been confined to the place where it originated.

Patent wool mosaic is another novelty. This manufacture was introduced into England from Germany. It is produced by cementing with caoutchouc a close velvet pile on a plain cloth. Messrs John Crossley and Sons of Halifax have brought out some admirable specimens of this mosaic-work, in carpets, rugs, and hangings for walls; but as yet this method has been more extensively applied to the manufacture of small articles.

A very cheap description of carpet is now made near Manchester. It is first woven in plain colours by steam-power, under Seivier's patent, by Bright & Co. It is then printed with coloured blocks by machinery patented by Burch & Co. This article has a large export sale.

The carpet manufacture is rapidly increasing in Great Britain. Upwards of 5000 looms, it is computed, are now in operation, upon every description. The wages of the operatives may average from 15s. to 30s. per week.

It remains to speak of carpet design. This matter is regulated by prevailing fashion and caprice, under the ever-varying semblance of good taste. There are revolutions in decorative art, as in all things else, and in these carpet design is involved. An acute observer can discover here symptomatic indications of national or individual character. The supremacy of Gothic architecture, in our day, implies the revival of mediæval art. Simple ornamental designs, in quiet and subdued colouring, are now about to take the place of their more brilliant predecessors. Many colours will only be tolerated in Moorish and Arabesque ornament, or in the *bizarre* Turkey carpet. But this reformation is not yet general. (A. W—K.)

CARPET-*Knights,* a denomination sometimes given to gown-men and others of peaceable professions, who, when they receive the honour of knighthood, usually kneel on a carpet; and thus are distinguished from knights created in the camp, or on the field of battle.

CARPI, a town of Italy, in the duchy of Modena, 10 miles from the city of that name. Its public buildings worthy of note are the citadel and the cathedral. Pop. 5300.

CARPI, *Girolamo da,* a historical and portrait painter, was born at Ferrara in 1501, and was one of the most promising pupils in the school of Benvenuto Garofalo. On leav-

[1] In the United States there were fifty of Mr Bigelow's power-looms at work upon tapestry carpeting in 1851. An inconsistent prejudice, however, exists there against indigenous produce, and if an article does not come from "Europe" it is in many cases a sufficient cause of condemnation. A similar prejudice prevails here in favour of foreign manufacture.

ing Ferrara he spent several years at Parma and Modena, carefully copying the works of Correggio and Parmigiano; and on his return he executed some original paintings for the churches of Bologna and Ferrara, which so closely resembled the works of Correggio as to have been attributed to that artist. His finest paintings are, *The descent of the Holy Spirit*, in the church of St Francis at Rovigi; a *Madonna, St Giorgio, St Maurelio*, and *St Girolamo*, at Ferrara; the *Adoration of the Magi*, the *Madonna*, and *St Catherine*, at Bologna. He died in 1556.

Carpi, *Ugo da*, an Italian painter who flourished about the year 1500. He is chiefly remarkable as having been supposed the inventor of that species of engraving on wood distinguished by the name of chiaroscuro, in imitation of drawing. Huber, Heinecken, and Breitkopf, however, have distinctly proved that the art of printing in chiaroscuro was known long before in Germany; and have produced existing works of Jan Ulric Pilguin and of Mair, who flourished before the time of Ugo. One of Mair's prints of this sort is dated 1499; the earliest of Da Carpi's is 1518. Printing in chiaroscuro is performed by using several blocks. Ugo da Carpi usually had three; the first for the outline and dark shadows, the second for the lighter shadows, and the third for the half tint. In this manner he struck off prints after several designs, and the cartoons of Raphael, particularly one of the Sibyl, a Descent from the Cross, and the History of Simon the Sorcerer. Carpi died about 1530. The art was brought to a high degree of perfection by Baldassare Peruzzi of Siena, and Parmigiano.

CARPINI, Giovanni di Plano, a Franciscan monk, who about 1246 was sent by pope Innocent IV. to the Great Khan of Tartary, to convert him to Christianity. The mission reached the Mongolian monarch somewhere to the north of the great desert east of the Caspian; where they were long detained, but at last dismissed. Carpini wrote an account of his travels in Latin, an abstract of which, with an Italian translation, appeared in the *Raccolta* of Ramusio, and has been transcribed into the *Navigations and Discoveries* of our own Hakluyt. After his return from his perilous eastern journey, Carpini devoted his life to preaching the gospel in Bohemia, Hungary, Denmark, and Norway. He was born about 1210, and reached extreme old age. For an account of his eastern travels, see Geography.

CARPINO, a city of Italy, in the Neapolitan province Capitanata. It is situated on Mount Gargano. Pop. 5500.

CARPOCRATIANS, a branch of the ancient Gnostics, so called from *Carpocrates*, who in the second century revived the errors of Simon Magus, Menander, Saturinus, and other Gnostics. He owned with them one sole principle and author of all things, whose name as well as nature was unknown. He maintained that the world was created by angels; and he opposed the divinity of Christ—representing him as a mere man, born of Joseph and Mary in the ordinary course of nature, though possessed of uncommon gifts, which set him above other creatures. He inculcated a community of women; and not only gave his disciples license to sin, but imposed on them the necessity of sinning; for he taught that the soul could not be saved till it had committed all kinds of abominations.

CARPOLOGY, that part of botany which treats of the structure of seed-vessels and seeds.

CARRAC or Carraca, the name given by the Portuguese to the vessels which they formerly sent to Brazil and the East Indies. They were of great size and extraordinary depth, and fitted for war as well as burden.

CARRARA, a town of Italy, in the province of Massa-Carrara, about 60 miles S.W. of Modena. N. Lat. 44. 4., E. Long. 10. 7. It stands on a rising ground near the river Avenza, and at a short distance from the Mediterranean. The principal buildings are the collegiate church, the church of La Madonna delle Grazie, and the ducal palace. In the principal square is a colossal statue of one of the duchesses of Modena. The cheapness and excellence of the marble attracts a number of artists to Carrara, where they are formed into an academy. The quarries (from which it derives its name) give employment to the most of the inhabitants. The town is nearly on the site of the ancient Etrurian Luna. Pop. about 6200.

Carrara *Marble*, a species of white marble, which was called *marmor lunense*, and *ligustrium*, by the ancients. It is distinguished from the Parian by the fineness of its grain and superior hardness.

CARRENNO DE MIRANDA, Don Juan, an eminent Spanish painter (1614–1681), studied under Pedro de las Cuevas and Bartolomé Roman. He was appointed painter to the court by Philip IV., and as a colourist is ranked by the Spaniards with Titian and Vandyk. His most celebrated paintings are, a *Magdalen in the Desert*, at Madrid; a *Holy Family*, at Toledo; and a *Baptism of our Saviour*, at Alcala de Henares.

CARRIAGE, a vehicle for the conveyance of persons, goods, merchandise, &c., from place to place. For the construction and mechanical principles of wheel-carriages, see Mechanics.

CARRICK, one of the three districts into which the county of Ayrshire, in Scotland, is divided—Kyle and Cunningham being the other two. The eldest son of the reigning sovereign, as prince of Scotland, enjoys the title of Earl of Carrick.

Carrick-on-Shannon, a market and post-town in the county of Leitrim, Ireland, about 98 miles N.W. from Dublin. N. Lat. 53. 57., W. Long. 8. 5. It stands on the left bank of the Shannon, and contains an Established church, Roman Catholic chapel, county jail, court-house, infirmary, &c. Before the Union it returned two members to the Irish parliament. Its trade and industry are purely local. Pop. 1796.

Carrick-on-Suir, a town of Ireland, county of Tipperary, province of Munster, situated on the Suir, 12 miles south of Clonmel. It was formerly a walled town, and contains some very ancient buildings, such as the bridge, the castle, and the parish church. The other public edifices of importance are the Catholic chapel, the prison, the workhouse of the Union, and the barracks. The town exports a little grain, and has some unimportant cotton manufactures. Pop. (1851) 8202.

CARRICKFERGUS, a maritime county of a town, including the parliamentary borough of the same name, in the province of Ulster, in Ireland. It is surrounded by the county of Antrim on all sides, except the south, which is skirted by the Bay of Carrickfergus (Belfast Lough). It comprises an area of 26 square miles, or 16,700 acres. The surface is in general hilly. Lough Morne, a lake of about 90 acres in extent, is 556 feet above the level of the sea, and the highest mountain, Slieve True, which commands a magnificent prospect, attains an elevation of 1100 feet; but the land near the sea-shore is an alluvial plain. The farms are small, except in the hilly district, where grazing is carried on. The chief crops are oats and potatoes, for which sea-weed, with lime and vegetable matter, forms the manure; and the district has long been famous for the manufacture of cheese. The fisheries are valuable and extensive, and the oysters taken off this coast are highly prized for their size and flavour. About a mile and a-half from the town, on the property of the Marquis of Downshire, rock-salt of remarkable purity and great thickness has recently been discovered, but all searches after coal in this district have proved abortive. The amount of property valued under 6th and 7th Will. IV., c. 84 (Griffith's valuation), is L.13,521.

According to ecclesiastical arrangement, this county forms a single rectory in the diocese of Connor. The population in 1834 numbered 8860 persons, of whom 1387 were of the Established Church; 6499 were Presbyterians and other

Carrickfergus.

Protestant Dissenters, and 974 were Roman Catholics. The entire population of the county and town in 1851 was 8520.

The town of Carrickfergus, from which the county and adjoining bay take their name, is the only place of importance in the district. The town stretches along the shore of Belfast Lough about one mile in length, and consists of the old or walled town in the centre, the Irish quarter on the west, and the Scotch quarter on the east; the latter being chiefly inhabited by fishermen, descendants from a colony driven by religious persecution from Galloway and Argyllshire about the year 1665. The town is irregularly built, and deficient in neatness. The principal building is the old castle, standing on the projecting rock from which the town derives a portion of its name, formerly a place of much strength, and still maintained as an arsenal, and mounted with heavy guns. The ancient donjon or keep, 90 feet in height, is still in good preservation.

The parish church, an antiquated cruciform structure, was originally a chapel or oratory dependant on a Franciscan monastery in another part of the town. The entrance to a subterranean passage between the two establishments is still visible under the communion-table of the church.

The gaol, built on the site of the above-mentioned monastery, was formerly the county of Antrim prison. The court-house, which adjoins the gaol, is a neat building of modern erection, and when Carrickfergus was the county town of Antrim (which it ceased to be in 1850), the assizes were held here. The other public buildings in the town are, the market-place, the Roman Catholic chapel, and meeting-houses for different sects of Protestant Dissenters.

The town has some little trade and manufacture, and vessels of 100 tons burthen can now discharge at the landing pier; but the superior advantages of the neighbouring town of Belfast hinder the extension of the maritime trade of Carrickfergus, which is confined to the import of coal and the export of cattle and grain.

In the reign of Queen Elizabeth the town obtained a charter confirming and extending its former privileges. The corporation was regulated, and the mayor received the jurisdiction of high admiral of the adjoining seas. This charter was confirmed by James I., who added the additional privilege of sending two burgesses to the Irish parliament. The corporation, styled "the mayor, sheriffs, burgesses, and commonalty of the town of Carrickfergus," were superseded, under the provisions of the Municipal Reform act, by a board of municipal commissioners, in whom the corporate property is vested. Originally the corporation property comprised all the land within the county of the town, but by degrees it was wasted down to its present value of about L.330 per annum.

In 1182, John De Courcy, to whom Henry II. had granted all the parts of Ulster he could obtain possession of by the sword, fixed a colony in this district. De Courcy built the castle which afterwards came into possession of the De Lacy family, who, being ejected, invited Edward Bruce to besiege it. After a desperate resistance the garrison surrendered. In 1386, the town was burned by the Scots; and in 1400 destroyed by the combined Scots and Irish. Subsequently, it suffered much by famine and the occasional assaults of the neighbouring Irish chieftains, whose favour the townsmen were at length necessitated to secure by the payment of an annual tribute.

In the reign of Charles I., many Scotch Covenanters settled in this neighbourhood to avoid the persecution directed against them. In the civil wars, in 1641, &c., Carrickfergus was one of the chief places of refuge for the Protestants of the county of Antrim; and on July 10, 1642, the first presbytery held in Ireland met here. In that year the garrison was commanded by General Munroe, who having afterwards relinquished the cause of the English parliament, was, in 1648, surprised and taken prisoner by Sir Robert Adair, who had been sent for the purpose with a troop of horse from Lisburn by General Monk. The town was taken possession of for the English parliament. Carrickfergus was held by the partisans of James II., but surrendered in 1689 to the forces under King William's general Schomberg; and in 1690 was visited by King William, who landed here on his expedition to Ireland.

Carrickmacross ‖ Carrier.

In the beginning of the year 1760 it was unexpectedly surprised by a French squadron under Commodore Thourot, who landed with about 1000 men, and, after holding the place for a few days, evacuated it on the approach of the English troops. The French squadron was attacked two days afterwards near the Isle of Man, by the Æolus, Pallas, and Brilliant frigates, under the command of Captain Elliott, and Commodore Thourot was killed in the action. In the year 1778 the town was alarmed by the sudden appearance of the celebrated Paul Jones in his ship the Ranger; but he left without molesting the town, having, however, succeeded in capturing the Drake, a British sloop-of-war.

The population of the town of Carrickfergus in 1851 was 3543, being 342 less than in 1841. The borough now returns one member to the imperial parliament; the constituency, under 13th and 14th Vict. cap. 69, in 1853, numbered 1195. There is a weekly market on Saturdays, a butter market on Mondays, and a monthly market for the sale of cattle.—(M'Skimin's *History of Carrickfergus;* Thorne's *Irish Almanac for* 1854.) (H. S—R.)

CARRICKMACROSS, a market-town of Ireland, in the county of Monaghan, province of Ulster, 14 miles from Dundalk. The principal public buildings are the parish church and the union workhouse. The ruins of a large castle belonging to the Essex family are to be seen in the neighbourhood. In the town there is a large distillery; and the trade in grain also is considerable. Pop. (1851) 4268, including 1734 in the workhouse.

CARRIER, in its general acceptation, is a person who conveys the goods of another for hire. In its mere colloquial use it was applied to the class of men, now rendered comparatively obsolete by the railway system, who conveyed goods in carts or waggons on the public roads. In jurisprudence, however, the term is collectively applied to all conveyers of property, whether by land or water; and in this sense the late changes and enlargements of the system of transit throughout the world have given additional importance to the subject. The law by which carriers, both by land and sea, are made responsible for the goods intrusted to them, is founded on the prætorian edict of the civil law, to which the ninth title of the fourth book of the Pandects is devoted. The edict itself is contained in these few words, "*Nautæ, Caupones, Stabularii, quod cujusque salvum fore receperint, nisi restituent, in eos judicium dabo.*" The beautiful simplicity of the rule so announced has had a most beneficial influence on the commerce of the world. Throughout the great civilized region, which took its law directly from the Roman fountain, and through the other less civilized countries which followed their commercial code, it laid a foundation for the principle, that the carrier's engagement to the public is a contract of indemnity. It bound him, in the general case, to deliver what he had been intrusted with, or its value; thus sweeping away all secondary questions or discussions as to the conditions of more or less culpability on his part under which loss or damage may have occurred; and it left any limitations on this general responsibility to be separately adjusted by special contract.

The evident utility of the principle caused its adoption in the common law of England, though, without acknowledgment of the source whence it was derived. Lord Mansfield, in Forward *v.* Pittard (1 T. R. 27), thus clearly laid down the principle: "By the custom of the realm—that is, by the common law—a carrier is of the nature of an insurer It is laid down that he is liable for every accident,

Carrier-pigeon.

except by the act of God, or the king's enemies * * * To prevent litigation, collusion, and the necessity of going into circumstances impossible to be unravelled, the law presumes against the carrier, unless it was done by the king's enemies, or by such act as could not happen by the intervention of man; as storms, lightning, or tempests. If an armed force came to rob the carrier of his goods, he is liable; and the true reason is, for fear it may give room to collusion, that the master may contrive to be robbed on purpose, and share the spoil." In the early part of the present century, the law lapsed into a state of confusion by the efforts of carriers to limit their responsibility. They frequently attempted to do so by notices and advertisements, which were only effective so far as they could be brought home to the knowledge of the employer. To obviate the complex inquiries thus arising, the statute called the Carrier's Act, was passed in July 1830, "for the more effectual protection of mail contractors, stage coach proprietors, and other common carriers for hire" (1st Will. IV., cap. 68). It enumerates certain articles of a costly character, beginning with gold and silver, precious stones, jewellery, &c., for which the carrier is not to be responsible, except for the misconduct of himself and his servants, when parcels exceed the value of L.10, unless the nature of the contents have been imparted to him, and any additional charge as insurance premium demanded by him has been paid. It is a condition that a notice of the increased rate so chargeable must be publicly hung up in the carriers' office, and if it be not, he has no benefit from the act. At the same time, the act excludes all limitation of responsibility by mere notice or advertisement, except in the special cases of limitation for which it provides, leaving parties at liberty to make separate contracts. It is understood that canal companies are brought within this act by the 8th and 9th Vict., cap. 42, to enable canal companies to become carriers of goods on their canals. It does not apply to marine navigation; and for the special application of the principle to this great class of carriers the article Charter-party may be consulted. The peculiar statutory laws applicable to railway companies will be found under the head Railway; but here it may be noticed, that questions of considerable delicacy are opened by allowing railway companies the same power of specially stipulating for limited responsibility which belongs to ordinary carriers. The carrier in general has no monopoly, but competes with others; and if one refuse to take a particular risk, another may be found who will not decline it. The railway companies, however, which monopolize the means of transit over so great an area, by self-imposed limitations on their responsibility would virtually abrogate the law over the large districts to which their operations extend; and it becomes questionable how far on grounds of public policy they should possess such a privilege. The public attention was alarmingly directed to this point by an announcement that the directors of one company were determined to relieve themselves of responsibility for the personal safety of passengers conveyed on their line. (J. H. B.)

Carrier-*Pigeon* or *Courier-Pigeon*, a sort of pigeon which is trained to carry letters from one place to another. See Ornithology, *Columba*.

Though these birds be hood-winked, and carried 20, 30, or even 100 miles away, they will return in a very short space of time to the place where they were bred. They are trained to this service in Turkey and Persia; and are carried first, while young, short flights of half a mile, afterwards more, till at length they will return from the farthest part of the kingdom. Every pasha has a basket of these pigeons bred in the seraglio, which, upon any emergency, he despatches, with letters braced under the wings, to the seraglio. Lithgow affirms that one of these birds will carry a letter from Babylon to Aleppo, which is thirty days' journey, in forty-eight hours. The use of carrier-pigeons is very ancient. Hirtius and Brutus, at the siege of Mutina (Modena), maintained a correspondence with each other by means of pigeons. And Ovid relates that Taurosthenes gave notice to his father of his victory at the Olympic games by sending to him at Ægina a pigeon stained with purple.

Carron.

In modern times, the most noted were the pigeons of Aleppo, which served as couriers at Alexandretta and Baghdad. But this use of them was laid aside because the Kurd robbers killed the pigeons. The manner of sending advices by them was this: They took pairs which had young ones, and carried them on horseback to the place whence they wished them to return, taking care to let them have a full view. When the news arrived, the correspondent tied a billet to the pigeon's foot, and let her loose. The bird, impatient to see its young, flew off like lightning, and arrived at Aleppo in ten hours from Alexandretta, and in two days from Baghdad. The carrier-pigeon has nothing very peculiar in its form except its nostrils, which, instead of being smooth and even, are swelled and rough.

In this country there seem to be two other varieties of pigeon frequently used as messengers, namely, the *horseman* and *dragoon*. The following fact is related of the last-named variety:—A gentleman sent a dragoon by the stage-coach to a friend at St Edmund's Bury, along with a note, desiring that the bird, two days after its arrival there, might be thrown up into the air precisely as the town clock struck nine in the morning. This was accordingly done; and the pigeon was observed to fly into a loft in Bishopsgate Street, London, at half-past eleven of the same morning, having flown, probably without any violent exertion, 72 miles in two hours and a half.

Carrier-pigeons are still used to carry occasional despatches from the Bell Rock lighthouse to the northern shore of the Frith of Forth. They refuse, however, to leave the lighthouse during hazy weather; and as in this country considerable training seems necessary, the feats of these aerial messengers, though very admirable, are not so purely instinctive, and consequently not so unerring, as is usually supposed. Their use in obtaining intelligence of changes in the foreign stocks is well known.

CARRON, a small but remarkable river in Scotland, rising about the middle of the isthmus between the Friths of Forth and Clyde. Both its source, and the place where it empties itself into the sea, are within the shire of Stirling, which it divides into two nearly equal parts. The whole length of its course, which is from west to east, is not above fourteen miles. It falls into the Frith of Forth about three miles to the N.E. of Falkirk. The stream is small, and scarcely deserves the notice of a traveller; yet there is no river in Scotland, and few in the whole island of Britain, whose banks have been the scene of so many memorable transactions. When the Roman empire was in all its glory, and had its eastern frontiers upon the Euphrates, the banks of the Carron were its boundaries upon the N.W.; for the wall of Antoninus, which was raised to mark the limits of that mighty empire, stood in the neighbourhood of this river, and ran parallel to it for several miles.

From the valley of Dunipace the river runs for some time in a deep and hollow channel, with steep banks on both sides. Here it passes by the foundations of the ancient Roman bridge, not far from which, as is generally thought, was the scene of the memorable conference between the Scottish patriot William Wallace and Robert Bruce (father of the king of that name), which first opened the eyes of the latter to a just view both of his own true interest and that of his country.

After the river has left the village and bridge of Larbert it soon enters another smaller valley, through the midst of which it has now worn out to itself a straight channel; but in former ages it had taken a considerable sweep round, as appears by the track of the old bed, which is still visible.

The high and circling banks upon the south side give to this valley the appearance of a spacious bay; and, according to the tradition of the country, there was once a harbour here. Nor does the tradition seem altogether groundless—pieces of broken anchors having been found here, and some of them at no distant period. The stream-tides would still flow near the place if they were not kept back by the dam-head built across the river at Stenhouse; and there is reason to believe that the frith flowed considerably higher in former ages than it does at present. In the near neighbourhood of this valley, upon the south, stand the ruins of ancient Camelon, which after it was abandoned by the Romans was probably inhabited for some ages by the natives of the country.

Another ancient monument called *Arthur's Oven* once stood upon the banks of the Carron; but it has been entirely demolished. The corner of a small inclosure between Stenhouse and the Carron iron-works is pointed out as the place where it stood. This is generally supposed to have been a Roman work; though it is not easy to conceive what could be their motive for erecting such a fabric at so great a distance from any other of their works, and in a spot which at that time must have been very remote and unfrequented.

As the Carron extends over half of the isthmus, and runs so near the ancient boundaries of the Roman empire, the adjacent country naturally became the scene of many battles and rencounters. Historians mention a bloody battle fought near the river between the Romans and the confederate army of the Scots and Picts in the beginning of the fifth century. The scenes of some of Ossian's poems were, according to Macpherson, upon the banks of this river. About the distance of half a mile from the river, and near the town of Falkirk, is the field of battle where the English defeated Wallace in the year 1298. It goes by the name of *Graham's muir*, from the valiant Sir John Graham, who fell there, and whose gravestone is still to be seen in the churchyard of Falkirk.

Carron, a small village of Scotland, at which the celebrated iron-works are situated, lies in the parish of Larbert, on the northern bank of the river Carron, about two miles from Falkirk. These works belong to a chartered company established in 1760, with a capital of L.150,000, and afford employment to upwards of 2000 individuals.

CARRONADE, a short piece of ordnance, with a large calibre, and a chamber for the powder, like a mortar. It will throw a ball or a shell, and is very useful in close engagements at sea. This species of cannon takes its name from Carron, where it was first made, or the principle applied to an improved construction.

CARROT (*Daucus carota*, Lin.), a well-known biennial plant, a native of Britain. See Agriculture.

CARROUSAL, a course of chariots and horses, or a magnificent entertainment given by princes or other great personages, who, richly dressed and equipped after the manner of ancient cavaliers, and divided into squadrons, met in some public place to practise jousts, tournaments, and the like. The last carrousals in France were in the reign of Louis XIV. The word comes from the Italian word *carosello*, a diminutive of *carro* a chariot. Tertullian ascribes the invention of carrousals to Circe, and states that they were instituted in honour of the Sun, her father; whence some derive the word from *carrus*, or *carrus solis*. The Moors introduced ciphers, liveries, and other ornaments of arms, with trappings, &c., for their horses; and the Goths added crests, plumes, &c. See Tournament.

CARRUCA, in *Antiquity*, a splendid kind of car or chariot, mounted on four wheels, and richly decorated with gold, silver, ivory, &c., in which the emperors, senators, and people of rank were carried. The word comes from the Latin *carrus*, or British *car*

Carruca, or Caruca, is also used by writers of the middle ages to signify a plough, in French, *charrue*.

CARRUCATE (*carucata*), in our ancient laws, as much land as one team can plough in a year.

In Doomsday Inquisition the arable land is estimated in carrucates, the pasture in hides, and the meadow in acres. Skene makes the *carrucata* the same with *hilda* or *hida terræ*; Littleton, the same with soc.

In the reign of Richard I. a carrucate was estimated at sixty acres, and at one period of the same reign at a hundred acres; in the time of Edward I. it was rated at a hundred and eighty acres; and in the twenty-third of Edward III. a carrucate of land in Burcester contained a hundred and twelve acres, and in Middleton a hundred and fifty acres.

By a statute of William III., charging persons to repair the highways, a plough-land is rated at fifty pounds per annum, and may contain buildings, wood, pasture, &c.

CARRYING, in falconry, signifies a hawk's flying away with the quarry, instead of obeying the lure.

Carrying, among huntsmen, is when a hare runs on ground which sticks to her feet.

CARSE, a word signifying a flat piece of ground by a river, has been applied to three several tracts of country in Scotland, namely, the Carse of Falkirk, the Carse of Gowrie, and the Carse of Stirling.

CARSON, Aglionby Ross, M.A., LL.D., an eminent teacher and scholar, and for 25 years rector of the High School of Edinburgh, was born at Holywood in Dumfriesshire in 1778. He received the elements of his education at the Wallace Hall Academy, where he afterwards acted as assistant for two years. In 1801 he was elected to the rectorship of the Dumfries Grammar School, and in 1806 to a mastership in the High School of Edinburgh. When the rectorship of that latter seminary became vacant in 1820, it was conferred upon Mr Carson, who held it till his retirement in 1845. In 1826 his services to the cause of classical learning in Scotland were acknowledged by the University of St Andrews, which conferred upon him the degree of LL.D. His excellent editions of Phædrus, Tacitus, and other classics, are still extensively used in Scotland; but his most important work is his *Rules for the Construction of the Relative Qui, Quæ, Quod, established by a copious selection of Examples from Classical Authors;* a treatise to whose merits emphatic testimony has been borne by the most eminent scholars of the day. (See Dr Parr's works, vol. viii. pp. 533–54.) Dr Carson died in 1850.

CARSTAIRS or CARSTARES, William, an eminent Scottish divine, born at the village of Cathcart near Glasgow in 1649. He received the rudiments of his education at a school at Ormiston in East Lothian; but on commencing his studies for the church he removed to Edinburgh, and subsequently studied theology and philosophy at the University of Utrecht. While abroad he became acquainted with pensionary Fagel, and warmly espoused the interests of the Prince of Orange. On his return he became disheartened at the arbitrary proceedings of the Episcopal clergy, who were then high in the confidence of the king, and resolved immediately to retire to Holland; but he was speedily brought back to stand his trial on a charge of having been accessory to the Rye-house plot, and of being the medium of communication between the Presbyterian party in Scotland and the exiles in Holland. On manifesting great reluctance to divulge the nature of the correspondence with which he had been intrusted, he was put to the torture, but refused to make any disclosures until he had received the assurance that his replies should not be taken in evidence against himself or his compatriots. Having received the king's pardon, he was dismissed, and retired to Holland, where he rose still higher in the favour of the Prince of Orange. On King William's accession to the throne he

was appointed royal chaplain for Scotland, and contributed greatly to the firm establishment of the Presbyterian form of church government in that country. He still held his chaplaincy in the reign of Queen Anne; and while exercising considerable influence over the minds of the Scottish clergy in inducing them to approve of the Treaty of Union, he exerted himself strenuously to oppose the restoration of patronage in the church. In 1704 he was appointed principal and professor of divinity in the University of Edinburgh, in addition to the ministerial charge, first of the Greyfriars and afterwards of the High Church. He was four times chosen moderator of the General Assembly; and on the accession of George I. was sent on a deputation from the Assembly to congratulate the king. Carstairs died in 1715, and in 1744 was published the volume of *State Papers* from which he is chiefly known. They were edited by the Rev. Dr M'Cormick.

CART, a carriage with two wheels, drawn commonly by horses, and used to carry heavy goods, &c. The word seems formed from the French *charrette*, or the Latin *carreta*, a diminutive of *carrus*. See MECHANICS, *Wheel-carriages*.

CARTS *of War*, a peculiar kind of artillery anciently in use among the Scotch. In an act of parliament passed in 1456 they are thus described: "It is thought speidfull, that the king may requeist to certain of the great burrous of the land that are of ony myght, to mak carts of weir, and in ilk cart twa gunnis, and ilk ane to have twa chalmers, with the remnant of the graith that effeirs thereto, and an cunnand man to shut thame." By another act passed in 1471, the prelates and barons are commanded to provide such carts of war against their old enemies the English.

CARTE, THOMAS, an English historical writer, was the son of a clergyman, and was born at Clifton in Warwickshire in 1686. He took orders in 1713, but on the accession of George I. refused to take the oaths to government, and laid aside his clerical habit. From his open attachment to the house of Stuart he became obnoxious to government; and a reward of L.1000 having been offered for his apprehension, he fled to France, where he prepared an English translation of the works of De Thou. About 1703 he obtained permission to return to England, and began to write *The History of the Life of James, Duke of Ormonde, from his birth in* 1610, *to his death in* 1688. In 1744, when preparing to publish his *History of England*, he again fell under the suspicion of the government and was committed to prison, but was soon released. The last volume of his history did not appear till after his death, which took place in 1754.

CARTE-BLANCHE (French, white paper), a blank paper signed at the bottom with a person's name, and sometimes sealed with his seal, given to another person with power to superscribe what conditions he pleases.

CARTEL, a writing or agreement between two states for the exchange of prisoners of war. Cartel signifies also a letter of defiance or challenge to single combat. See DUEL.

CARTEL *Ship*, a ship employed in the exchange of prisoners, or in carrying propositions between belligerent powers. A cartel ship is allowed to carry no cargo, ammunition, or warlike implements, except one gun for firing signals.

CARTES, RÉNÉ DES, or DESCARTES, RÉNÉ, was born at La Haye, in Touraine, on the 31st of March 1596, and descended of a noble family, who came originally from Bretagne. In infancy his constitution was extremely delicate, or rather weak, a peculiarity which he shared in common with many other men of genius; and, in fact, it is sometimes in the feeblest body that the intellectual faculties exhibit the greatest vigour. He was educated among the Jesuits, then recently established in the college of La Flèche, and early distinguished himself by an extreme passion for study. It was at this seminary that he became first connected with Mersenne, afterwards a monk of the order of Minims, whose friendship was subsequently approved by its usefulness as well as fidelity to the illustrious object of it. Having completed the usual course of scholastic study, and of what was then as it is still in some parts of the world called *philosophy*, Descartes at once perceived the worthlessness of the acquisition he had made; but he was keenly alive to the interest and importance of the mathematical sciences, which nature had destined him to renovate. The first thing which he did on leaving college was, as he tells us in his Discourse on Method, to renounce all books, and to labour to efface from his mind every thing uncertain which he had learned, in order henceforward to admit nothing except what appeared to him to be demonstrated by reason and experience; and, in following out this mode of inquiry, he invented that method of sceptical examination which has since become the first principle of all our positive knowledge. At the present day we are unable to appreciate fully the greatness of such an effort, because we are educated in conformity with this very doctrine, which appears to us as natural as it is reasonable. But if we reflect that, at the period when Descartes lived, the Aristotelian philosophy exercised a despotic dominion over all minds, that it reigned supreme in the world as well as in the colleges, that it seemed a necessary support of religion, and that to doubt its truth was then considered as an act of unpardonable temerity, if not a crime, some conception may be formed of that force of mind which enabled a young man of nineteen to discard this intellectual idolatry, and to undertake the reformation of all his opinions. Nor is it less wonderful that at the period in question Descartes seems to have been in possession of his finest geometrical discoveries. This is sufficiently evinced by the history of his life; but the time had not yet arrived for the publication of his new ideas; and he thought that travelling, by extending his knowledge of mankind, would furnish him with favourable opportunities for improving himself in the only true philosophy.

Accordingly, he went abroad, and, conformably with his condition and the manners of his age, engaged in the profession of arms. He served successively as a volunteer in the army of Holland and in that of the Duke of Bavaria; and, in 1620, he was present at the battle of Prague. But although the ardour of youth led him then to take some pleasure in this tumultuous kind of life, he nevertheless knew how to appreciate rightly the bloody game of war; and seeking neither advancement nor fortune, he consented to take part in it only because it was necessary to accompany the men whom he wished to study closely. In the midst of camps he accordingly continued his metaphysical and mathematical speculations, and, as often as an occasion presented itself, put them to the test of experimental application. While he was in garrison at Breda, chance led him one day to a place where he observed on a wall a placard written in Flemish, with a number of persons assembled in a group before it, and containing the enunciation of a geometrical problem, which some unknown person proposed to mathematicians, according to the usage of the time. Not understanding Flemish, Descartes requested one of the spectators to explain the problem. The person to whom he applied was Beckman, principal of the college of Dort, and himself a mathematician, who, finding the problem very difficult, appeared surprised to see a young soldier inquiring about things of this sort, and, in answering him, assumed that air of pedantry and superiority which is common enough among his tribe; but his astonishment was extreme when the young soldier without hesitation promised a solution of the problem, and

actually transmitted it to him the following day.[1] For several years Descartes continued to lead this meditative and military life; but at length the reverses of which he was a witness in Hungary disgusted him with the profession of arms, which he therefore renounced, and continued his travels as a private individual. At this period an adventure happened to him which had nearly cost him his life. He had completed his travels through the north of Germany, and was returning to Holland by sea, when the crew of the vessel on board of which he had embarked, observing him to be of a quiet and gentle disposition, took him for a young man without experience, and concluded that it would be an easy matter to kill him, in order to take possession of his property, more especially as he was only attended by a single French domestic. Having come to this resolution, they held council together as to the means of executing their project; and they did not scruple to do so in the presence of their intended victim, under the impression that, being a foreigner, he would not understand them. But in this they were fortunately mistaken. Descartes had understood every word that passed, and when he was fully aware of their design, he started up suddenly, drew his sword, and addressing the ruffians in their own tongue, and in a determined manner, threatened to run them through if they dared to offer him the slightest insult. Intimidated by his boldness, the villains relinquished their purpose, and put him ashore in safety at the place where he wished to land. He then visited in succession Holland, France, Italy, Switzerland, the Tyrol, and ultimately spent some time at Venice and at Rome. Whilst in Italy, he did not visit Galileo, who had just entered upon the career of experimental philosophy; and, what is still more remarkable, he seems never to have entertained a proper sense of the merit of this great man; a circumstance which of itself would be sufficient to prove that Descartes, although admirable as a geometrician, was ignorant of the true method by which alone the physical sciences can be advanced.

Having returned from his travels, and taken a survey of the various occupations of men, Descartes perceived that the only one which suited him was the cultivation of reason; but as his ardent temperament naturally led him into extremes, he conceived a notion that, if he remained in France, he would neither be sufficiently solitary nor sufficiently free for the prosecution of the pursuits in which he was anxious to engage. Accordingly, having sold part of his property, he, in 1629, retired into Holland, which he regarded as a tranquil retreat, peculiarly suitable for peaceful and free meditation; and there applied himself to the study of metaphysics, anatomy, chemistry, and astronomy. He composed a treatise on the System of the World, such as he then conceived it; but on the news of the imprisonment of Galileo, he suppressed this production; and it was probably the dread of similar persecution which caused him, at a later period, to adopt the improbable and absurd notion of the sun and the planets revolving round the earth, as Tycho Brahe had done before him. As yet Descartes had published no mathematical work of any extent; but his genius for the exact sciences, and his immense superiority over the greater part of his contemporaries, were already evinced by the extreme facility with which he resolved, almost in sport, the questions which appeared to them the most difficult. The vivacity of his character involved him in quarrels with some of them; and in these he was sometimes in the right, sometimes in the wrong. He was in the right with Roberval, a French mathematician, who, denying his genius, laboured long to represent him as a vile plagiary of the discoveries of others; but he was in the wrong with regard to Fermat, to whom he did not at first do full justice, and who, though able to maintain a contest on equal terms, was ever desirous to render homage to the genius of Descartes, and to seek his friendship. At length, yielding to the solicitations of his friends, and probably influenced by an honourable desire to shut the mouths of his adversaries, Descartes consented to publish his discoveries. But attaching more value to metaphysical speculations, to which he had then devoted himself, than to the geometrical methods of which he was the inventor, and which had already perhaps lost the charm of novelty, he gave his geometry only as a single chapter of his Treatise on Method, and this chapter was worked up slightly and in haste. Posterity, however, has reversed this judgment, and regarded the geometrical labours of Descartes as affording the best proofs of his genius. Before his time considerable progress had been made in researches purely algebraic, and the resolution of equations of the second, third, and fourth order had already been invented; but the notation employed was still rude, and affected by material relations, which intermixed with algebra, strictly so called, ideas of length, of surface, and of solidity. Algebra, however, is a language the special object as well as the principal advantage of which is to express only the abstract relations of quantities. To extend it, therefore, it is necessary to begin by freeing it from all foreign considerations or elements by which it is limited. Descartes was the first who rendered it this important service; for the metaphysical bent of his mind, which was injurious to him in the sciences of application, proved singularly useful in this particular. According to the ancient limitation of algebra, the successive products of the same quantity were represented in the three first dimensions by a square and a cube in perspective, sometimes by the initial letter of the word "square" or the word "cube" placed above the quantity, and sometimes by the repetition of the letter by means of which the quantity was designated. For this embarrassing mode of notation, which impeded the current of thought, Descartes substituted one clear, simple, general, and, above all, adapted to the purposes of calculation. He placed a cipher above the quantity, and by its different values he indicated the different powers of that quantity. But his greatest discovery consisted in the application of algebra to geometry. He imagined that the nature of each curve might be expressed and defined by a certain relation between two variable lines, of which one represented the absciss and the other the ordinate; and he conceived that, in order to find this relation, it would be sufficient to express in algebraic language one of the characteristic properties of the curve, as, for instance, of the circle, which is a plane curve, all the points of which are equidistant from a given point called the centre. And this discovery had the inestimable advantage, that being once translated into a formula, all that remained to be done was to consider in an abstract manner the resultant equation, in order to deduce from it the other geometrical properties involved in the primary definition.

Descartes, however, did not stop here; but, pursuing his investigations, he made a discovery exactly the inverse of the preceding. Having learned to express and to know the properties of curves by algebraic equations, he no longer

[1] It was during his stay at Breda that Descartes composed his *Compendium Musicæ*, which was not printed till after his death. (Utrecht, 1650, 4to.) A French translation by Father Poisson, of the Oratory, will be found at the end of the *Méchanique* of Descartes. Paris, 1668, 4to.

regarded these equations, except as emblems of curves intersected so that the abscisses formed the roots of the equations; and, once in possession of these general methods, he was enabled to enunciate in algebraic language, and to resolve directly, geometrical problems which had baffled all antiquity. This he himself exemplified in the very first question of his geometry; and it is easy to conceive how, possessed of this secret, he was enabled to disport with the greater part of the questions which puzzled the mathematicians of his age. His geometry, at the time when it appeared, was found exceedingly difficult to read; and he himself tells us that he had not sought to develop the different steps of procedure by which he arrived at his results; but at the present day his methods are the first which are taught to youth, and for this reason they appear to us much more easy. In a word, the treatise on geometry does honour to the genius of Descartes, and forms one of his proudest titles to immortality.

His Discourse on Dioptrics also contains many ingenious geometrical applications; but whilst the unequal refrangibility of the different rays of light was unknown, it was impossible that any available progress could be made in this branch of science. Nevertheless it contains another proof of the genius of Descartes in the discovery therein made of the true law of refraction; a discovery which was contested by Huygens after his death, but which, notwithstanding the pretensions of that philosopher, unquestionably belongs to him. The Treatise on Meteors, which is also contained in his Discourse on Method, is much more imperfect than his Dioptrics, inasmuch as he gives rein to his imagination, and undertakes to explain all meteorological phenomena, including even the formation of lightning. It is, however, distinguished by a discovery; for he has given the true theory of the rainbow, as far as it was possible to do so at a period when the unequal refrangibility of light was altogether unknown. His *Principia*, or Principles of Philosophy, were first published in 1644, at the age of forty-nine. This work is divided into four parts; the first, devoted to rational philosophy or metaphysics, contains an exposition of the principles of all human knowledge; the second treats of the principles of natural things; and the last two develop his theory of the system of the world, the once celebrated, but, since the time of Newton, for ever exploded theory of vortices. We abstain from making any observations either as to the metaphysical notions or physical theories of Descartes, both of which have been treated of with consummate ability and sufficient amplitude of detail in the Dissertations prefixed to this work. With regard to the former, we shall merely add, that in his celebrated Discourse on the Method of conducting the Reason, and seeking Truth in the Sciences, published in 1637, Descartes had already made known the principal points of his doctrine, and broached the most abstract questions of metaphysics. These, however, he had treated with greater order and fulness in the not less celebrated work which he published in 1641, three years before his *Principia*, entitled "Meditations concerning the first Philosophy, in which are demonstrated the Existence of God, and the Immortality of the Soul." These Meditations are six in number, forming a book small in itself, but which was considerably enlarged by the objections of several metaphysicians of the time, among whom may be mentioned Arnauld, Gassendi, and Hobbes, and by the answers which Descartes made to these objections. They were originally published in Latin; but, in 1642, the Duke of Luynes translated the Meditations, and Clerselier the Objections and Answers, into French.

The influence which Descartes exercised over his age was very great indeed; his fame spread rapidly, and soon became all but universal. In France, particularly, the novelty of his hypotheses, the grandeur and boldness of his views, and the apparent generality of his methods, swayed more or less the most cultivated minds of the age of Louis XIV. It has been remarked that his partizans were for the most part of the number of those who professed the most independent ideas. Bossuet and Fenelon, Malebranche and the principal members of the congregation of the Oratory, and almost all the writers of the celebrated school of Port-Royal, adopted Cartesianism; and from the same source Pascal derived that spirit of discussion which distinguishes the Provincial Letters. The Jesuits were later in giving in their adherence to the dominant philosophy; and the University admitted it still more reluctantly, and only as it were at the last extremity. But in its transmission the metaphysical doctrine of Descartes experienced the fate which must ever attend all systems of dogmatic philosophy. In adopting it, each modified it according to the bent of his own mind, or the cast of his own character; receiving or rejecting as much of it as suited his convenience, and deducing from it consequences which, in their turn, formed the basis of new systems. Hence the most opposite, not to say contradictory theories, all acknowledged Cartesianism as their common source. From it Malebranche derived his mystical spiritualism, and Berkeley his pure idealism; Spinosa found in it the germ of what has been called his materialism; and the greater part of the schools of philosophy which have succeeded each other in Germany since the time of Descartes, may be considered as originating in the same common source.

The writings of Descartes involved him in controversy, and exposed him to persecution. His disputes with Roberval and Fermat have been already noticed by us when adverting to his geometrical investigations and discoveries. But controversies purely scientific are seldom pursued with exasperation, or calculated to mar the happiness of life; and, in point of fact, if Descartes was misrepresented by Roberval, he was guilty of injustice to Fermat. In the hazy region of metaphysics, however, where it is equally difficult to attain any measure of certainty, and easy to discover pretexts for accusations of error or heresy, the most violent contentions are commonly engendered, and men's passions become excited and envenomed from the very cause which ought to beget charity and forbearance. And so it proved in the case of Descartes. To his metaphysical writings he owed all the disputes which served to disturb the tranquillity of his life; and amongst the clergy he found the bitterest enemies and persecutors. Of the latter, by far the most inveterate was Gisbert Voet, primarius professor of theology in the university of Utrecht; a man whose respectable station and austere manners had secured him a degree of credit much beyond what was due to his ability or learning, and who felt no compunction in accusing of atheism a philosopher who had exhausted all the resources of his genius to discover new demonstrations of the existence of God. But when hatred addresses itself to credulity, it is almost certain to triumph. The fierce theologian of Utrecht attempted in vain to engage Father Mersenne, the intimate and much-loved friend of Descartes, to write publicly against him in defence of the Catholic religion; but though deceived in his expectation of enlisting Mersenne as an auxiliary, he did not relinquish his design; and by continued solicitations and manœuvres he at length succeeded in "impetrating" a sentence against Descartes, condemning him to pay a very considerable fine, and ordaining his works to be burned. Voet is said to have assisted the executioner in carrying into effect the latter part of the sentence. The theologians of Leyden, imitating the example of those of Utrecht, soon stirred up a new persecution against the philosopher; who, harass-

Cartes, René des || Carthage.

ed and vexed by these annoyances, cursed the celebrity he had acquired, and regretting the sweets of his retired and studious life, took as his device *Qui bene latuit, bene vixit.*

Whilst he was in this mood of mind, Descartes received an invitation from Christina, queen of Sweden, to repair to the court of that country, where he was promised an asylum and protection. Although he had always loved independence, and valued his liberty so highly that, as he said, no prince on earth could induce him to surrender it, yet he accepted this proposal, as indeed he had every reason to do. It was made to him at a moment when he was unhappy; whilst the honour of being sought after by a great queen, and called to her presence and society, was calculated to be useful in enabling him to confound his persecutors. He determined therefore to quit his hermitage at Egmont, in order to repair to Sweden and pass his days in the rigorous climate of that country. On his arrival at court, he was received with the greatest distinction by the queen, and obtained, at his own solicitation, the favour of being exempted from all observance of ceremony, and of only appearing at court when he was specially called. But as the price of this dispensation, the queen stipulated that he would come to converse with her every morning at five o'clock in her library. Descartes, however, who always needed repose, and whose health required great attention, was unable to bear up under the change of life which this matutinal duty imposed on him, especially in so cold a climate, and during the rigour of winter. He was attacked by a disease in the chest, accompanied with delirium, and expired on the 11th February 1650, at the comparatively early age of fifty-four. The queen wished his remains to be interred amongst those of the first families of Sweden; but the ambassador of France interposed, and his corpse was conveyed to Paris for sepulture among his countrymen.

Cartesian || Carthage.

The works of Descartes have been collected under the title of *Opera Omnia*, Amsterdam, 1690–1701, 9 vols. 4to, or 1713, also 9 vols. The French edition consists of 13 vols. 12mo, containing, 1. Les Principes de la Philosophie, écrits en Latin par Descartes, et traduits en Français par un de ses Amies (Picot), 1724; 2. L'Homme de René Descartes, et la Formation du Fœtus, avec les Rémarques de Louis de Laforge, 1729; 3. Méditations Métaphysiques, 1724; 4. Les Passions de l'Ame, le Monde, ou Traité de la Lumière, et la Géométrie, &c. 1726; 5. Discours de la Méthode, &c. la Dioptrique et les Météores, la Mécanique et la Musique, 1724; 6. Lettres, 1724–1725; together with Bayle's Recueil de quelques Piéces curieuses concernant la Philosophie de Descartes, 1684. (See *Biographie Universelle*, art. DESCARTES.) (J. B—E.)

CARTESIANS, a sect of philosophers, who adhered to the system of Descartes, founded on two principles, the one metaphysical, the other physical. The metaphysical principle is, *I think, therefore I am;* the physical principle is, that *nothing exists but substance.* Descartes considered substances as of two kinds; the one a substance that thinks, the other a substance extended; and hence actual thought and actual extension are, according to him, the essence of substance. The essence of matter being thus fixed in extension, the Cartesians conclude that there is no vacuum, nor any possibility of one, in nature, and that the universe is absolutely full. Mere space is excluded by this principle, because extension being implied in the idea of space, matter is so too. Upon these principles the Cartesians endeavoured to explain mechanically the formation of the world, and to account for the celestial phenomena.

CARTHAGE,

A FAMOUS city of antiquity, the capital of *Africa Propria,* which for many years disputed with Rome the sovereignty of the world. According to Velleius Paterculus, this city was built 65, according to Justin and Trogus 72, according to others 100 or 140 years, before the foundation of Rome. It is agreed on all hands that the Phœnicians were the founders.

History.

The beginning of the Carthaginian history, like that of all other nations, is obscure and uncertain. In the seventh year of Pygmalion, king of Tyre, his sister Elisa, or Dido, is said to have fled, with some of her companions and vassals, from the cruelty and avarice of her brother, who had put to death her husband Sichæus in order to obtain possession of his wealth. She first touched at the island of Cyprus, where she met with a priest of Jupiter, who expressed a desire of attending her; a proposal to which she readily consented, and fixed the priesthood in his family. At that time it was a custom in the island of Cyprus for the young women to go on certain stated days, before marriage, to the sea side, there to look for the arrival of strangers on their coasts, in order to prostitute themselves for gain, that they might thereby acquire a dowry. Of these strange damsels the Tyrians selected eighty, whom they carried along with them. From Cyprus they sailed directly for the coast of Africa; and at last landed safely in the province called *Africa Propria,* not far from Utica, a Phœnician city of great antiquity. The inhabitants received their countrymen with great demonstrations of joy, and invited them to settle in the country. The common fable is, that the Phœnicians imposed upon the Africans. They desired for their intended settlement only as much ground as an ox's hide would encompass. This request the Africans laughed at; but they were surprised when, upon their granting it, they saw Elisa cut the hide into the smallest shreds, by which means it surrounded a large territory, in which she built the citadel called *Byrsa.* The learned, however, are now unanimous in exploding this fable; and it is certain that the Carthaginians for many years paid an annual tribute to the Africans for the ground they occupied.

Byrsa.

The new city soon became populous and flourishing by the accession of the neighbouring Africans, who resorted thither at first with a view of traffic. In a short time it became so considerable, that Jarbas, a neighbouring prince, thought of making himself master of it without any effusion of blood. To effect this, he desired that an embassy of ten of the most noble Carthaginians might be sent to him; and, upon their arrival, he proposed to them a marriage with Dido, threatening war in the event of refusal. The ambassadors, being afraid to deliver this message, told the queen that Jarbas desired some person might be sent to him who was capable of civilizing his Africans, but that there was no possibility of finding any of her subjects who would leave his relations for the conversion of such barbarians. For this they were reprimanded by the queen, who told them that they ought to be ashamed of refusing to live in any manner for the benefit of their country; upon which they informed her of the true nature of their message from Jarbas, adding that, according to her own decision, she ought to sacrifice herself for the good of her country. The unhappy queen, rather than submit to be the wife of such a barbarian, caused a funeral pile to be erected, and put

Carthage.

Dido kills herself.

an end to her life with a dagger. This is Justin's account of the death of Queen Dido; as to Virgil's story of her amour with Æneas, it is obviously fabulous, and was so considered even in the days of Macrobius.

How long monarchical government continued in Carthage, or what happened to this state in its infancy, we are altogether ignorant, by reason of the Punic archives having been destroyed by the Romans; so that there is a chasm in the Carthaginian history for above 300 years. It appears, however, that from the very beginning the Carthaginians applied themselves to maritime affairs, and were formidable by sea in the time of Cyrus and Cambyses. From Diodorus Siculus and Justin it appears that the principal support of the Carthaginians were the mines of Spain, in which country they seem to have very early established themselves; and by means of the riches drawn from these mines they were enabled to equip the formidable fleets which they are said to have fitted out in the time of Cyrus or Cambyses. Justin insinuates that the first Carthaginian settlement in Spain happened when the city of Gades, now Cadiz, was only in its infancy. The Spaniards finding this new colony beginning to flourish, attacked it with a numerous army, insomuch that the inhabitants were obliged to call to their aid the Carthaginians, who very readily granted their request, and not only repulsed the Spaniards, but made themselves masters of almost the whole province in which their new city stood. By this success they were encouraged to attempt the conquest of the whole country; but having to deal with very warlike nations, they could not push their conquests to any great length at first; and it appears from the accounts of Livy and Polybius, that the greater part of Spain remained unsubdued till the time of Hamilcar, Asdrubal, and Hannibal.

First treaty with Rome.

About 503 years before the birth of Christ the Carthaginians entered into a treaty with the Romans. It related chiefly to matters of navigation and commerce. From it we learn that the whole island of Sardinia, and part of Sicily, were then subject to Carthage; that the Carthaginians were very well acquainted with the coasts of Italy, and had previously made some attempts upon them; and that, even at this early period, a spirit of jealousy had been excited between the two republics.

Sicily invaded.

By degrees the Carthaginians extended their power over all the islands in the Mediterranean, Sicily excepted; and for the entire conquest of this island they made vast preparations about 480 years before Christ. Their army consisted of 300,000 men; their fleet was composed of upwards of 2000 men of war and 3000 transports; and with such an immense armament they made no doubt of conquering the whole island in a single campaign. In this, however, they found themselves miserably deceived. Hamilcar their general having landed his numerous forces, invested Himera, a city of considerable importance, and carried on his approaches with the greatest assiduity; but he was at last attacked in his trenches by Gelon and Theron, the tyrants of Syracuse and Agrigentum, who inflicted on the Carthaginians one of the greatest overthrows mentioned in history. A hundred and fifty thousand were killed in the battle and pursuit, and all the rest taken prisoners, so that of so mighty an army not a single individual escaped. Of the 2000 ships of war and 3000 transports of which the Carthaginian fleet consisted, eight ships only, which happened to be out at sea, made their escape, and immediately set sail for Carthage; but these were all cast away, and every soul perished, except a few who were saved in a small boat, and at last reached Carthage with the dismal news of the total loss of the fleet and army. No words can express the consternation of the Carthaginians upon receiving the news of so terrible a disaster. Ambassadors being immediately dispatched to Sicily, with orders to conclude a peace upon any terms, they put to sea without delay, and landing at Syracuse, threw themselves at the conqueror's feet, begging Gelon, with many tears, to receive their city into favour, and grant them a peace on whatever conditions he should choose to prescribe. Gelon granted their request, upon condition that Carthage should pay him 2000 talents of silver to defray the expenses of the war; that they should build two temples, in which the articles of the treaty might be lodged and kept as sacred; and that for the future they should wholly abstain from human sacrifices. This peace, for which there existed so much necessity, was not thought too dearly purchased; and to show their gratitude for Gelon's moderation, the Carthaginians complimented his wife Demerata with a crown of gold worth a hundred talents.

From this time we find little mention of the Carthaginians for seventy years. During the latter period, however, they greatly extended their dominions in Africa, and likewise shook off the tribute which gave them so much uneasiness. They had also warm disputes with the inhabitants of Cyrene, the capital of Cyrenaica, about a regulation of the limits of their respective territories. The consequence of these disputes was a war, which reduced both nations so low that they consented first to a cessation of hostilities, and then to a peace. At last it was agreed that each state should appoint two commissioners, who should set out from their respective cities on the same day, and that the spot on which they met should be the boundary of both states. In consequence of this, two brothers called Philæni were sent out from Carthage, and advanced with great celerity, whilst those from Cyrene were much slower in their motions. Whether this proceeded from accident, or design, or perfidy, we are not certainly informed; but the Cyreneans, finding themselves greatly outstripped by the Philæni, accused them of breach of faith, asserting that they had set out before the time appointed, and consequently that the convention between their principals was broken. The Philæni desired them to propose some expedient by which their differences might be accommodated, promising to submit to it, whatever it might be. The Cyreneans then proposed, either that the Philæni should retire from the place where they were, or that they should be buried alive upon the spot. With this last condition the brothers immediately complied, and by their death gained a large extent of territory to their country. The Carthaginians ever afterwards celebrated this as a most brave and heroic action, paid the brothers divine honours, and endeavoured to immortalize their names by erecting two altars there, with suitable inscriptions upon them.

Dispute with the Cyreneans.

Sicily again invaded.

About the year before Christ 412, some disputes happening between the Egestines and Selinuntines, inhabitants of two cities in Sicily, the former called in the Carthaginians to their assistance, and occasioned a new invasion of Sicily by that nation. Great preparations were made for this war; and Hannibal, whom they had appointed as general, was empowered to raise an army equal to the undertaking, as well as equip a suitable fleet. They also appropriated certain funds for defraying the expenses of the war, intending to exert their whole force to reduce the island under subjection.

The Carthaginian general having landed his forces, immediately marched for Selinus. In his way he took Emporium, a town situated on the river Mazara; and having arrived at Selinus he immediately invested it. The besieged made a very vigorous defence; but at last the city was taken by storm, and the inhabitants were treated with the utmost cruelty. All were massacred by the savage con-

Carthage. queror, except the women who fled to the temples; and these escaped, not through the merciful disposition of the Carthaginians, but because it was feared that, if driven to despair, they would set fire to the temples, and by that means consume the treasure they expected to find in these places. Sixteen thousand were massacred; 2250 escaped to Agrigentum; and the women and children, about 5000 in number, were carried away into captivity. At the same time the temples were plundered, and the city razed to the ground. After the reduction of Selinus Hannibal laid siege to Himera, a city which he desired above all things to become master of, in order that he might revenge the death of his grandfather Hamilcar, who had been slain before it by Gelon. His troops, flushed with their late success, behaved with undaunted courage; but finding that his battering engines did not answer his purpose sufficiently, he undermined the wall, supporting it with large beams of timber, to which he afterwards set fire, and thus laid part of it flat on the ground. Notwithstanding this advantage, however, the Carthaginians were several times repulsed with great slaughter; but at last they became masters of the place, and treated it in the same manner as they had done Selinus. After this, Hannibal, dismissing his Sicilian and Italian allies, returned to Africa.

The Carthaginians were now so much elated that they meditated the reduction of the whole island. But as the age and infirmities of Hannibal rendered him incapable of commanding the forces alone, they joined in commission with him Imilcar, the son of Hanno, one of the same family. On the landing of the Carthaginian army, all Sicily was alarmed, and the principal cities put themselves into the best state of defence they were able. The Carthaginians immediately marched to Agrigentum, and began to batter the walls with great fury. The besieged, however, defended themselves with incredible resolution, burnt in a sally all the machines raised against their city, and repulsed the enemy with great slaughter. In the mean time, the Syracusans, alarmed at the danger of Agrigentum, sent an army to its relief. On their approach they were immediately attacked by the Carthaginians; but after a sharp contest the latter were defeated, and forced to fly to the very walls of Agrigentum, with the loss of about 6000 men. Had the Agrigentine commanders now sallied out and fallen upon the fugitives, the Carthaginian army must in all probability have been destroyed; but, either through fear or corruption, they refused to stir out of the place, and this occasioned its fall. Immense booty was found in the city; and the Carthaginians behaved with their usual cruelty, putting all the inhabitants to the sword, not excepting those who had fled to the temples.

The next attempt of the Carthaginians was intended to be against the city of Gela; but the Geleans, being greatly alarmed, implored the protection of Syracuse; and, at their request, Dionysius was sent to assist them with 2000 foot and 400 horse. The Geleans were so well satisfied with his conduct, that they treated him with the highest marks of distinction; they even sent ambassadors to Syracuse to return thanks for the important services done them by sending him thither; and soon afterwards he was appointed generalissimo of the Syracusan forces and those of their allies, against the Carthaginians. In the mean time, Imilcar, having razed the city of Agrigentum, made an incursion into the territories of Gela and Camarina, which he ravaged in a dreadful manner, carrying off an immense quantity of plunder, which filled his whole camp. He then marched against the city; but though it was indifferently fortified, he met with a vigorous resistance, and the place held out for a long time without receiving any assistance from its allies. At last Dionysius came to its relief with an army of 50,000 foot and 1000 horse. At the head of this body he attacked the Carthaginian camp, but was repulsed with great loss; upon which he called a council of war, the result of whose deliberations was, that since the enemy was so much superior to them in strength, it would be highly imprudent to put all to the issue of a battle, and that the inhabitants should therefore be persuaded to abandon the country, as the only means of saving their lives. A trumpet was accordingly sent to Imilcar to desire a cessation of hostilities until the next day, in order, as was pretended, to bury the dead, but in reality to give the people of Gela an opportunity of making their escape. About the beginning of the night the greater part of the citizens left the place; and Dionysius himself with the army followed them about midnight. To amuse the enemy, he left 2000 of his light-armed troops behind him, commanding them to make fires all night, and set up loud shouts, as though the army still remained in the town. But at day-break this body took the same route as their companions, and pursued their march with great celerity. The Carthaginians, finding the city deserted by almost all its inhabitants, immediately entered it, putting to death such as remained; after which Imilcar, having thoroughly plundered it, moved towards Camarina. The inhabitants of this city had been likewise drawn off by Dionysius, and it underwent the same fate with Gela.

Notwithstanding these successes, however, Imilcar finding his army greatly weakened, partly by the casualties of war, and partly by a plague which broke out in it, sent a herald to Syracuse to offer terms of peace. His unexpected arrival was very agreeable to the Syracusans, and a peace was immediately concluded, upon the conditions that the Carthaginians, besides their ancient acquisitions in Sicily, should still possess the countries of the Silicani, the Selinuntines, the Himereans, and Agrigentines; that the people of Gela and Camarina should be permitted to reside in their respective cities, which, however, were to be dismantled, upon their paying an annual tribute to the Carthaginians; and that all the Sicilians should preserve their independence, except the Syracusans, who were to continue in subjection to Dionysius.

Carthaginians attacked by Dionysius.

The tyrant of Syracuse, however, had concluded this peace with no other view than to gain time, and to put himself in condition to attack the Carthaginian territories at greater advantage. Having accomplished his object, he acquainted the Syracusans with his design, and they immediately approved of it; upon which he gave up to the fury of the populace the persons and possessions of the Carthaginians who resided in Syracuse, and traded there, relying on the faith of treaties. As there were at that time many of their ships in the harbour, laden with cargoes of great value, the people immediately plundered them, and, not content with this, ransacked their houses in a most outrageous manner. This example was followed throughout the whole island; and in the mean time Dionysius dispatched a herald to Carthage, with a letter to the senate and people, telling them, that if they did not immediately withdraw their garrisons from all the Greek cities in Sicily, the people of Syracuse would treat them as enemies. With this demand, however, he did not allow them time to comply; for, without waiting for any answer from Carthage, he advanced with his army to Mount Eryx, near which stood the city of Motya, a Carthaginian colony of great importance, which he immediately invested. But soon afterwards, leaving his brother Leptines to carry on the attack, he proceeded with the greater part of his forces to reduce the cities in alliance with the Carthaginians. He destroyed their territories with fire and sword, levelled all their trees, and then invested Egesta and Entella, most of the other towns having opened their gates at his approach; but these having baffled his utmost efforts, he returned to

Carthage.

Motya, and pushed on the siege of that place with the utmost vigour. The Carthaginians, in the mean time, though alarmed at the message sent them by Dionysius, and reduced to a miserable condition by the plague, which had broken out in their city, did not despond, but dispatched officers to Europe, with considerable sums, to raise troops with the utmost diligence. Ten galleys were also sent from Carthage to destroy all the ships that might be found in the harbour of Syracuse. The admiral, according to his orders, entered the harbour during the night, without being discerned by the enemy; and having sunk most of the ships he found there, returned without the loss of a man. Meantime the Motyans defended themselves with incredible vigour; whilst their enemies, desirous of revenging the cruelties exercised upon their countrymen by the Carthaginians, fought like lions. At last the place was taken by storm, and the Greek soldiers began a general massacre, which Dionysius was for some time unable to restrain; but at last he ordered the Motyans to fly to the Greek temples, which they accordingly did, and a stop was thus put to the slaughter. The soldiers, however, took care thoroughly to plunder the town, in which they found great treasure.

The following spring Dionysius invaded the Carthaginian territories, and made an attempt upon Egesta; but here he was again disappointed. The Carthaginians were greatly alarmed at his progress; but next year, notwithstanding a considerable loss sustained in a sea-fight with Leptines, Himilco their general landed a powerful army at Panormus, seized upon Eryx, and then advancing towards Motya, made himself master of it before Dionysius could send any forces to its relief. He next proceeded to Messana, which he likewise besieged and took; after which most of the Siculi revolted from Dionysius.

Greeks defeated at sea.

Notwithstanding this defection, Dionysius, finding that his forces still amounted to 30,000 foot and 3000 horse, advanced against the enemy. At the same time Leptines was sent with the Syracusan fleet against that of the Carthaginians, but with positive orders not to break the line of battle upon any account whatsoever. Notwithstanding these orders, he thought proper to divide his fleet, and the consequence was that he suffered a total defeat, above 100 of the Syracusan galleys being sunk or taken, and 20,000 men killed either in the battle or in the pursuit. Dionysius, disheartened by this misfortune, returned with his army to Syracuse, being afraid that the Carthaginian fleet might become masters of that city if he advanced to fight the army. On the other hand, Himilco did not fail immediately to invest the capital; and would certainly have become master of it, and consequently of the whole island, had not a most malignant pestilence obliged him to desist from all further operations. This dreadful malady made great havock among his forces both by land and sea; and, to complete his misfortunes, Dionysius attacked him unexpectedly, totally ruined his fleet, and made himself master of his camp.

Syracuse besieged.

Himilco obliged to return.

Himilco, finding himself altogether unable to sustain another attack, was obliged to come to a private agreement with Dionysius, who for three hundred talents consented to permit him to escape to Africa with the shattered remains of his fleet and army. The unfortunate general arrived at Carthage clad in mean and sordid attire, where he was met by a great number of people bewailing their sad and inauspicious fortune. Himilco joined them in their lamentations; and, being unable to survive his misfortunes, put an end to his own life. Having left Mago in Sicily to take care of the Carthaginian interests in the best manner he could, this person treated all the Sicilians subject to Carthage with the greatest humanity; and, having received a considerable number of soldiers from Africa, he at last formed an army, with which he ventured a battle. But in this he was defeated, and driven out of the field, with the loss of 800 men; which obliged him to desist from further attempts of that nature.

Another invasion of Sicily.

Notwithstanding these terrible disasters, the Carthaginians could not refrain from making new attempts upon the island of Sicily, and about the year before Christ 392 Mago landed in it with an army of 80,000 men. This attempt, however, was attended with no better success than the former ones; and Dionysius found means to reduce him to such straits for want of provisions, that he was obliged to sue for peace, which lasted nine years. At the end of this period the war was renewed with various success, and continued with little interruption till the year before Christ 376, when the Syracusan state being rent by civil dissensions, the Carthaginians thought it a proper time to exert themselves, in order to become masters of the whole island. They fitted out a great fleet, and entered into alliance with Icetas, tyrant of the Leontini, who pretended to have taken Syracuse under his protection. By this treaty the two powers engaged to assist each other in order to expel Dionysius II.; after which they were to divide the island between them. The Syracusans applied for succours to the Corinthians, who readily sent them a body of troops under the command of Timoleon, an experienced general. By a stratagem this commander succeeded in landing his forces at Taurominium. The whole of them did not exceed 1200 in number; yet with these he marched against Icetas, who was at the head of 5000 men, surprised his army at supper, put 300 of them to the sword, and took 600 prisoners. Then marching to Syracuse, he penetrated into one part of the town before the enemy had any notice of his approach. Here he took post, and defended himself with such resolution, that he could not be dislodged by the united power of Icetas and the Carthaginians.

In this place he remained for some time in expectation of a reinforcement from Corinth, till the arrival of which he did not judge it practicable to extend his conquests. But the Carthaginians, being apprised that the Corinthian succours were detained by tempestuous weather at Thurium, posted a strong squadron, under Hanno their admiral, to intercept them in their passage to Sicily. That commander, however, not imagining the Corinthians would attempt a passage to Sicily in such a stormy season, left his station at Thurium, and ordering his seamen to crown themselves with garlands, and adorn their vessels with bucklers of both the Greek and Carthaginian form, sailed to Syracuse in a triumphant manner. Upon his arrival there, he gave the troops in the citadel to understand that he had taken the succours Timoleon expected, thinking by this means to intimidate them into a surrender. But while he thus trifled away his time, the Corinthians marched with great expedition to Rhegium, and, taking the advantage of a gentle breeze, crossed over into Sicily. Mago, the Carthaginian general, no sooner received information of the arrival of this reinforcement, than he was struck with terror; and though the whole Corinthian army did not exceed 4000 men, he soon afterwards weighed anchor, in spite of all the remonstrances of Icetas, and set sail for Africa. But he no sooner arrived, than, overcome with remorse and shame for his unparalleled cowardice, he laid violent hands on himself. His body was hung upon a gallows or cross, in order to deter succeeding generals from forfeiting their honour in so flagrant a manner.

Exploits of Timoleon.

After the flight of Mago, Timoleon carried all before him. He obliged Icetas to renounce his alliance with the state of Carthage, nay even deposed him, and continued his military preparations with the greatest vigour. On the other hand, the Carthaginians prepared for the ensuing campaign with the utmost alacrity. An army of

70,000 men was sent over, with a fleet of 200 ships of war and 1000 transports laden with warlike engines, armed chariots, horses, and all other sorts of provisions. This immense multitude, however, was overthrown on the banks of the Crimesus by Timoleon; 10,000 were left dead on the field of battle, and of these more than 3000 were native Carthaginians of the best families in the city. Above 15,000 were taken prisoners; and all their baggage and provisions, with 200 chariots, 1000 coats of mail, and 10,000 shields, fell into Timoleon's hands. The spoil, which consisted chiefly of gold and silver, was so immense that the whole Sicilian army was occupied three days in collecting it and stripping the slain. After this signal victory, he left his mercenary forces upon the frontiers of the enemy, in order to plunder and ravage the country; whilst he himself returned to Syracuse with the rest of his army, where he was received with the greatest demonstrations of joy. Soon afterwards, Icetas, having grown weary of a private station, concluded a new peace with the Carthaginians, and, assembling an army, ventured an engagement with Timoleon; but in this he was utterly defeated, and Icetas himself, with Eupolemus his son, and Euthymus his general of horse, were brought bound to Timoleon by their own soldiers. The first two were immediately executed as tyrants and traitors, and the last murdered in cold blood; Icetas's wives and daughters were likewise cruelly put to death after a public trial. In a short time afterwards, Mamercus, another of the Carthaginian confederates, was overthrown by Timoleon, with the loss of 2000 men. These misfortunes induced the Carthaginians to conclude a peace on the conditions that all the Greek cities should be set free; that the river Halycus should be the boundary between the territories of both parties; that the natives of cities subject to the Carthaginians should be allowed to withdraw, if they pleased, to Syracuse or its dependencies, with their families and effects; and lastly, that Carthage should not, for the future, give any assistance to the remaining tyrants against Syracuse.

Peace concluded.

War renewed.

About 316 years before Christ, we find the Carthaginians engaged in another bloody war with the Sicilians. Sosistratus, who had usurped the supreme authority at Syracuse, having been forced by Agathocles to raise the siege of Rhegium, returned with his shattered troops to Sicily; but, soon after this unsuccessful expedition, he was obliged to abdicate the sovereignty and quit Syracuse. With him were expelled above 600 of the principal citizens, who were suspected of having formed a design to overturn the plan of government then established in the city. As Sosistratus and the exiles thought themselves ill treated, they had recourse to the Carthaginians, who readily espoused their cause. But the Syracusans, having recalled Agathocles, who had before been banished by Sosistratus, appointed him commander-in-chief of all their forces, principally on account of the known aversion he bore that tyrant. The war, however, did not then continue long; for Sosistratus and the exiles were quickly received again into the city, and peace was concluded with Carthage. The people of Syracuse, however, finding that Agathocles wanted to make himself absolute, exacted an oath from him that he would do nothing to the prejudice of the democracy. But notwithstanding this oath, Agathocles pursued his purpose, and, by a general massacre of the principal citizens of Syracuse, raised himself to the throne. For some time he was obliged to keep the peace he had concluded with Carthage; but at last, finding his authority established, and his subjects ready to second his ambitious designs, he paid no regard to treaties, and immediately made war on the neighbouring states, which he had expressly agreed not to do, after which he carried his arms into the very heart of the island. In these expeditions he was attended with such success, that in two years he brought into subjection all the Greek part of Sicily; and when this was accomplished, he committed great devastations in the Carthaginian territories, their general Hamilcar not offering to give him the least disturbance. Conduct so perfidious greatly incensed the people of those districts against Hamilcar, whom they accused before the senate. He died however, in Sicily, and Hamilcar the son of Gisco was appointed to succeed him in the command of the forces. The last place which held out against Agathocles was Messana, whither all the Syracusan exiles had retired. But Pasiphilus, Agathocles's general, found means to cajole the inhabitants into a treaty, which Agathocles, according to custom, paid no regard to; and as soon as he got possession of the town he cut off all those who had opposed his government; for, as he intended to prosecute the war with the utmost vigour against Carthage, he thought it a point of good policy to destroy as many of his Sicilian enemies as possible.

Agathocles raised to the throne of Syracuse.

In the mean time the Carthaginians having landed a powerful army in Sicily, an engagement soon ensued, in which Agathocles was defeated with the loss of 7000 men. After this defeat he was obliged to shut himself up in Syracuse, which the Carthaginians immediately invested, and most of the Greek states in the island submitted to them.

Agathocles, seeing himself stripped of almost all his dominions, and his capital itself in danger of falling into the hands of the enemy, formed a design, which, were it not attested by writers of undoubted authority, would seem absolutely incredible. This was no less than to transfer the war into Africa, and lay siege to the enemy's capital, at a time when he himself was besieged, and only one city left to him in all Sicily. Before he departed, however, he made all the necessary preparations for the defence of the place, and appointed his brother Antandrus governor. He also gave permission to all who were not willing to encounter the fatigues of a siege to retire out of the city. Many of the principal citizens accepted of this offer; but they had no sooner got out of the place than they were cut off by parties posted on the road for that purpose. Having seized upon their estates, Agathocles raised a considerable sum, which was intended in some measure to defray the expense of the expedition. He carried with him, however, only fifty talents to supply his present wants, being well assured that he should find in the enemy's country whatever was necessary for his subsistence. As the Carthaginians had a much superior fleet, they for some time kept the mouth of the harbour blocked up; but at last a fair opportunity offered, and Agathocles weighing anchor, soon got clear of both the port and city of Syracuse. The Carthaginians pursued him with all expedition; but notwithstanding their utmost efforts, Agathocles kept ahead, and landed his troops with very little opposition.

He invades Africa.

Soon after his forces had disembarked, Agathocles burnt his fleet, in order that his soldiers might behave with the greater resolution, when they saw all possibility of retreat cut off. He first advanced to a place called the Great City, which, after a feeble resistance, he took and plundered. He then marched to Tunis, which surrendered on the first summons; and Agathocles levelled both places with the ground.

He burns his fleet.

The Carthaginians were at first thrown into the greatest consternation. But, soon recovering themselves, the citizens took up arms with so much alacrity, that in a short time they raised an army of 40,000 foot and 1000 horse, with 2000 armed chariots, and intrusted the command to Hanno and Bomilcar, two generals between whom there subsisted a great animosity. But this disunion occasion-

Carthage. ed the defeat of their whole army, with the loss of their camp, although the force of Agathocles did not exceed 14,000 men. Among the rich spoils the conqueror found many chariots of curious workmanship, which carried 20,000 pairs of fetters and manacles which the enemy had provided for their expected prisoners. After this defeat, the Carthaginians, supposing themselves to have fallen under the displeasure of their deities on account of their neglecting to offer in sacrifice children of noble families, resolved to expiate this guilt. Accordingly two hundred children of the first rank were sacrificed to their gods, besides three hundred other persons who voluntarily offered themselves to pacify the wrath of these sanguinary deities.

Carthaginians defeated.

After these expiations Hamilcar was recalled from Sicily. When the messengers arrived, Hamilcar commanded them not once to mention the victory of Agathocles; but, on the contrary, to give out among the troops that he had been entirely defeated, his forces cut off, and his fleet destroyed by the Carthaginians. This threw the Syracusans into the utmost despair; however, one Eurymnon, an Etolian, prevailed upon Antandrus not to consent to a capitulation, but to stand a general assault. Hamilcar, informed of this, prepared his battering engines, and made all the necessary preparations for storming the town without delay. But while matters were in this situation, a galley, which Agathocles had caused to be built immediately after the battle, got into the harbour of Syracuse, and informed the inhabitants of the victory which he had obtained. Hamilcar, observing that the garrison flocked down to the port on this occasion, and expecting to find the walls unguarded, ordered his soldiers to erect scaling ladders, and begin the intended assault. The enemy having left the ramparts quite exposed, the Carthaginians mounted them without being discovered, and had almost possessed themselves of a portion situated between two towers, when the patrole discovered them. Upon this a warm contest ensued; and at last the Carthaginians were repulsed with loss. Hamilcar, therefore, finding it in vain to continue the siege after such glad tidings had revived the spirits of the Syracusans, drew off his forces, and sent a detachment of 5000 men to reinforce the troops in Africa. He still, however, entertained hopes that he might oblige Agathocles to quit Africa, and return to the defence of his own dominions. With this view he spent some time in making himself master of such cities as had sided with the Syracusans; and, after having brought all their allies under subjection, he returned again to Syracuse, hoping to surprise it in a night attack. But being attacked while advancing through narrow passes, where his numerous army had not room to act, he was defeated with great slaughter, taken prisoner, carried into Syracuse, and put to death.

Assault of Syracuse.

The siege raised.

In the mean time the Agrigentines, finding that the Carthaginians and Syracusans had greatly weakened each other by this war, thought it a proper opportunity for attempting to gain the sovereignty of the whole island. They therefore commenced a war against both parties; and prosecuted it with such success, that in a short time they wrested many places of consequence out of the hands both of the Syracusans and Carthaginians.

Success of Agathocles in Africa.

In Africa the tyrant carried every thing before him. He reduced most of the places of any importance in the territory of Carthage; and hearing that Elymas king of Libya had declared against him, he immediately entered Libya Superior, and in a great battle overthrew that prince, putting to the sword a considerable part of his troops, and the general who commanded them; after which he advanced against the Carthaginians with such expedition, that he surprised and defeated them with the loss of two thousand killed, and a great number taken prisoners. He next prepared for the siege of Carthage itself; and, with a view to this, advanced to a post within five miles of that city. On the other hand, notwithstanding the great losses they had already sustained, the Carthaginians encamped with a powerful army between him and their capital. In this situation Agathocles received advice of the defeat of the Carthaginian forces before Syracuse, and also the head of Hamilcar their general; upon which he immediately rode up to the enemy's camp, and showing them the head, gave them an account of the total destruction of their army before Syracuse. This threw them into such consternation, that in all human probability Agathocles would have made himself master of Carthage, had not an unexpected mutiny arisen in his camp, which gave the Carthaginians time to recover from their terror.

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The year following an engagement happened, in which neither party gained any great advantage; but soon afterwards, the tyrant, notwithstanding all his victories, found himself unable to carry on the war alone; and he therefore endeavoured to gain over to his interest Ophellas, one of the captains of Alexander the Great. In this he succeeded perfectly; and in order to succour his new ally the more effectually, Ophellas sent to Athens for a body of troops. Having completed his military preparations, Ophellas found his army to consist of 10,000 foot and 600 horse, all regular troops, besides 100 chariots, and a body of 10,000 men, attended by their wives and children, as if he had been going to plant a new colony. At the head of these forces he continued his march towards the position of Agathocles for eighteen days, and then encamped at Automale, a city about three thousand stadia distant from the capital of his dominions. He then advanced through the *Regio Syrtica*, but found himself reduced to such extremities, that his army were in danger of perishing for want of bread, water, and other provisions. They were also greatly annoyed by serpents and wild beasts, with which that desert region abounded. The serpents made the greatest havock among the troops; for, being of the same colour with the earth, and extremely venomous, many soldiers, who trod upon without seeing them, were stung to death. At last, after a very fatiguing march of two months, he approached the position of Agathocles, and encamped at a small distance, to the no small terror of the Carthaginians, who apprehended the most fatal consequences from this junction. Agathocles at first caressed him, and advised him to take all possible care of his troops, who had undergone so many fatigues, but soon afterwards cut him off by treachery, and then by fair words and promises persuaded his troops to serve under himself.

His alliance with Ophellas.

Agathocles, now finding himself at the head of a numerous army, assumed the title of king of Africa, intending soon to complete his conquests by the reduction of Carthage. He began with the siege of Utica, which was taken by assault. He then marched against Hippo Diarrhytus, the Biserta of the moderns, which was also taken by storm; and after this most of the people bordering upon the sea-coasts, and even those who inhabited the inland parts of the country, submitted to him. But in the midst of this career of success, the Sicilians formed an association in favour of liberty, which obliged the tyrant to return home, leaving his son Archagathus to carry on the war in Africa.

Archagathus.

Archagathus, after his father's departure, greatly extended the African conquests. He sent Eumachus at the head of a large detachment to invade some of the neighbouring provinces, whilst he himself, with the greater part of his army, observed the motions of the Carthaginians. Eumachus passing into Numidia, first took the great city of Tocas, and conquered several of the Numidian cantons. Afterwards he besieged and took Phillina, which was at-

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tended with the submission of the Asphodelodians, a nation, according to Diodorus, as black as the Ethiopians. He then reduced several cities; and being at last elated with his good fortune, resolved to penetrate into the most remote parts of Africa. And in this he at first met with success; but hearing that the barbarous nations were advancing in a formidable body to give him battle, he abandoned his conquests, and retreated with the utmost precipitation towards the sea-coast, after having lost a great number of men.

Reduced to the utmost distress.

This unfortunate expedition produced a great revolution in the affairs of Archagathus. The Carthaginians, informed of Eumachus's bad success, resolved to exert themselves in order to repair their former losses, and divided their forces into three bodies; one of these they sent to the sea-coast, to keep the towns there in awe; another they dispatched into the Mediterranean parts, to preserve the allegiance of the inhabitants there; and the last body they ordered to Upper Africa, in order to support their confederates in that country. Apprised of the motions of the Carthaginians, Archagathus likewise divided his forces into three bodies. One of these he sent to observe the Carthaginian troops on the sea-coast, with orders to advance afterwards into Upper Africa; another, under the command of Æschrion, one of his generals, he posted at a proper distance in the heart of the country, to observe both the enemy there and the barbarous nations; and with the last, which he led in person, he kept near Carthage, preserving a communication with the other two, in order to send them succours or recal them, as the exigency of affairs might require. The Carthaginian troops sent into the heart of the country were commanded by Hanno, a general of great experience, who, being informed of the approach of Æschrion, laid an ambuscade for him, into which he was drawn, and cut off with 4000 foot and 200 horse. Himilco, who commanded the Carthaginian forces in Upper Africa, having received advice of Eumachus's march, immediately advanced against him; and an engagement ensued, in which the Greeks were almost totally cut off, or perished with thirst after the battle; for out of 8000 foot only thirty, and of 800 horse only forty, had the good fortune to make their escape.

Archagathus having received the melancholy news of these two defeats, immediately called in the detachments he had sent out to harass the enemy, which would otherwise have been instantly cut off. He was, however, in a short time hemmed in on all sides, reduced to the last extremity for want of provisions, and ready every moment to be swallowed up by the numerous forces which surrounded him. In this deplorable situation Agathocles received an express from Archagathus, acquainting him of the losses which the latter had sustained, and the scarcity of provisions he laboured under. Upon this the tyrant, leaving the care of the Sicilian war to one Leptines, got out of the harbour, by a stratagem, eighteen Etruscan ships which came to his assistance; and then engaging the Carthaginian squadron which lay in its neighbourhood, took five of their ships, and made all their men prisoners. In this way he became master of the port, and secured a passage into it for the merchants of all nations, who soon restored plenty where the famine had before begun to make great havoc. Supplying himself, therefore, with a sufficient quantity of necessaries for the voyage which he was about to undertake, he immediately set sail for Africa.

Arrival of Agathocles in Africa.

Upon his arrival in that country, Agathocles reviewed his forces, and found them to consist of 6000 Greeks, and as many Samnites, Celtes, and Etruscans, besides 10,000 Africans and 1500 horse. As he found his troops in a state bordering on despair, he thought this a proper time for offering the enemy battle. The Carthaginians, however, did not think proper to accept the challenge, especially as, by keeping close in their camp, where they had plenty of every thing, they could starve the Greeks into a surrender without striking a blow. Upon this Agathocles attacked the Carthaginian camp with great bravery, made a considerable impression upon it, and might perhaps have carried it, had not his mercenaries deserted him almost at the first onset. By this piece of cowardice he was forced to retire with precipitation to his camp, whither the Carthaginians pursued him very closely, doing great execution in the pursuit.

Disaster in the Carthaginian camp.

The next night, the Carthaginians sacrificed all the prisoners of distinction, as a grateful acknowledgment to their gods for the victory they had gained. Whilst they were employed in this inhuman work, the wind, suddenly rising, carried the flames to the sacred tabernacle near the altar, which was entirely consumed, together with the general's tent, and those of the principal officers adjoining to it. A dreadful alarm was raised throughout the whole camp, which was heightened by the great progress of the fire; for as the soldiers' tents consisted of very combustible materials, and the wind blew in a most violent manner, the whole camp was almost entirely reduced to ashes; and many of the soldiers, endeavouring to carry off their arms and the rich baggage of their officers, perished in the flames. Some of those who made their escape met with a fate equally unhappy; for after the repulse of Agathocles the Africans deserted him, and were at that instant coming over in a body to the Carthaginians. But these the persons who were flying from the flames took to be the whole Syracusan army advancing in order of battle to attack their camp; upon which a dreadful confusion ensued, some taking to their heels, while others fell down in heaps one upon another, and many engaged their comrades, mistaking them for the enemy. Five thousand men lost their lives in this tumult, and the rest thought proper to take refuge within the walls of Carthage; nor could the appearance of daylight for some time dissipate their apprehensions. In the mean time the African deserters, observing the great confusion among the Carthaginians, and not knowing the meaning of it, were so terrified, that they thought proper to return to the place from which they had come. The Syracusans, seeing a body of troops advancing towards them in good order, concluded that the enemy were marching to attack them, and therefore immediately cried out, "To arms;" while the flames ascending from the Carthaginian camp into the air, and the lamentable outcries proceeding thence, confirmed them in this opinion, and greatly heightened their confusion. The consequence was much the same as in the Carthaginian camp; for coming to blows with one another instead of the enemy, they scarcely recovered their senses upon the return of light; and the intestine tumult proved so bloody that it cost Agathocles four thousand men.

Panic in that of Agathocles.

He escapes privately.

This last disaster so disheartened the tyrant, that he immediately set about contriving means for making his escape privately, which he at last effected, though with great difficulty. After his departure his two sons were immediately put to death by the soldiers, who, choosing a leader from among themselves, made peace with the Carthaginians upon the conditions that the Greeks should deliver up all the places which they held in Africa, on receiving from them three hundred talents; that such of them as were willing to serve in the Carthaginian army should be kindly treated, and receive the usual pay; and that the rest should be transported to Sicily, and have the city of Selinus allotted for their habitation.

Causes of the first Punic war.

From this time till the commencement of their first war with the Romans, we find nothing remarkable in the history

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of the Carthaginians. The first Punic war, as it is commonly called, happened about 255 years before Christ. At that time the Carthaginians were possessed of extensive dominions in Africa; they had made considerable progress in Spain; they were masters of Sardinia, Corsica, and all the islands on the coast of Italy; and they had extended their conquests to a great part of Sicily. The occasion of the first rupture between the two republics may be briefly stated. The Mamertines, being vanquished in battle, and reduced to great straits, by Hiero, king of Syracuse, had resolved to deliver up Messina, the only city they now possessed, to that prince, with whose mild government and strict probity they were well acquainted. Accordingly, Hiero was advancing at the head of his troops in order to take possession of the city, when Hannibal, who at that time commanded the Carthaginian army in Sicily, prevented him by a stratagem. He came to meet Hiero as if to congratulate him on his victory, and amused him, whilst some of the Carthaginian troops filed off towards Messina. Meanwhile the Mamertines, seeing their city supported by a new reinforcement, were divided into several opinions. Some were for accepting the protection of Carthage, and others were for surrendering to the king of Syracuse; but the greater part declared for calling in the Romans to their assistance. Deputies were accordingly dispatched to Rome, offering the possession of the city to the Romans, and in the most moving terms imploring protection. This, after some debate, was agreed to; and the consul Appius Claudius received orders to attempt a passage to Sicily at the head of a powerful army. Being obliged to stay some time at Rome, however, one Caius Claudius, a person of great intrepidity and resolution, was dispatched with a few vessels to Rhegium. But, on his arrival there, he observed the Carthaginian squadron to be so much superior to his own, that he thought it hopeless to attempt at that time to transport forces to Sicily. He crossed the straits, however, and had a conference with the Mamertines, in which he prevailed with them to accept the proffered protection of Rome; and upon this he made the necessary preparations for transporting his forces. The Carthaginians, being informed of the resolution of the Romans, sent a strong squadron of galleys under the command of Hanno, to intercept the Roman fleet; and accordingly the Carthaginian admiral, coming up with them near the coast of Sicily, attacked them with great fury. During the engagement a violent storm arose, which dashed many of the Roman vessels against the rocks, and did a vast deal of damage to their squadron; in consequence of which Claudius was forced to retire to Rhegium, which he accomplished with great difficulty. Hanno restored all the vessels he had taken, but ordered the deputies sent with them to expostulate with the Roman general upon the infraction of the treaties subsisting between the two republics. This expostulation, however just, produced an open rupture; and Claudius soon afterwards took possession of Messina.

Hanno intercepts the Roman fleet.

Such was the beginning of the first Punic war, which lasted twenty-four years. The first year the Carthaginians and Syracusans laid siege to Messina, but, not acting in concert, as they ought to have done, were overthrown by the consul Appius Claudius; and this defeat so much disgusted Hiero with the Carthaginians, that he soon afterwards concluded an alliance with the Romans. After this treaty, having no enemy to contend with but the Carthaginians, the Romans made themselves masters of all the cities on the western coast of Sicily, and at the end of the campaign withdrew most of their troops to winter quarters in Italy.

Carthaginians and Syracusans defeated.

The second year, Hanno the Carthaginian general fixed his principal magazine at Agrigentum. Strong by nature, this place had been rendered almost impregnable by the new fortification which the Carthaginians had raised during the preceding winter, and was defended by a numerous garrison, commanded by Hannibal, a general of great experience in war. For five months the Romans attempted to reduce the place by famine, and had actually brought the inhabitants to great distress, when a Carthaginian army of 50,000 foot, 6000 horse, and sixty elephants, landed at Lilybæum, and marched thence to Heraclea, within twenty miles of Agrigentum. There the general received a deputation from some of the inhabitants of Erbessa, where the Romans had their magazines, offering to put the town into his hands. It was accordingly delivered up; and by this means the Romans became so much distressed, that they would certainly have been obliged to abandon their enterprise, had not Hiero supplied them with provisions. All the assistance he was able to give, however, would not long have supported them, as their army was so much weakened by famine, that out of 100,000 men, of whom it originally consisted, scarcely a fourth part remained fit for service, and could no longer subsist on such inadequate supplies as were furnished them. But in the mean time Hannibal acquainted Hanno that the city was reduced to the utmost distress; upon which he resolved to venture an engagement, which he had previously declined. In this, however, the Romans were victorious, and the city surrendered at discretion, though Hannibal and the greater part of the garrison made their escape. This ended the campaign; and the Carthaginians being greatly chagrined at their bad success, fined Hanno in an immense sum of money, and deprived him of his command, appointing Hamilcar to succeed him in the command of the army, and Hannibal in that of the fleet.

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The third year, Hannibal received orders to ravage the coast of Italy; but the Romans had taken care to post detachments in such places as were judged most proper to prevent his landing, so that the Carthaginian found it impossible to execute his orders. At the same time, the Romans, perceiving the advantages of being masters of the sea, set about building a hundred and twenty galleys. While this work was in progress they made themselves masters of most of the inland cities, but the Carthaginians reduced or kept steady in their interest most of the maritime ones; so that both parties were equally successful during this campaign.

The fourth year Hannibal by a stratagem made himself master of seventeen Roman galleys; after which he committed great ravages on the coast of Italy, whither he had advanced to take a view of the Roman fleet. But he was afterwards attacked in his turn, lost the greater part of his ships, and with great difficulty made his own escape; and soon afterwards he was totally defeated by the consul Duilius, with the loss of eighty ships taken, thirteen sunk, 7000 men killed, and as many taken prisoners. After this victory Duilius landed in Sicily, put himself at the head of the land forces, relieved Segesta, which was besieged by Hamilcar, and made himself master of Macella, though defended by a numerous garrison.

The Carthaginians defeated at sea.

The fifth year a difference arose between the Romans and their Sicilian allies, which proceeded to such a height that they encamped separately. Of this Hamilcar availed himself, and attacking the Sicilians in their entrenchments, put 4000 of them to the sword. He then drove the Romans from their posts, took several cities, and overran the greater part of the country. In the mean time Hannibal, after his defeat, sailed with the shattered remains of his fleet to Carthage. But, in order to secure himself from punishment, he sent one of his friends with all speed, before the event of the battle was known there, to acquaint the senate that the Romans had put to sea

Sicilians defeated.

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with a great number of heavy ill-built vessels, each of them carrying some machine, the use of which the Carthaginians did not understand; and he asked whether it was the opinion of the senate that Hannibal should attack them. These machines were the *corvi*, then newly invented, and by means of which, chiefly, Duilius had gained the victory. The senate were unanimous in their opinion that the Romans should be attacked; upon which the messenger acquainted them with the unfortunate event of the battles. As the senators had already declared themselves for the engagement, they spared their general's life, and, according to Polybius, even continued him in the command of the fleet. Accordingly, being reinforced by a good number of galleys, and attended by some officers of great merit, he in a short time sailed for the coast of Sardinia. But he had not been long there before he was surprised by the Romans, who carried off many of his ships, and took great numbers of his men prisoners; which so incensed the rest, that they seized their unfortunate admiral, and crucified him. It does not appear who was his immediate successor.

Corsica and Sardinia reduced.

The sixth year the Romans made themselves masters of the islands of Corsica and Sardinia. Hanno, who commanded the Carthaginian forces in the latter, defended himself at a city called Olbia with incredible bravery; but being at last killed in one of the attacks, the place was surrendered, and the Romans soon became masters of the whole island.

The Roman army rescued from great danger by a legionary tribune.

The seventh year the Romans took the town of Mytestratum, in Sicily, whence they marched towards Camarina; but in their way they were surrounded in a deep valley, and in the most imminent danger of being cut off by the Carthaginian army. In this extremity a legionary tribune, called M. Calpurnius Flamma, desired the general to give him three hundred chosen men, promising, with this small company, to find the enemy such employment as should oblige them to leave a passage open for the Roman army. He performed his promise with a bravery truly heroic; for having seized an eminence in spite of all opposition, and intrenched himself on it, the Carthaginians, jealous of his design, flocked from all quarters to drive him from his post. But the brave tribune kept their whole army in play, till the consul, taking advantage of the diversion, drew his army out of the perilous situation into which he had imprudently brought it. The legions were no sooner out of danger than they hastened to the relief of their brave companions; but all they could do was to save their bodies from the insults of their enemies; for they found them all dead on the spot except Calpurnius, who lay under a heap of dead bodies covered with wounds, but still breathing. His wounds were immediately dressed, and it fortunately happened that none of them proved mortal; and for this glorious enterprise he received a crown of *gramen*. After this the Romans reduced several cities, and drove the enemy out of the territory of the Agrigentines; but they were in turn repulsed with great loss before Lipara.

Regulus.

The eighth year Regulus, who commanded the Roman fleet, observing that of the Carthaginians lying along the coast in disorder, sailed with a squadron of ten galleys, to reconnoitre their number and strength, ordering the rest of the fleet to follow him with all expedition. As he drew too near the enemy, however, he was surrounded by a great number of Carthaginian galleys. The Romans fought with their usual bravery; but being overpowered with numbers, they were obliged to yield. The consul, however, found means to make his escape, and join the rest of the fleet; and then he had his full revenge of the enemy, eighteen of their ships being taken, and eight sunk.

He invades Africa.

The ninth year the Romans made preparations for invading Africa. The fleet prepared for this purpose consisted of 330 galleys, each of them having on board 120 soldiers and 300 rowers. The Carthaginian fleet consisted of 360 sail, and was much better manned than that of the Romans. The two fleets met near Ecnomus, a promontory of Sicily; where, after a bloody engagement, which lasted the greater part of the day, the Carthaginians were entirely defeated, with the loss of thirty galleys sunk and sixty-three taken. The Romans lost only twenty-four galleys, which were all sunk. After this victory, the Romans having refitted their fleet, set sail for the coast of Africa with all expedition, and arrived before Clupea, a city to the east of Carthage, where they made their first descent. No words can express the consternation of the Carthaginians on the arrival of the Romans in Africa. The inhabitants of Clupea were so terrified, that they abandoned the place, which the Romans immediately took possession of, and having left there a strong garrison to secure their shipping, and keep the adjacent territory in awe, moved nearer Carthage, taking a great number of towns in their advance. They likewise plundered a prodigious number of villages, laid many noblemen's seats in ashes, and took above 20,000 prisoners. In short, having plundered and ravaged the whole country, almost to the gates of Carthage, they returned to Clupea loaded with an immense booty which they had acquired in the expedition.

Success of Regulus.

The tenth year Regulus pushed on his conquests with great rapidity. To oppose his progress, Hamilcar was recalled from Sicily, and with him Bostar and Asdrubal were joined in command. Hamilcar commanded an army about equal to that of Regulus. The other two commanded separate bodies, which were to join him or act separately as occasion required. But before they were in a condition to take the field, Regulus, pursuing his conquests, arrived on the banks of the Bagrada, a river which empties itself into the sea at a small distance from Carthage. Having passed this river, he besieged Adis, or Adda, not far from Carthage, which the enemy attempted to relieve; but as they lay encamped among hills and rocks, where their elephants, in which the main strength of their army consisted, could be of no use, Regulus attacked them in their lines, killed 17,000, and took 5000 prisoners and eighteen elephants. On receiving the tidings of this victory, deputations came from all quarters, insomuch that the conqueror in a few days became master of eighty towns, among which were the city and port of Utica. This increased the alarm at Carthage, which was reduced to despair when Regulus laid siege to Tunis, a great city about nine miles distant from the capital. The place was taken in sight of the Carthaginians, who, from their walls, beheld all the operations of the siege, without making the least attempt to raise it. And, to complete their misfortunes, the Numidians, their neighbours and implacable enemies, entered their territories, committing everywhere the most dreadful devastations. In this extremity Regulus advanced to the very gates of Carthage; and, having encamped under the walls, sent deputies to treat of a peace with the senate. The deputies were received with inexpressible joy; but the conditions which they proposed were such that the senate could not listen to them without the greatest indignation. They were, that the Carthaginians should relinquish all claims to Sardinia, Corsica, and Sicily; that they should restore to the Romans all the prisoners they had taken since the beginning of the war; that if they wished to redeem any of their own prisoners, they should pay as much a head for them as Rome should judge reasonable; that they should for ever pay the Romans an annual tribute; and that for the future they should fit out but one man of war for their own use, and fifty triremes to serve in the

The Carthaginians defeated.

His proposals of peace rejected.

Carthage. Roman fleet, at the expense of Carthage, when required by any of the future consuls. These extravagant demands provoked the senators, who loudly and unanimously rejected them; the Roman deputies, however, told them that Regulus would not alter a single letter of the proposals, and that they must either conquer the Romans or accept them.

Xanthippus appointed to command.

In this desperate emergency some mercenaries arrived from Greece, among whom was a Lacedemonian, by name Xanthippus, a man of approved valour and experience in war. This man having informed himself of the circumstances of the late battle, declared publicly that their overthrow was more owing to their own misconduct than to the superiority of the enemy. This discourse having spread abroad, came at last to the knowledge of the senate, by whom, with the concurrence even of the Carthaginian generals themselves, Xanthippus was appointed commander-in-chief of their forces. The first care of this officer was to discipline his troops in a proper manner. He taught them how to march, encamp, widen and close their ranks, and rally after the Lacedemonian manner under their proper colours. He then took the field with 12,000 foot, 4000 horse, and 100 elephants. The Romans were surprised at the sudden alteration which they observed in the enemy's conduct; but Regulus, elated with his former success, came and encamped at a small distance from the Carthaginian army, in a vast plain, where their elephants and horse had room to act. The two armies were separated by a river, which Regulus boldly passed, thus leaving no room for a retreat in case of any misfortune. The engagement began with great fury, but ended in the total defeat of the Romans, who, with the exception of 2000 who escaped to Clupea, were all killed or taken prisoners; and among the latter was Regulus himself. The loss of the Carthaginians scarcely exceeded 800 men. The Carthaginians remained on the field of battle till they had stripped the slain; and then entered their metropolis, which was almost the only place left them, in great triumph. They treated all their prisoners with great humanity, except Regulus; but as for him, he had so insulted them in his prosperity, that they could not forbear showing him the highest marks of their resentment. According to Zonaras and others, he was thrown into a dungeon, where he had only sustenance allowed him sufficient to keep him alive; while his cruel masters, in order to heighten his other torments, directed a huge elephant, at the sight of which animal he was it seems greatly terrified, to be constantly placed near him, and thus prevented him from enjoying any tranquillity or repose.

The Romans defeated, and Regulus taken.

Carthaginians defeated by sea and land.

In the eleventh year of this war, the Carthaginians, elated with their victory over Regulus, began to talk in a very high strain, threatening Italy itself with an invasion. To prevent this, the Romans took care to garrison all their maritime towns, and fitted out a new fleet. In the mean time, the Carthaginians besieged Clupea and Utica in vain, being obliged to abandon their enterprise upon hearing that the Romans were equipping a fleet of 350 sail. The Carthaginians having with incredible expedition refitted their old vessels, and built a considerable number of new ones, met the Roman fleet off Cape Hermea. An engagement ensued, in which the Carthaginians were utterly defeated; 104 of their ships being sunk, thirty taken, and 15,000 of their soldiers and rowers killed in the action. The Romans pursued their course to Clupea, where they had no sooner landed than they found themselves attacked by the Carthaginian army under the two Hannos, father and son. But the brave Xanthippus no longer commanded their army; and, notwithstanding the Lacedemonian discipline he had introduced among them, they were routed at the very first onset, with the loss of 9000 men, among whom were many of their chief lords.

Notwithstanding all their victories, however, the Romans found themselves obliged, for want of provisions, to evacuate both Clupea and Utica, and abandon Africa. But being desirous of signalizing the end of their consulate by some important conquest in Sicily, the consuls steered for that island, contrary to the advice of their pilots, who represented the danger they incurred on account of the season being far advanced. Their obstinacy, however, led to the destruction of the whole fleet; for a violent storm arising, out of 370 vessels only eighty escaped shipwreck, the rest being swallowed up by the sea, or dashed in pieces against the rocks. This was by far the greatest loss that Rome had ever sustained; for besides the ships which were cast away with their crews, a numerous army was destroyed, with all the riches of Africa, which had been amassed by Regulus and deposited in Clupea, and were now being transported thence to Rome. The whole coast from Pachinum to Camerina was covered with dead bodies and wrecks of ships; so that history scarcely affords an example of a more dreadful disaster.

Carthage

Romans abandon Africa.

Their fleet destroyed in a storm.

The twelfth year the Carthaginians, hearing of this misfortune of the Romans, renewed the war in Sicily with fresh fury, hoping the whole island, which was now left defenceless, would fall into their hands. Carthalo, a Carthaginian commander, besieged and took Agrigentum. He laid the town in ashes, and demolished the walls, obliging the inhabitants to fly to Olympium. Upon the news of this success, Asdrubal was sent to Sicily with a large reinforcement of troops and 150 elephants. They likewise fitted out a squadron, with which they retook the island of Corcyra, and marched a strong body of forces into Mauritania and Numidia, to punish the people of those countries for showing a disposition to join the Romans. In Sicily the Romans possessed themselves of Cephalodium and Panormus, but were obliged by Carthalo to raise the siege of Drepanum with great loss.

A new fleet fitted out, and also destroyed.

The thirteenth year the Romans sent out a fleet of 260 galleys, which appeared off Lilybæum in Sicily; but finding this place too strong, they steered from thence to the eastern coast of Africa, where they effected several descents, surprised some cities, and plundered several towns and villages. They arrived safely at Panormus, and in a few days set sail for Italy, having a fair wind till they came off Cape Palinurus, where a violent storm overtook them, and 160 of their galleys, with a great number of their transports, were lost; upon which the Roman senate decreed, that in future not more than fifty vessels should be equipped, and that these should be employed only in guarding the coast of Italy, and in transporting troops into Sicily.

The fourteenth year the Romans made themselves masters of Himera and Lipara in Sicily; and the Carthaginians conceiving new hopes of conquering that island, began to make fresh levies in Gaul and Spain, and to equip a new fleet. Their treasures were exhausted, and they applied to Ptolemy, king of Egypt, intreating him to lend them two thousand talents; but he, being resolved to remain neutral, refused to comply with their request, telling them that he could not, without a breach of fidelity, assist one friend against another. However, the republic of Carthage, by a great effort, equipped a fleet of 200 sail, raised an army of 30,000 men, with 140 elephants, and appointed Asdrubal commander-in-chief both of the fleet and army. Meanwhile the Romans, finding the great advantage of a fleet, resolved to equip one, notwithstanding all former disasters; and whilst the vessels were building, two consuls, men of valour and experience, were chosen to supersede those acting in Sicily. But Metellus, one of the former consuls, being continued with the title of proconsul, found means to draw Asdrubal into a battle on dis-

Carthage.

Carthaginians defeated.

advantageous terms near Panormus, and then sallying out, overthrew him with a terrible slaughter. Twenty thousand of the enemy were killed, and many elephants destroyed. A hundred and four elephants, with their leaders, were taken, and sent to Rome, where they were hunted and put to death in the circus.

The fifteenth year the Romans besieged Lilybæum, and the siege continued during the rest of the first Punic war, being the only thing remarkable that happened during that time. The Carthaginians, on the first news of its being besieged, sent Regulus with some deputies to Rome to treat for a peace; but instead of forwarding the negotiation, Regulus hindered it; and notwithstanding he knew the torments prepared for him at Carthage, could not be prevailed upon to stay at Rome, but returning to captivity, was put to death in a most cruel manner. During this siege, the Roman fleet under Claudius Pulcher was utterly defeated by Adherbal the Carthaginian admiral. Ninety of the Roman galleys were lost in the action, 8000 men were either killed or drowned, and 20,000 taken and sent prisoners to Carthage; while the Carthaginians gained this signal victory without the loss of a single ship, or even a single man. Another Roman fleet met with a still harder fate. It consisted of 120 galleys and 800 transports, and was laden with all sorts of military stores and provisions. Every one of these vessels was lost in a storm, with all they contained, not a single plank being saved that could be used again; so that the Romans found themselves once more deprived of their whole naval force.

Hamilcar Barcas sent into Sicily.

In the mean time the Carthaginian soldiery having shown a disposition to mutiny, the senate sent Hamilcar Barcas, father of the celebrated Hannibal, into Sicily. He received *carte blanche* from the senate to act as he thought proper; and by his excellent conduct and resolution, he showed himself the greatest general of his age. Eryx, which he had taken by surprise, he defended with such vigour that the Romans would never have been able to make themselves masters of it, had they not fitted out, at the expense of private citizens, a fleet which utterly defeated that of the Carthaginians; so that Hamilcar, notwithstanding all his valour, was obliged to yield up the place which he had long and bravely defended. Articles of peace were immediately agreed to between the two commanders. The Carthaginians were to evacuate all the places which they occupied in Sicily, and entirely quit that island; to pay the Romans in twenty years, and by equal payments every year, 2200 talents of silver, or about L.437,250 sterling; to restore the Roman captives and deserters without ransom, and redeem their own prisoners with money; and to refrain from making war upon Hiero king of Syracuse or his allies. These articles being agreed to, Hamilcar surrendered Eryx upon condition that all his soldiers should march out with him, on his paying for each of them eighteen Roman *denarii*. Hostages were mutually given, and deputies sent to Rome to procure a ratification of the treaty by the senate. When the senators had thoroughly informed themselves as to the state of affairs, two more articles were added, namely, that 1000 talents should be paid immediately, and the 2200 in the space of ten years in equal payments; and that the Carthaginians should quit all the little islands about Italy and Sicily, and never more approach them with ships of war, or raise mercenaries in those places. Necessity obliged Hamilcar to consent to these terms; but he returned to Carthage with a hatred of the Romans, which he did not even suffer to die with him, but transmitted to his son the illustrious Hannibal.

Peace.

War with the Mercenaries.

The Carthaginians were no sooner freed from this sanguinary and expensive war than they found themselves engaged in another of the most dangerous kind. It is called by ancient historians the Libyan War, or the War with the Mercenaries. The principal cause of this war may be shortly stated. When Hamilcar returned to Carthage, he found the republic so much impoverished, that, far from being able to give these troops the largesses and rewards promised them, it could not pay them their arrears. He had committed the care of transporting them to one Gisco, an officer of great penetration, who, as if he had foreseen what would happen, did not ship them off all at once, but in small and separate parties, in order that those who landed first might be paid off and sent home before the arrival of the rest. The Carthaginians, however, did not act with the same prudence as Gisco. As the state was almost entirely exhausted by the late war, and the immense sum of money paid to the Romans in consequence of the peace, they judged it proper to endeavour to save something to the public, and with this view they did not pay off the mercenaries as they arrived, thinking it better to wait till they had all arrived, in the hope of obtaining some remission of their arrears. But, being soon made sensible of their error, by the frequent disorders of which these barbarians were guilty in the city, they with some difficulty prevailed on the officers to take up their quarters at Sicca, and canton their troops in that neighbourhood. To induce them to do so, however, they gave them a sum of money for their present subsistence, and promised to comply with their demands when the remainder of the troops should have arrived from Sicily. But the troops, being wholly immersed in idleness, to which they had long been strangers, a neglect of discipline ensued, and of course a petulant and licentious spirit immediately showed itself. They were now determined not to acquiesce in receiving their bare pay, but to insist upon the rewards which Hamilcar had promised them, and even to compel the state of Carthage by force of arms to comply with their demands. The senate being informed of the mutinous disposition of the soldiery, dispatched Hanno, one of the suffetes, to pacify them. Upon his arrival at Sicca, he expatiated largely on the poverty of the state, and the heavy taxes with which the citizens of Carthage were loaded; and, instead of answering their extravagant expectations, he desired them to be satisfied with receiving part of their pay, and to remit the remainder in consideration of the pressing exigencies of the republic. But the mercenaries, highly provoked that neither Hamilcar nor any other of the principal officers who commanded them in Sicily, and were the best judges of their merit, made their appearance on this occasion, but only Hanno, a person utterly unknown, and above all others disagreeable to them, immediately had recourse to arms; and assembling in a body, to the number of 20,000, they advanced to Tunis, and immediately encamped before that city.

The Carthaginians, being greatly alarmed at the approach of so formidable a body to Tunis, made large concessions to the mercenaries, in order to bring them back to their duty; but, far from being softened, the latter grew more insolent upon these concessions, considering them as the effects of fear, and therefore became altogether averse to thoughts of accommodation. Making a virtue of necessity, the Carthaginians showed a disposition to satisfy them in all points, and agreed to refer the points at issue to the opinion of some general in Sicily, as they had all along desired, leaving the choice of such commander entirely to the soldiery themselves. Gisco was accordingly pitched upon to mediate this affair, the mercenaries believing Hamilcar to have been a principal cause of the ill treatment they had met with, since he never appeared amongst them, and, according to the general opinion, had voluntarily resigned his commission. Gisco soon arrived at Tunis with money to pay the troops; and, after confer-

ring with the officers of the several nations apart, he harangued them in such a manner, that a treaty was upon the point of being concluded, when Spendius and Mathos, two of the principal mutineers, occasioned a tumult in every part of the camp. Spendius was by nation a Campanian, and had been a slave at Rome, whence he fled to the Carthaginians. The apprehensions he entertained of being delivered up to his old master, by whom he was sure to be hanged or crucified, prompted him to break off the accommodation. Mathos was an African, and free born; but as he had been active in raising the rebellion, and was well acquainted with the implacable disposition of the Carthaginians, he knew that a peace must infallibly prove his ruin. He therefore joined with Spendius, and insinuated to the Africans the danger of concluding at that juncture a treaty, which could not but leave them exposed singly to the rage of the Carthaginians. This so incensed the Africans, who were much more numerous than the troops of any other nation, that they immediately assembled in a tumultuous manner, and the foreigners soon joined them, being inspired by Spendius with an equal degree of fury. Nothing was now to be heard but the most horrid oaths and imprecations against Gisco and the Carthaginians. Whoever offered to make any remonstrance, or lend an ear to temperate counsels, was stoned to death by the enraged multitude; and many persons lost their lives for attempting to speak, before it could be known whether they were in the interest of Spendius or of the Carthaginians.

In the midst of these commotions Gisco behaved with great firmness and intrepidity, and left no methods untried to soften the officers and calm the minds of the soldiery; but the torrent of sedition was now so strong, that there was no possibility of keeping it within bounds. They therefore seized upon the military chest, dividing the money among themselves as part payment of their arrears; put the person of Gisco under an arrest; and treated him, as well as his attendants, with the utmost indignity. Mathos and Spendius, in order to destroy all hopes of an accommodation with Carthage, applauded the courage and resolution of their men, loaded the unhappy Gisco and his followers with irons, and formally declared war against the Carthaginians. The cities of Africa to which deputies had been sent to exhort them to recover their liberty soon came over to them, except Utica and Hippo Diarrhytus. And the army being thus greatly increased, they divided it into two parts, with one of which they moved towards Utica, whilst the other marched to Hippo, in order that both places might be simultaneously besieged. The Carthaginians, in the mean time, found themselves ready to sink under the pressure of their misfortunes. After they had been harassed twenty-four years by a most cruel and destructive foreign war, they entertained some hopes of enjoying repose. The citizens of Carthage drew their individual subsistence from the rents or revenues of their lands, and the public expenses from the tribute paid by Africa; all which they were not only deprived of at once, but, what was worse, had it directly turned against them. They were destitute of arms and forces either by sea or land, and had made no preparations for sustaining a siege, or the equipping of a fleet. They suffered all the calamities incident to the most ruinous civil war; and, to complete their misery, had not the least prospect of receiving assistance from any foreign friend or ally. Notwithstanding their deplorable situation, however, they did not despair, but pursued all the measures necessary to put themselves in a suitable posture of defence.

Hanno was dispatched to the relief of Utica with a considerable body of forces, 100 elephants, and a large train of battering engines. Having reconnoitred the enemy, he immediately attacked their intrenchments, and, after an obstinate contest, forced them. The mercenaries lost a vast number of men, and consequently the advantages gained by Hanno were so great, that they might have proved decisive had he made a proper use of them; but victory having rendered him too confident, and his troops neglecting their duty, the mercenaries rallied their forces, fell upon him, cut off many of his men, forced the rest to fly into the town, retook and plundered the camp, and seized all the provisions and military stores brought to the relief of the besieged. Nor was this the only instance of Hanno's military incapacity. Notwithstanding he lay encamped in the most advantageous manner, near a town called Gorza, where he twice overthrew the enemy, and had it in his power to ruin them totally, he yet neglected to improve these advantages, and even suffered the mercenaries to possess themselves of the isthmus which joined to the continent of Africa the peninsula on which Carthage stood.

These repeated mistakes induced the Carthaginians once more to place Hamilcar Barcas at the head of their forces. This commander marched against the enemy with 10,000 men, horse and foot, being all the troops the Carthaginians could then assemble for their defence; a proof of the very low state to which they had at that time been reduced. As Mathos, after the occupation of the isthmus, had posted proper detachments in the passes of two hills facing the continent, and guarded the bridge over the Bagrada, which through Hanno's neglect he had taken, Hamilcar saw little probability of engaging him upon equal terms, or indeed of even getting at him. Observing, however, that on the blowing of certain winds the mouth of the river was choked up with sand, so as to become passable, though with no small difficulty, while these winds continued, he halted at the river's mouth, without communicating his design to any person. As soon as the wind favoured his project, he crossed the river privately by night, and immediately after his passage drew up the troops in order of battle; and advancing into the plain, where his elephants were capable of acting, moved towards Mathos, who was posted at the village near the bridge. This daring action greatly surprised and intimidated the Africans. However, Spendius, receiving intelligence of the enemy's motions, drew a body of 10,000 men out of Mathos's camp, with which he attended Hamilcar on one side, and ordered 15,000 from Utica to observe him on the other; thinking by this means to surround the Carthaginians, and cut them off at one stroke. But by feigning a retreat, Hamilcar found means to engage them at a disadvantage, and gave them a total overthrow, with the loss of 6000 killed and 2000 taken prisoners, while the rest fled, some to the town at the bridge, and others to the camp at Utica. He did not give them time to recover from their defeat, but pursued them to the town near the bridge before mentioned, which he entered without opposition, the mercenaries flying in great confusion to Tunis; and upon this many towns submitted of their own accord to the Carthaginians, whilst others were reduced to subjection by force of arms.

Notwithstanding these disasters, Mathos pushed on the siege of Hippo with great vigour, and appointed Spendius and Autaritus, commanders of the Gauls, with a strong body, to observe the motions of Hamilcar. These commanders, therefore, at the head of a choice detachment of 6000 men drawn out of the camp at Tunis, and 2000 Gallic horse, attended the Carthaginian general, approaching him as near as they could with safety, and keeping close to the skirts of the mountains. At last Spendius having received a strong reinforcement of Africans and Numidians, and occupied all the heights surrounding the plain in which Hamilcar lay encamped, resolved not to let

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slip so favourable an opportunity of attacking him. Had a battle now ensued, Hamilcar and his army must in all probability have been cut off; but, by the desertion of one Naravasus, a young Numidian nobleman, with 2000 men, he found himself enabled to offer his enemies battle. The fight was obstinate and bloody; but at last the mercenaries were entirely overthrown, with the loss of 10,000 men killed and 4000 taken prisoners. All the prisoners who were willing to enlist in the Carthaginian service Hamilcar received into his army, supplying them with the arms of the soldiers who had fallen in the engagement; and to the rest he gave full liberty to go where they pleased, upon condition that they should never for the future bear arms against the Carthaginians; informing them, at the same time, that every violator of this agreement who fell into his hands must expect no mercy.

Mathos and his associates, fearing that this affected lenity of Hamilcar might occasion a defection among the troops, thought that the best expedient would be to put them upon some action so execrable in its own nature that no hopes of reconciliation should remain. By their advice, therefore, Gisco, and all the Carthaginian prisoners were put to death; and when Hamilcar sent to demand the remains of his countrymen, he received for answer, that whoever presumed hereafter to come upon that errand, should meet with Gisco's fate; after which they came to a resolution to treat with the same barbarity all Carthaginians who should fall into their hands. In return for this enormity, Hamilcar delivered up all the prisoners who fell into his hands to be devoured by wild beasts; being convinced that compassion served only to render his enemies more fierce and untractable.

The war was now carried on generally to the advantage of the Carthaginians; nevertheless, the malcontents still found themselves in a capacity to take the field with an army of 50,000 men. They watched Hamilcar's motions, but kept on the hills, carefully avoiding to come down into the plains, on account of the Numidian horse and Carthaginian elephants. But Hamilcar, being much superior in skill to any of their generals, at last shut them up in a post so situated that it was impossible to get out of it. Here he kept them strictly besieged; and the mercenaries, not daring to venture a battle, began to fortify their camp, and surround it with ditches and intrenchments. But they were soon pressed so sorely by famine, that they were obliged to eat one another; yet as they were rendered desperate by the consciousness of their guilt, they did not desire any terms of accommodation. At last, being reduced to the utmost extremity of misery, they insisted that Spendius, Autaritus, and Zarxas, their leaders, should in person have a conference with Hamilcar, and make proposals to him. Peace was accordingly concluded, upon the conditions that ten of the ringleaders of the malcontents should be left entirely to the mercy of the Carthaginians, and that the troops should all be disarmed, every man retiring only in a single coat. The treaty was no sooner concluded than Hamilcar, by virtue of the first article, seized upon the negotiators themselves; and the army being informed that their chiefs were under arrest, had immediately recourse to arms, suspecting they were betrayed; but Hamilcar, drawing out his army in order of battle, surrounded them, and either cut them to pieces or trod them to death with his elephants. The number of wretches who perished on this occasion amounted to above 40,000.

Terrible defeat of the mercenaries.

After the destruction of the army, Hamilcar invested Tunis, whither Mathos had retired with his remaining forces. The former had another general, named Hannibal, joined in the command with him. Hannibal's quarters were on the road leading to Carthage, and Hamilcar's on the opposite side. The army was no sooner encamped, than Hamilcar caused Spendius and the rest of the prisoners to be led out in the view of the besieged, and crucified near the walls. Mathos, however, observing that Hannibal did not keep so good a guard as he ought to have done, made a sally, attacked his quarters, killed many of his men, made several prisoners, among whom was Hannibal himself, and plundered his camp. Taking down the body of Spendius from the cross, Mathos immediately substituted Hannibal in its stead; and thirty Carthaginian prisoners of distinction were crucified around him. After this disaster, Hamilcar decamped, and posted himself along the sea-coast, near the mouth of the river Bagrada.

The senate, though greatly terrified by so unexpected a blow, omitted no means necessary for their preservation. They sent thirty senators, with Hanno at their head, to consult with Hamilcar about the proper measures for putting an end to this unnatural war; conjuring Hanno in the most pressing manner to be reconciled to Hamilcar, and to sacrifice his private resentment to the public benefit. This was effected with some difficulty; and the two generals came to a full resolution to act in concert for the good of the public. The senate, at the same time, ordered all the youth capable of bearing arms to be pressed into the service; and by these means a strong reinforcement being sent to Hamilcar, he soon found himself in a condition to act offensively. He now defeated the enemy in every rencounter, drew Mathos into frequent ambuscades, and gave him one notable overthrow near Leptis. This reduced the rebels to the necessity of hazarding a decisive battle, which proved fatal to them. The mercenaries fled almost at the first onset, and most of their army fell either in the field of battle or in the pursuit. Mathos, with a few, escaped to a neighbouring town, where he was taken alive, carried to Carthage, and executed; and then, by the reduction of the revolted cities, an end was put to this war, which, from the excesses of cruelty committed in it, went among the Greeks by the name of the *inexpiable war*.

During the Libyan war, the Romans, upon some absurd pretences, wrested from the Carthaginians the island of Sardinia; and the latter, not being able to resist, were obliged to submit to the loss. Hamilcar, finding his country not in a condition to enter into an immediate war with Rome, formed a scheme to put it on a level with that haughty republic. This was by making an entire conquest of Spain, by which means the Carthaginians might have troops capable of contending with the Romans. In order to facilitate the execution of this scheme, he inspired both his son-in-law Asdrubal, and his son Hannibal, with an implacable aversion to the Romans, as the great enemies of his country's grandeur. And having completed all the necessary preparations, Hamilcar, after greatly enlarging the Carthaginian dominions in Africa, entered Spain, where he commanded nine years, during which time he subdued many warlike nations, and amassed an immense quantity of treasure, which he distributed partly amongst his troops and partly amongst the great men at Carthage, by which means he supported his interests with these two powerful bodies. At last he was killed in a battle, and was succeeded by his son-in-law Asdrubal. This general fully answered the expectations of his countrymen, having greatly enlarged their dominions in Spain, and built the city of New Carthage, now Carthagena. He made such progress in his conquests that the Romans began to be alarmed. They did not, however, choose at present to come to an open rupture, on account of the apprehensions which they entertained of an invasion by the Gauls. They judged it most proper, therefore, to have recourse to milder methods; and prevailed upon Asdrubal to conclude a new treaty with them, upon the conditions

Hamilcar's scheme to equal Carthage with Rome.

Asdrubal.

Carthage. that the Carthaginians should not pass the Iberus; and that the Saguntines, a colony of Zacynthians, and a city situated between the Iberus and that part of Spain subject to the Carthaginians, as well as the other Greek colonies there, should enjoy their ancient rights and privileges.

Murder of Asdrubal. Asdrubal, after having governed the Carthaginian dominions in Spain for eight years, was treacherously murdered by a Gaul, whose master he had put to death. Hannibal. Three years before this happened, he had written to Carthage to desire that young Hannibal, then twenty-two years of age, might be sent to him. This request was complied with, notwithstanding the opposition of Hanno; and, from the first arrival of the young man in the camp, he became the darling of the whole army. The great resemblance he bore to Hamilcar rendered him extremely agreeable to the troops. He seemed to possess every talent and qualification that contribute towards forming a great commander. After the death of Asdrubal, he was saluted as general by the army with the highest demonstrations of joy. He immediately put himself in motion; and in the first campaign conquered the Olcades, a nation situated near the Iberus. The next year he subdued the Vaccæi, another nation immediately adjoining. Soon afterwards, the Carpætani, one of the most powerful nations in Spain, declared against the Carthaginians. Their army consisted of 100,000 men, with which they proposed to attack Hannibal on his return from the Vaccæi; but by a stratagem they were utterly defeated, and the whole nation obliged to submit.

Nothing now remained to oppose the progress of the Carthaginian arms but the city of Saguntum, the modern Murviedro. Hannibal, however, for some time did not think proper to come to an open rupture with the Romans by attacking that place. At last he found means to embroil some of the neighbouring cantons, especially the Turdetani, or, as Appian calls them, the Torboletæ, with the Saguntines, and thus furnished himself with a pretext for attacking their city. Siege of Saguntum. On the commencement of the siege, the Roman senate dispatched two ambassadors to Hannibal, with orders to proceed to Carthage in case the general refused to give them satisfaction. But they had scarcely landed, when Hannibal, who was carrying on the siege of Saguntum with great vigour, sent them word that he had something else to do than to give audience to ambassadors. At last, however, he admitted them, and, in answer to their remonstrances, told them that the Saguntines had drawn their misfortunes upon themselves, by committing hostilities against the allies of Carthage; at the same time he desired the deputies, if they had any complaints to make of him, to carry them to the senate of Carthage. They did so, and on their arrival in that capital, demanded that Hannibal might be delivered up to the Romans, to be punished according to his deserts. This of course was not complied with, and war was immediately declared between the two nations.

The Saguntines are said to have defended themselves for eight months with incredible bravery. At last, however, the city was taken, and the inhabitants were treated with the utmost cruelty. After this conquest, Hannibal put his African troops into winter quarters at New Carthage; but, in order to gain the affection of the Spaniards, he permitted them to retire to their respective homes.

Hannibal sets out for Italy. The next campaign, having taken the necessary measures for securing Africa and Spain, he passed the Iberus, subdued the different nations betwixt that river and the Pyrenees, appointed Hanno commander of all the new conquered districts, and immediately began his march for Italy. Upon mustering his forces, after they had been weakened by sieges, desertion, mortality, and a detachment of 10,000 foot and 1000 horse left with Hanno to support him in his new post, he found them to amount to 50,000 foot and 9000 horse, all veteran troops, and the best in the world. As they left their heavy baggage with Hanno, and were all light armed, Hannibal easily crossed the Pyrenees; passed by Ruscino, a frontier town of the Gauls; and arrived on the banks of the Rhone without opposition. This river he passed, notwithstanding some opposition by the Gauls, and for some time remained in doubt whether he should advance to engage the Romans, who, under Scipio, had landed near the mouth of the Rhone, or continue his march for Italy. But he was soon induced to adopt the latter course by the arrival of Magilus, prince of the Boii, who brought rich presents with him, and offered to conduct the Carthaginian army across the Alps. Nothing could have happened more favourable to Hannibal's affairs than the arrival of this prince, since he possessed a local knowledge of the difficult region to be traversed, and there was no room to doubt the sincerity of his intentions; for the Boii bore an implacable enmity to the Romans, and had even come to an open rupture with them upon the first news that Italy was threatened with an invasion from the Carthaginians.

He crosses the Alps. It is not known with absolute certainty where Hannibal began to ascend the Alps, although the subject has been critically examined and discussed by many very able writers.[1] As soon as he began his march, the petty kings

[1] The commonly received opinion now is, that Hannibal, having passed the Rhone in the manner described by Polybius and Livy, advanced northwards along its left bank, cutting across the neck of the peninsula formed by the incurvation of the Rhone towards Lyons, but observing the general direction of the stream; that he then entered the *Insula Allobrogum*, a tract included between the Rhone and the Isère, which he traversed, still keeping a northerly direction; that having cleared the space between the two rivers, he turned off suddenly to the right, proceeded along the valley of the Isère, crossed the Alps by the Little St Bernard, and descended into Insubria, now Piedmont, between the Doria Baltea and the Orca. This route was first traced out by General Melville, who, with Polybius in his hand, surveyed the whole line of march, from the passage of the Rhone to the descent into Piedmont, and found it to agree in almost every particular with the account given by the military historian. As Polybius is remarkable for his general historical fidelity, and as he had himself personally investigated Hannibal's route little more than half a century after the Carthaginian commander had achieved his celebrated passage, his authority in this matter was justly assumed by the general as decisive; and hence, in order to discover what line Hannibal had actually followed, it was only necessary to find one which should, upon the whole, coincide better than any other with the description of Polybius. But of all the lines by which the Alps could have been crossed in the time of Hannibal, that of the Little St Bernard alone answered this condition; and, therefore, General Melville concluded that he had fully resolved the interesting question which he had proposed to himself in regard to this great achievement. The general himself, however, published nothing on the subject. He gave his notes to M. de Luc of Geneva, by whom they were very skilfully worked up into the form of a regular discourse, in which are embodied many additional illustrations of the general's theory, which are due to the learning and research of the redacteur himself. The same subject is treated with much ability and cogency of reasoning in the dissertation of Messrs Wickham and Cramer, which in fact comprehends all that is necessary to be known respecting it. With regard to the theory of Whitaker, who contends that Hannibal went round by Lyons, and crossed the Alps by the Great St Bernard, it is so demonstrably irreconcilable both with time and distance, to say nothing of insurmountable physical obstacles, that it carries its own refutation along with it. A new theory, differing in some respects from all former ones, has been proposed in a small volume recently published at Cambridge; but the anonymous author has failed as signally in the exposition of his own views of the subject, as in the attack he has thought proper to make, in no measured terms, on the joint production of Messrs Wickham and Cramer; and of the route he has proposed, it is sufficient to say, that it is impracticable in itself, and inconsistent with historical authority.

of the country assembled their forces in great numbers, and, taking possession of the eminences over which the Carthaginians must necessarily pass, continued harassing them, and were no sooner driven from one eminence than they seized on another, disputing every foot of ground with the enemy, and, by the local advantages they possessed, destroying great numbers of them. Hannibal, however, having found means to possess himself of an advantageous post, defeated and dispersed the enemy, and soon afterwards took their capital city, where he found the prisoners, horses, and baggage, that had before fallen into their hands, and likewise corn sufficient to serve the army for three days. At last, after a most fatiguing march of nine days, he arrived at the highest point in the route. Here he encamped, and halted two days, to give his wearied troops some repose, and to wait for the stragglers. But as the snow had recently fallen in great quantity, and covered the ground, this sight terrified the Africans and Spaniards, who were much affected with the cold. In order, therefore, to encourage them, the Carthaginian general led them to the top of the highest rock on the side of Italy, and thence gave them a view of the large and fruitful plains of Insubria, informing them that the Gauls, whose country they then beheld, were ready to join them. He also pointed out to them the place whereabout Rome stood, telling them, that by climbing the Alps they had scaled the walls of that rich metropolis; and, having thus animated his troops, he began to descend the mountains. The difficulties the troops met with in their descent were much greater than those which had occurred in the ascent. They had indeed no enemy to contend with, except some scattered parties who came to steal rather than to fight; but the deep snows, the mountains of ice, craggy rocks, and frightful precipices, proved more terrible than any enemy. After they had marched for some days through narrow, steep, and slippery pathways, they came at last to a place which neither elephants, horses, nor men could pass. The way, which lay between two precipices, was exceedingly narrow; and the declivity, which was naturally very steep, had still become more dangerous by the falling away of the earth. Here the guides stopped; and the whole army being terrified, Hannibal proposed at first to march round about, and attempt to turn the obstacle which appeared insurmountable; but all places around being covered with snow, he found himself reduced to the necessity of cutting a path into the rock itself, through which his men, horses, and elephants might descend. This work was accomplished with incredible labour; when Hannibal, having spent nine days in ascending, and six in descending the Alps, at length gained Insubria, and, notwithstanding the disasters he had met with by the way, entered the country with all the boldness of a conqueror.

Hannibal, on his entry into Insubria, reviewed his army, when he found that of the 50,000 foot with whom he had set out from New Carthage five months and fifteen days before, he had now only 20,000, and that his 9000 horse were reduced to 6000. His first care after entering Italy was to refresh his troops, who, after so long a march, and such inexpressible hardships, looked like as many skeletons raised from the dead, or savages born in a desert. He did not, however, suffer them to languish long in idleness; but, joining the Insubrians, who were then at war with the Taurinians, laid siege to Taurinum or Turin, the only city in the country, and in three days carried it by storm, putting all who resisted to the sword. This struck the neighbouring barbarians with such terror, that of their own accord they submitted to the conqueror, and supplied his army with all sorts of provisions.

Taurinum taken.

In the mean time, Scipio, the Roman general, who had been sent in quest of Hannibal to the Rhone, and who had even had an affair with his rear-guard on the banks of that river, was surprised to find that his antagonist had crossed the Alps and entered Italy. He therefore returned with the utmost expedition; and an engagement ensued near the river Ticinus, in which the Romans were worsted. The immediate consequence was, that Scipio repassed that river, and Hannibal continued his march to the banks of the Po, where he was detained two days before he could cross by means of a bridge of boats. He then sent Mago in pursuit of the enemy, who had rallied their scattered forces, repassed the Po, and encamped at Placentia. He next concluded a treaty with several of the Gallic cantons, and having joined his brother with the rest of the army, again offered battle to the Romans; but this they thought proper to decline; and at last the consul, intimidated by the desertion of a body of Gauls, abandoned his camp, passed the Trebia, and posted himself on an eminence near that river, where he drew lines round his camp, and waited the arrival of his colleague with the forces from Sicily.

Battle near the Ticinus.

Hannibal being apprised of the consul's departure, sent the Numidian horse in advance to harass him on his march, and himself moved at the head of the main body to support them in case of need. The Numidians arrived before the rear of the Roman army had quite passed the Trebia, and put to the sword or made prisoners all the stragglers they found there; and Hannibal coming up soon afterwards, encamped in sight of the Roman army on the opposite bank. Here, having learned the character of the consul Sempronius, who had lately arrived, he soon brought him to an engagement, and entirely defeated him. Ten thousand of the enemy retired to Placentia; but the rest were either killed or taken prisoners. The Carthaginians pursued the flying Romans as far as the Trebia, but did not think proper to repass that river, on account of the excessive cold.

Romans again defeated.

After this action upon the Trebia, Hannibal ordered the Numidians, Celtiberians, and Lusitanians, to make incursions into the Roman territories, where they committed great devastations. During his state of inaction, he endeavoured to win the affections of the Gauls, and likewise of the allies of the Romans, declaring to the Gallic and Italian prisoners, that he had no intention of making war upon them, being determined to restore them to their liberty, and protect them against the Romans; and to confirm them in a good opinion of him, he dismissed them all without ransom.

Next year, having crossed the Apennines, and penetrated into Etruria, Hannibal received intelligence that the new consul Flaminius lay encamped with the Roman army under the walls of Aretium; and having learned the true character of this general, who was of a haughty, fierce, and rash disposition, he doubted not of being soon able to bring him to a battle. In order to inflame the impetuous spirit of Flaminius, the Carthaginian general took the road to Rome, and leaving the Roman army behind him, laid waste with fire and sword the country through which he passed; and as that part of Italy abounded with all the elegancies as well as necessaries of life, the Romans and their allies suffered an incredible loss on this occasion. The headstrong consul was inflamed with rage at seeing the ravages committed by the Carthaginians, and therefore approached them with great temerity, as if confident of victory. Hannibal in the mean time kept still advancing towards Rome, having Crotona on the left, and Lake Thrasymenus on the right; and at last having drawn Flaminius into an ambuscade, entirely defeated him. The general himself, with fifteen thousand of his men, fell on the field of battle; a great number were taken prisoners; and a body of six thousand men, who had fled to a town in

Battle near Lake Thrasymenus.

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Etruria, surrendered to Maherbal the next day. Hannibal lost only fifteen hundred men on this occasion, most of whom were Gauls; though great numbers both of his soldiers and of the Romans died of their wounds. Being soon afterwards informed that the consul Servilius had detached a body of four thousand, or, according to Appian, eight thousand horse, from Ariminum, to reinforce his colleague in Etruria, Hannibal sent out Maherbal, with all the cavalry, and some of the infantry, to attack him. The Roman detachment consisted of chosen men, commanded by Centenius, a patrician. Maherbal soon fell in with the enemy, and after a short contest entirely defeated them. Two thousand Romans were left dead on the spot; and the rest retiring to a neighbouring eminence, were surrounded by Maherbal's forces, and obliged next day to surrender at discretion. This disaster happening within a few days after the defeat at Lake Thrasymenus, gave almost the finishing stroke to the affairs of Rome.

Fabius Maximus appointed dictator.

The Romans being now in the utmost consternation, named a dictator, as was their custom in seasons of great emergency. The person they chose on this occasion was Fabius Maximus, surnamed Verruscosus, a man as cool and cautious as Sempronius and Flaminius were warm and impetuous. Fabius set out with a design not to engage Hannibal, but only to watch his motions and cut off his provisions, which he knew was the most proper way to destroy him in a country so far from his own. Accordingly he followed him through Umbria and Picenum into the territory of Adria, and then through the territories of the Marucini and Frentani into Apulia. When the enemy marched he followed them; when they encamped he did the same, but for the most part on eminences, and at some distance from their camp, watching all their motions, cutting off their stragglers, and keeping them in a state of continual alarm. This cautious method of proceeding greatly distressed the Carthaginians, but at the same time raised discontents in the Roman army. But neither these discontents, nor the ravages committed by Hannibal, could prevail upon Fabius to alter his measures. The former, therefore, entered Campania, one of the finest countries of Italy; and the ravages he committed there raised such complaints in the Roman army, that the dictator, for fear of irritating his soldiers, was obliged to pretend a desire of coming to an engagement. Accordingly he followed Hannibal with greater expedition than usual; but at the same time avoided, under various pretences, an engagement, with more care than the enemy sought it. Hannibal finding he could not by any means bring the dictator to a battle, resolved to quit Campania, which he found more abundant in fruit and wine than in corn, and to return to Samnium through the pass called Eribanus. Concluding from his march that such was his design, Fabius got there before him, and encamped on Mount Calicula, which commanded the pass, after having placed several bodies in all the avenues leading to it.

He is outwitted by Hannibal.

Hannibal was for some time at a loss what to do; but at last contrived a stratagem, which Fabius could neither foresee nor guard against. Being encamped at the foot of Mount Calicula, he ordered Asdrubal to pick out from among the cattle taken in the country two thousand of the strongest and nimblest oxen, to tie faggots to their horns, and to have them with the herdsmen ready without the camp. After supper, when all was quiet, the cattle were brought in good order to the hill, where Fabius had placed some Roman parties in ambush to stop up the pass. Upon a signal given the faggots upon the horns of the oxen were set on fire; and the herdsmen, supported by some battalions armed with small javelins, drove them on quietly. The Romans seeing the light of the fires, imagined that the Carthaginians were marching by torch-light. However, Fabius kept close in his camp, depending on the troops he had placed in ambuscade; but when the oxen, feeling the fire on their heads, began to run up and down the hills, the Romans in ambush thought themselves surrounded on all sides, and climbing the paths where they saw least light, returned to their camp, leaving the pass open to Hannibal. Fabius, though rallied by his soldiers for being thus overreached by the Carthaginian, still continued to pursue the same plan, marched directly after Hannibal, and encamped on some eminences near him.

Soon after this, the dictator was recalled to Rome; and as Hannibal, notwithstanding the ravages he had committed, had all along spared the lands of Fabius, the latter was suspected of holding a secret correspondence with the enemy. In his absence, Minucius, the general of the horse, gained some advantages, which greatly tended to increase the dissatisfaction with the dictator, insomuch that before his return Minucius was placed upon an equal footing with himself. The general of the horse proposed that each should command his day; but the dictator chose rather to divide the army, hoping by that means to save at least part of it. Hannibal soon found means to draw Minucius into an engagement, and, by his masterly skill in laying ambuscades, the Roman general was surrounded on every side, and would have been cut off with all his troops, had not Fabius hastened to his assistance, and relieved him. Then the two armies uniting, advanced in good order to renew the fight; but Hannibal, not caring to venture a second action, sounded a retreat, and retired to his camp; and Minucius, ashamed of his rashness, resigned the command of the army to Fabius.

Minucius relieved by Fabius.

Battle of Cannæ.

The year following the Romans augmented their army to 87,000 men, horse and foot, under the command of Æmilius Paulus and Terentius Varro, the consuls for the year; and Hannibal being reduced to the greatest straits for want of provisions, resolved to abandon Samnium and penetrate into the heart of Apulia. Accordingly he decamped in the night; and as he left fires burning, and tents standing in his camp, the Romans for some time believed that his retreat was only feigned. When the truth was discovered, Æmilius declared against pursuing him; but in this he was seconded by few besides Servilius, one of the consuls of the preceding year; Terentius and all the other officers being obstinately bent on pursuit. They accordingly overtook the enemy at Cannæ, till this time an obscure village in Apulia, and a battle ensued at this place, as memorable as any mentioned in history. In this desperate conflict the Romans, though almost twice the number of the Carthaginians, were put to flight with terrible slaughter, about 45,000 being left dead on the field of battle, and 10,000 taken prisoners in the action or pursuit. The night was spent in Hannibal's camp in feasting and rejoicings, and next day in stripping the dead bodies of the unhappy Romans; after which the victorious general invested their double camp, where he found 4000 men.

Consequences of the victory.

The immediate consequence of this victory, as Hannibal had foreseen, was a disposition on that part of Italy called the Old Province, Magna Græcia, Tarentum, and part of the territory of Capua, to submit to him. The neighbouring provinces likewise discovered an inclination to shake off the Roman yoke, but wanted first to see whether Hannibal was able to protect them. The latter, accordingly, being informed that the Hirpini and other neighbouring nations were disposed to enter into an alliance with the Carthaginians, marched into Samnium, and advanced to Compsa, which opened its gates to him. In this place he left his heavy baggage, as well as the immense plunder he had acquired; after which he ordered his brother Mago, with a body of troops destined for that purpose, to occupy all the fortresses in Campania, the most

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delicious province of Italy. The humanity with which Hannibal had all along treated the Italian prisoners, as well as the fame of the complete victory he had lately obtained, wrought so powerfully upon the Lucani, Bruttii, and Apulians, that they expressed an eager desire of being taken under his protection; nay, even the Campanians themselves, a nation more obliged to the Romans than any in Italy except the Latins, discovered an inclination to abandon their natural friends. Of this the Carthaginian general received intelligence, and immediately bent his march towards Capua, not doubting but that, by means of the popular faction there, he should easily make himself master of the place, which he accordingly did. Soon after this place had submitted, many cities of the Bruttii opened their gates to Hannibal, who ordered his brother Mago to take possession of them. Mago was then dispatched to Carthage, with the important news of the victory at Cannæ, and the consequences attending it. Upon his arrival there, he acquainted the senate that Hannibal had defeated six Roman generals, four of whom were consuls, one dictator, and a general of horse; that he had engaged six consular armies, killed two consuls, wounded one, and driven another out of the field with scarcely fifty men to attend him; that he had routed the general of the horse, who was of equal power with the consuls; and that the dictator was esteemed the only general fit to command an army, merely because he had not the courage to engage him: and as a demonstrative proof of what he advanced, he produced, according to some authors, three bushels and a half of gold rings, taken from knights and senators who had been killed in the various engagements.

Capua submits to Hannibal.

Character of Hannibal.

Hitherto we have seen Hannibal almost uniformly victorious; and, indeed, if we call to mind what he had already done, we must consider his exploits as superior to those of any other general of ancient times. Other commanders have been celebrated for victories gained over barbarous and uncivilized nations. Alexander the Great, for instance, invaded and overran the empire of Persia; but that kingdom was then sunk in debasement and effeminacy; and if that great commander had turned his arms against the western nations, which were of a more martial disposition, it is more than probable he would not have conquered so easily. Hannibal, on the other hand, lived at a time when the Romans were not only the most powerful, but the most warlike nation in the world; yet that nation he attacked with an army of only 26,000 men, without resources either of recruits, money, or provisions, except what he could procure in the enemy's country. With these means he had for three years resisted the Roman armies, which had been hitherto invincible by all other nations. Their armies had been commanded by generals of different tempers, dispositions, and abilities; and the losses they had sustained were by the Roman writers imputed to the faults of the generals themselves; but experience had abundantly proved that these commanders, with all their defects, were able to conquer the most warlike nations when commanded by any one but Hannibal. In the battles fought with the Romans he had destroyed 200,000 of their men, and taken 50,000 prisoners. Yet from the time of the battle of Cannæ, the affairs of this great man totally declined. The reason of this, as stated by the Roman historians, is, that when he put his army into winter quarters in Capua, he so enervated himself and them by debaucheries in that place, that he became no longer capable of coping with the Roman forces. But this seems by no means to have been the case; for the Roman historians themselves own, that, after the battle of Cannæ, he gave their armies many severe defeats, and took a great number of towns in their sight.

Cause of the decline of his affairs.

The true cause of that reverse of fortune which Hannibal now experienced, was his not having sufficient resources for recruiting his army. On the first news, indeed, of his success at Carthage, a body of 4000 Numidian cavalry, 40 elephants, and 1000 talents of silver, were granted by the senate. A large detachment of Spanish forces was also appointed to follow them; and that these last might be ready in due time, Mago set out immediately for Spain to raise in that country 20,000 foot and 4000 horse. Had this ample supply been sent with proper expedition, it is by no means probable that the Romans would have had any occasion to reflect upon Hannibal's conduct at Capua; for that general would undoubtedly have obliged the haughty republic to submit to the superior force of his arms in the course of the next campaign. But, notwithstanding the influence of the Barcinian faction at Carthage, Hanno and his adherents found means not only to retard the march of the supplies intended, but even to diminish their number. Through the artifices of that infatuated party, Mago could obtain an order for only 12,000 foot and 2500 horse; and even with this inconsiderable body of troops he was sent into Spain. Hannibal being thus deserted by his country, found himself obliged to act upon the defensive; his army amounting now to little more than 26,000 foot and 9000 horse. But though obliged to act in this manner, he was only prevented from conquering; the utmost efforts of the Roman power were insufficient to drive this small army out of Italy in less than fourteen years.

Measures of the Romans.

The Romans, however, though greatly reduced, were not yet exhausted. They were still able to send two consular armies into the field, fully recruited and in good order; and as neither the Gauls nor Italians were natural allies of the Carthaginians, they did not fail to abandon them on the first reverse of fortune. After the Romans had recovered from the consternation into which they were thrown by the defeat at Cannæ, they chose a dictator, and recalled Marcellus, the conqueror of Syracuse, from Sicily. All the young Romans above seventeen years of age, of whatsoever rank, were obliged to enlist themselves; as were also those who had already completed their legal term of service. By these means four legions and 10,000 horse were soon raised in the city; while the allies of Rome, the colonies, and the municipia, furnished their contingents as usual. To these were added 8000 of the youngest and strongest slaves in the city, whom the republic purchased of their masters, but did not oblige to serve without their own consent, which they gave, by answering *Volo*, "I am willing;" and hence they were called *volones*, to distinguish them from the other troops. As the Romans, after the loss of so many battles, had no swords, darts, or bucklers, left in their magazines, the *volones* were supplied with the arms which had been formerly taken from the enemy and hung up in the public temples and porticoes. The finances of Rome were no less exhausted; but this defect was supplied by the liberality of her citizens. The senators showing the example, were followed first by the knights, and afterwards by the tribes; who, stripping themselves of all the gold they had, brought it to the public treasury. The senators only reserved their rings, and the *bullæ* about their children's necks. As for the silver coin, it was now, for the first time, alloyed with copper, and increased in value. Thus the finances were put into a tolerable condition, and a competent army raised.

This was plainly the last effort the Romans could make; and if Hannibal had procured a sufficient supply of men and money to enable him to cope with their new army, and to break it as he had done the others before, there would have been no more resistance on their part. He began, however, to be in want of money; and, in order to

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procure it, gave the Roman prisoners permission to ransom themselves. These unhappy men agreed to send ten of their body to Rome to negotiate their redemption; and Hannibal required no other security for their return but their oath. Carthalo was sent at their head to make proposals of peace; but upon the first news of his arrival, the dictator dispatched a lictor to command him immediately to quit the Roman territory; and it was resolved not to redeem the captives. Upon this Hannibal sent the most considerable of them to Carthage; and of the rest he made gladiators, obliging them to fight with one another, even relations with relations, for the entertainment of the troops.

Asdrubal defeated by the Romans in Spain.

At this time Cneius and Publius Scipio carried on the war in Spain with great success against the Carthaginians. Asdrubal had been ordered to enter Italy with his army to assist Hannibal; but being defeated by the Romans, was prevented doing so. The dictator and senate of Rome, encouraged by this news, carried on the preparations for the next campaign with the greatest vigour, whilst Hannibal remained inactive at Capua. This inaction, however, seems to have proceeded from his expectation of succours from Africa, which never arrived; and this delay occasioned his ruin. The Roman dictator now released from prison all criminals, and persons confined for debt, who were willing to enlist themselves; and of these he formed a body of 6000 foot, armed with the broad swords and bucklers formerly taken from the Gauls. Then the Roman army, to the number of about 25,000 men, marched out of the city under the command of the dictator; whilst Marcellus kept the remains of Varro's army, amounting to about 15,000 men, at Casilinum, in readiness to march whenever there should be occasion for their services.

Thus the Roman forces were still superior to those of Hannibal; and as they now saw the necessity of following the example of Fabius Maximus, no engagement of any consequence happened during the first year after the battle of Cannæ. Hannibal made a fruitless attempt upon Nola, expecting it would be delivered up to him; but this was prevented by Marcellus, who had entered that city, and who, sallying unexpectedly from three gates upon the Carthaginians, obliged them to retire in great confusion, with the loss of 5000 men. This was the first advantage which had been gained by the Romans where Hannibal commanded in person, and it raised their spirits not a little. But they were as much dejected on learning that the consul Posthumius Albinus, with his whole army, had been cut off by the Boii, as he was crossing a forest. Upon this it was resolved to draw all the Roman forces out of Gaul and other countries, and turn them against Hannibal; so that the Carthaginian stood daily more and more in need of those supplies which as yet never arrived from Carthage. He, however, reduced the cities of Nuceria, Casilinum, Petelia, Consentia, Crotona, Locri, and several others in Magna Græcia, before the Romans gained any advantage over him, except that before Nola, already mentioned. The Campanians, who had espoused the Carthaginian interest, raised an army of 14,000 of their own nation in favour of Hannibal, and placed one Marius Alsius at the head of it; but the latter was surprised by the consul Sempronius, who defeated and killed him, with 2000 of his men. It was now found that Hannibal had concluded a treaty of alliance, offensive and defensive, with Philip king of Macedon; but, in order to prevent any disturbance from that quarter, a Roman army was sent to Macedon. Soon after this Marcellus defeated Hannibal in a pitched battle, having armed his men with long pikes, used generally at sea, and chiefly in boarding ships; by which means the Carthaginians were pierced through, while they were totally unable to hurt their adversaries with the short javelins they carried. Marcellus pursued them closely, and, before they got to their camp, killed 5000, and took 600 prisoners, losing himself about 1000 men, who were trodden down by the Numidian horse, commanded by Hannibal in person. After this defeat the Carthaginian general found himself deserted by 1200 of his best horse, partly Spaniards and partly Numidians, who had crossed the Alps with him. This touched him so sensibly, that he left Campania, and retired into Apulia.

Marcellus gains an advantage over Hannibal.

Hannibal takes several cities.

He is defeated by Marcellus.

The Romans still continued to increase their forces; and Hannibal, not having the same resources, found it impossible to act at once against so many armies. Fabius Maximus advanced into Campania, whither Hannibal was obliged to return, in order to save Capua. He ordered Hanno, however, at the head of 17,000 foot and 1700 horse, to seize Beneventum; but the latter was utterly defeated, and scarcely 2000 of his men were left alive. Hannibal himself, in the mean-time, advanced to Nola, where he was again defeated by Marcellus. He now began to lose ground on all sides. The Romans retook Casilinum, Accua in Apulia, Arpi, and Aternum; but the city of Tarentum was delivered up to him by its inhabitants. The Romans then entered Campania, and ravaged the whole country, threatening Capua with a siege. The inhabitants immediately acquainted Hannibal with their danger; but he was so intent upon reducing the citadel of Tarentum, that he could not be prevailed upon to march to their assistance. In the mean time Hanno was again utterly defeated by Fulvius, his camp taken, and he himself forced to fly into Bruttium with a small body of horse. The consuls then advanced with the design of besieging Capua in form. But, in their way, Sempronius Gracchus, a man of great bravery, and an excellent general, was betrayed by a Lucanian, and killed; which proved a very great detriment to the republic. Capua, however, was soon afterwards invested on all sides; and the besieged having once more sent to Hannibal, he now came to their assistance with his horse, his light-armed infantry, and thirty-three elephants. He also found means to apprize the besieged of the moment when he designed to engage the Romans, and to order them to make a vigorous sally in support of the attack. Upon the first news of the enemy's approach, the Roman generals, Appius and Fulvius, divided their troops; Appius taking upon him to make head against the garrison, and Fulvius to defend the intrenchments against Hannibal. The former found no difficulty in repulsing the garrison, and would have entered the city pell-mell along with them, had he not been wounded at the very gate, which prevented him from pursuing his design. Fulvius found it more difficult to withstand Hannibal, whose troops behaved with extraordinary resolution. A body of Spaniards and Numidians had even the boldness to pass the ditch, and, climbing the ramparts, in spite of all opposition penetrated into the Roman camp; but, not being properly seconded by the rest, they were cut off to a man. The Carthaginian general was so disheartened at this, especially after the garrison was repulsed, that he sounded a retreat, which was effected in good order. His next attempt for the relief of Capua was to march to Rome, where he hoped his approach would strike so much terror that the armies would be recalled from before Capua; and, that the Capuans might not be disheartened by his sudden departure, he found means to apprize them of his design. The news of his approach caused great consternation in the metropolis. Some of the senators were for recalling the armies from all parts of Italy to the neighbourhood of Rome, thinking nothing less sufficient to resist the terrible Carthaginian. But Fabius told them that Hannibal's design was not to take Rome, but relieve Capua; up-

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Defeat of Hanno and of Hannibal.

Capua besieged.

Hannibal in vain attempts to relieve it.

He marches to Rome.

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on which Fulvius was recalled to Rome with 15,000 foot and 1000 horse; and this obliged Hannibal again to retire. He then returned so suddenly to Capua, that he surprised Appius in his camp, drove him out of it with the loss of a great number of men, and obliged him to intrench himself on some eminences, where he expected to be soon joined by his colleague Fulvius. As Hannibal, however, now expected to have all the Roman forces upon him, he could do nothing more for the relief of Capua, and consequently it at once was obliged to submit to the Romans.

Capua submits to the Romans.

Centenius Penula defeated by Hannibal;

A little before the surrender of Capua, Hannibal came up with a Roman army commanded by one M. Centenius Penula, who had signalized himself on many occasions as a centurion. This rash man, having been introduced to the senate, had had the assurance to tell them, that if they would entrust him with a body of only 5000 men, he would give a good account of Hannibal. They gave him 8000, and his army was soon increased to double that number. He engaged the Carthaginians on Hannibal's first offering him battle; but, after an engagement of two hours, he was defeated and slain, with all his men except about a thousand. Soon afterwards, having found means to draw the prætor Cneius Fulvius into an ambuscade, Hannibal cut in pieces almost his whole army, consisting of 18,000 men. In the mean time Marcellus was making great progress in Samnium, where the city of Salapia was betrayed to him; but he took two others by assault, in the last of which he found 3000 Carthaginians, whom he put to the sword, at the same time carrying off 240,000 bushels of wheat and 110,000 bushels of barley. This, however, was by no means a compensation for the defeat which Hannibal soon after inflicted on the proconsul Fulvius Centumalus, whom he surprised and cut off, with 13,000 of his men.

Fulvius Centumalus also defeated.

After this defeat Marcellus advanced with his army to oppose Hannibal; and various engagements took place, without any decisive result. In one of these the Romans are said to have been defeated, and in another Hannibal; but notwithstanding this, it was neither in the power of Marcellus nor of any other Roman general totally to defeat or disperse the army commanded by Hannibal in person. Nay, in the eleventh year of the war, Hannibal found means to decoy into an ambuscade and cut off Marcellus himself; the consequence of which was, that the Romans were obliged to raise the siege of Locri, with the loss of all their military engines.

Marcellus drawn into an ambuscade and killed.

Defeat of Asdrubal.

Hitherto the Carthaginians, though no longer the favourites of fortune, had lost but little ground; but now they met with a blow which totally ruined their affairs. This was the defeat of Asdrubal, Hannibal's brother, who had left Spain, and was marching to his assistance. He crossed the Pyrenees without any difficulty; and as the silver mines had supplied him with a great quantity of treasure, he not only prevailed upon the Gauls to grant him a passage through their territories, but likewise to furnish him with a considerable number of recruits. Meeting with many favourable circumstances to expedite his march, he arrived at Placentia sooner than either the Romans or his brother Hannibal expected. Had he continued to use the same expedition with which he set out, and hastened to join his brother, it would have been utterly impossible to save Rome; but, sitting down before Placentia, he gave the Romans time to concentrate their forces in order to attack him. At last he was obliged to raise the siege, and began his march for Umbria. He sent a letter to acquaint his brother of his intended movement; but the messenger was intercepted; and the two consuls, having formed a junction, fell upon the Carthaginians with their united forces. As the latter were inferior both in numbers and resolution, they were utterly defeated, and Asdrubal himself was killed. About the same time Hannibal is said to have suffered several defeats, and retired to Canusium; but on the fatal news of his brother's overthrow and death he was filled with despair, and withdrew to the extremity of Bruttium, where, assembling all his forces, he remained for a considerable time in a state of inaction, the Romans not daring to disturb him; so formidable did they esteem him alone, though every thing about him went to wreck, and the Carthaginian affairs seemed approaching the verge of ruin. Livy tells us, that it was difficult to determine whether his conduct was more wonderful in prosperity or in adversity. But notwithstanding this, Bruttium being a small province, and many of its inhabitants being either forced into the service, or forming themselves into parties of banditti, so that a great part of it remained uncultivated, he found it a difficult matter to subsist there, especially as no manner of supplies were sent him from Carthage. The people of that ill-fated republic were as solicitous about preserving their possessions in Spain, and as little concerned about the situation of affairs in Italy, as if Hannibal had met with an uninterrupted course of success, and as if no disaster had befallen him since he first entered that country.

Carthage.

Progress of Scipio Africanus.

All their solicitude, however, about the affairs of Spain was to no purpose; for their generals, one after another, were defeated by the Romans. They had indeed cut off the two Scipios; but they found a much more formidable enemy in the young Scipio, afterwards surnamed Africanus, who overthrew them in conjunction with Masinissa king of Numidia, who soon afterwards abandoned their interest; an example which was shortly after followed by Syphax king of the Masæsylii. Scipio also inflicted on the Spanish reguli, or petty princes, a great overthrow, and reduced the cities of New Carthage, Gades, and many other important places. At last the Carthaginians began to open their eyes, but it was now too late. Mago was ordered to abandon Spain, and sail with all expedition to Italy. He landed on the coast of Liguria with an army of 12,000 foot and 2000 horse, where he surprised Genoa, and also seized upon the town and port of Savo. A reinforcement was sent him to this place, and new levies went on very briskly in Liguria; but the opportunity was past, and could not be recalled. Scipio having carried all before him in Spain, passed over into Africa, where he met with no enemy capable of opposing his progress. The Carthaginians, then, seeing themselves on the brink of destruction, were obliged to recal their armies from Italy, in order to save their city. Mago, who had entered Insubria, was defeated by the Roman forces there; and having retreated into the maritime parts of Liguria, met a courier, who brought him orders to return directly to Carthage. At the same time Hannibal was likewise recalled. When the messengers acquainted him with the senate's pleasure, he expressed the utmost indignation and concern; groaning, gnashing his teeth, and scarce refraining from tears. Never did banished man, according to Livy, show so much regret in quitting his native country, as Hannibal evinced at leaving that of the enemy.

Scipio lands in Africa.

Mago and Hannibal recalled.

Hannibal's proceedings in Africa.

The Carthaginian general had no sooner landed in Africa than he sent out parties to procure provisions for the army, and buy horses to remount the cavalry. He entered into a league with the regulus of the Arcacidæ, one of the Numidian tribes; and four thousand of Syphax's horse came over in a body to him; but as he did not think proper to repose any confidence in them, he put them all to the sword, and distributed their horses amongst his troops. Vermina, one of Syphax's sons, and Macetulus, another Numidian prince, likewise joined him with a considerable body of horse; and most of the fortresses in Masinissa's kingdom either surrendered to him upon the first sum-

Carthage.

mons, or were taken by force. Narce, a city of considerable note, he obtained possession of by stratagem. Tychæus, a Numidian regulus, and faithful ally of Syphax, whose territories were famous for an excellent breed of horses, reinforced him also with 2000 of his best cavalry; and Hannibal advanced to Zama, a town about five days' journey distant from Carthage, where he encamped. He then sent out spies to observe the position of the Romans, and report. They were however made prisoners and brought before Scipio, who, far from inflicting any punishment upon them, which he might have done by the laws of war, commanded them to be led about the camp, in order that they might take an exact survey of it, and then dismissed them. Hannibal, admiring the noble confidence of his rival, sent a messenger to desire an interview with him, which, by means of Masinissa, he obtained. Escorted by equal detachments of horse, the two generals accordingly met at Nadagara, where, by the assistance of interpreters, they held a private conference. Hannibal flattered Scipio in the most refined and artful manner, expatiating upon all those topics which he thought calculated to influence that general to grant his nation a peace upon tolerable terms, and protesting that the Carthaginians would willingly confine themselves to Africa, since such was the will of the gods, in order to procure a lasting peace, whilst the Romans should be at liberty to extend their conquests to the remotest nations. Scipio answered, that the Romans were not prompted by ambition nor any sinister views to undertake either the former or present war against the Carthaginians, but by justice and a proper regard for their allies. He also observed, that the Carthaginians had, before his arrival in Africa, not only made him the same proposals, but likewise agreed to pay the Romans 5000 talents of silver, to restore all the Roman prisoners without ransom, and to deliver up all their galleys. He insisted on the perfidious conduct of the Carthaginians, who had broken a truce concluded with them; and added, that, so far from granting them more favourable, they ought to expect more rigorous terms, which, if Hannibal would submit to, peace might be concluded; if not, the decision of the dispute must be left to the sword.

His interview with Scipio.

The battle of Zama, and defeat of Hannibal.

This conference betwixt two of the greatest generals the world had ever produced thus ending in nothing, they retired to their respective camps, where they informed their troops, that not only the fate of Rome and Carthage, but that of the whole world, was to be determined by them the next day. An engagement ensued, in which, as Polybius informs us, the surprising military genius of Hannibal displayed itself in an extraordinary manner. Scipio likewise, according to Livy, pronounced a high encomium upon him, on account of his uncommon capacity in taking advantages, the excellent arrangement of his forces, and the manner in which he gave his orders during the engagement. The Roman general, indeed, not only approved his conduct, but openly declared that it was superior to his own. Nevertheless, being vastly inferior to the enemy in horse, and the state of Carthage obliging him to hazard a battle with the Romans at great disadvantage, Hannibal was utterly routed, and his camp taken. He fled first to Thon, and afterwards to Adrumentum, whence he was recalled to Carthage, where on his arrival he advised his countrymen to conclude a peace with Scipio, on whatever terms he thought proper to prescribe.

Peace concluded.

Thus was the second war of the Carthaginians with the Romans concluded. The conditions of peace were very humiliating to the Carthaginians. They were obliged to give up all the Roman deserters, fugitive slaves, prisoners of war, and all the Italians whom Hannibal had obliged to follow him. They also delivered over all their ships of war, except ten triremes, and all their tame elephants, and became bound not to train up any more of these animals for the service. They were not to engage in any war without the consent of the Romans. They engaged to pay to the Romans in fifty years 10,000 Euboic talents, in equal payments. They were to restore to Masinissa all they had usurped from him or his ancestors, and to enter into an alliance with him. They were also to assist the Romans both by sea and land whenever they were called upon to do so, and never to make any levies either in Gaul or Liguria. These terms appeared so intolerable to the populace, that they threatened to plunder and burn the houses of the nobility; but Hannibal having assembled a body of 6000 foot and 500 horse at Marthama, prevented an insurrection, and by his influence completed the accommodation.

Carthaginians oppressed by Masinissa.

The peace between Carthage and Rome was scarcely signed when Masinissa unjustly made himself master of part of the Carthaginian dominions in Africa, on the pretence that these had formerly belonged to his family. The Carthaginians, through the sinister mediation of the Romans, found themselves under the necessity of ceding these countries to that ambitious prince, and of entering into an alliance with him. An apparent good understanding between the two powers continued for many years afterwards; but at last Masinissa violated the treaties subsisting betwixt him and the Carthaginian republic, and not a little contributed to its subversion.

Hannibal flies to Antiochus.

After the conclusion of the peace, Hannibal still kept up his credit among his countrymen; and he was intrusted with the command of an army against some neighbouring nations in Africa; but this being disagreeable to the Romans, he was removed from it, and raised to the dignity of prætor in Carthage. Here he continued for some time, reforming abuses, and putting the affairs of the republic into a better condition; but as this likewise proved disagreeable to the Romans, he was obliged to fly to Antiochus, king of Syria. After his flight the Romans began to look upon the Carthaginians with a suspicious eye; though, to prevent every thing of this kind, the latter had ordered two ships to pursue Hannibal, had confiscated his effects, razed his house, and by a public decree declared him an exile. Soon afterwards, disputes having arisen between the Carthaginians and Masinissa, the latter, notwithstanding the manifest iniquity of his proceedings, was supported by the Romans. That prince, grasping at further conquest, endeavoured to embroil the Carthaginians with the Romans, by asserting that the former had received ambassadors from Perseus, king of Macedon; that the senate had assembled in the temple of Æsculapius in the night time, in order to confer with them; and that ambassadors had been dispatched from Carthage to Perseus, in order to conclude an alliance with him. Not long after this, Masinissa made an irruption into the province of Tysca, where he soon possessed himself of seventy, or, according to Appian, fifty towns and castles. This obliged the Carthaginians to apply with great importunity to the Roman senate for redress; their hands being so tied up by an article in the last treaty that they could not repel force by force, in case of an invasion, without their consent. Their ambassadors requested that the Roman senate would settle once for all what dominions they were to have, that they might from thenceforth know what they had to depend upon; or, if their state had in any way offended the Romans, they begged that the latter would punish them themselves, rather than leave them exposed to the insults and vexations of a merciless tyrant; and then prostrating themselves on the earth, they burst out into tears. But, notwithstanding the impression made by their speech, the matter was left undecided; so that Masinissa remained at liberty to pur-

Proceedings of Masinissa and the Romans.

Carthage. sue what course he pleased. But whatever designs the Romans might have entertained with respect to the republic of Carthage, they affected to show great regard to the principles of justice and honour. They therefore sent Cato, a man who scrupled not to commit enormities under the specious pretence of public spirit, into Africa, to accommodate all differences betwixt Masinissa and the Carthaginians. The latter very well knew their fate had they submitted to such a mediation; they therefore appealed to the treaty concluded with Scipio, as the only rule by which their conduct and that of their adversary ought to be tried. But this reasonable appeal so incensed the righteous Cato, that he pronounced them a devoted people, and from that instant resolved upon their destruction. For some time he was opposed by Scipio Nasica; but the people of Carthage knowing that the Romans were their inveterate enemies, and reflecting upon the iniquitous treatment which they had met with from them ever since the commencement of their disputes with Masinissa, were under great apprehensions of an invasion. To prevent a rupture as much as possible, they, by a decree of the senate, impeached Asdrubal, general of the army, and Carthalo, commander of the auxiliary forces, together with their accomplices, as guilty of high treason, and as being the authors of the war against the king of Numidia. They sent a deputation to Rome to discover what sentiments were entertained there of their late conduct, and to ascertain what satisfaction the Romans required; and their envoys meeting with a cold reception, others were dispatched, who returned with the same success. This led the unhappy citizens of Carthage to believe that their destruction was resolved upon, and consequently threw them into the utmost despair. And indeed they had but too just grounds for such a melancholy apprehension, as the Roman senate now discovered an inclination to adopt the measures suggested by Cato. About the same time the city of Utica, the second in Africa, and famous for its immense riches, as well as its commodious and capacious port, submitted to the Romans. On obtaining possession of so important a fortress, which, by reason of its vicinity to Carthage, might serve as a place of arms in the attack of that city, the Romans declared war against the Carthaginians without the least hesitation; and in consequence of this declaration, the consuls M. Manlius Nepos and L. Marcius Censorinus were dispatched with an army and fleet to commence hostilities with the utmost expedition. The land forces consisted of 80,000 foot and 4000 chosen horse; and the fleet of fifty quinqueremes, besides a vast number of transports. The consuls had secret orders from the senate not to conclude the operations but by the destruction of Carthage, without which, it was pretended, the republic could not but look upon all her possessions as insecure. Pursuant to the plan they had formed, the troops were first landed at Lilybæum in Sicily, whence, after receiving a proper refreshment, it was proposed to transport them to Utica.

War declared against Carthage.

Ambassadors sent to Rome.

The answer brought to Carthage by the last ambassadors had not a little alarmed the inhabitants of that city; but they were not as yet acquainted with the resolutions adopted at Rome. They therefore sent new ambassadors thither, whom they invested with full powers to act as they thought proper for the good of the republic, and even to submit themselves without reserve to the pleasure of the Romans. But the more sensible persons among them expected no great success from this condescension, since the early submission of the Uticans had rendered it infinitely less meritorious than it would have otherwise been. However, the Romans seemed to be in some measure satisfied with it, since they promised them their liberty, the enjoyment of their laws, and, in short, every thing that was dear and valuable to them. This threw them into a transport of joy, and they began to extol the moderation of the Romans. But the senate immediately dashed all their hopes, by acquainting them that this favour was granted upon condition of their sending three hundred young Carthaginian noblemen of the first distinction to the prætor Fabius at Lilybæum, within the space of thirty days, and complying with all the orders of the consuls. These hard terms filled the whole city with inexpressible grief; but the hostages were delivered, and as they arrived at Lilybæum before the thirty days were expired, the ambassadors were not without hopes of softening their hard hearted enemy. But the consuls only told them that upon their arrival at Utica they should learn the further orders of the republic.

Conduct of the Romans.

The ministers no sooner received intelligence of the Roman fleet appearing off Utica than they repaired thither in order to know the fate of their city. The consuls however did not judge it expedient to communicate all the commands of the republic at once, lest they should appear so harsh and severe that the Carthaginians would refuse to comply with them. They first, therefore, demanded a sufficient supply of corn for the subsistence of their troops; secondly, that the Carthaginians should deliver up into their hands all the triremes they were then masters of; thirdly, that they should put them in possession of all their military machines; and, fourthly, that they should immediately convey all their arms into the Roman camp.

As care was taken that there should be a convenient interval of time betwixt every one of these demands, the Carthaginians found themselves ensnared, and could not reject any one of them, though they submitted to the last with the utmost reluctance and concern. Censorinus, now imagining them incapable of sustaining a siege, commanded them to abandon their city, or, as Zonaras says, to demolish it; but kindly gave them permission to build another eighty stadia from the sea, but without walls or fortifications. This barbarous decree threw the senate and every one else into despair; and the whole city became a scene of horror, madness, and confusion. The citizens cursed their ancestors for not dying gloriously in the defence of their country, rather than concluding such ignominious treaties of peace, that had been the cause of the deplorable condition to which their posterity was then reduced. At length, when the first commotion had a little abated, the senators assembled, and resolved to sustain a siege. They were stripped of their arms, and destitute of provisions; but despair raised their courage, and made them find out expedients. They took care to shut the gates of the city, and gathered together on the ramparts great heaps of stones, to serve them instead of arms in case of a surprise. They released the malefactors from prison, gave the slaves their liberty, and incorporated them in the militia. They recalled Asdrubal, who had been sentenced to death only to please the Romans; and he was invited to employ in defence of his country 20,000 men whom he had raised against it. Another Asdrubal was appointed to command in Carthage; and all seemed resolute, either to save their city or perish in its ruins. They wanted arms; but, by order of the senate, the temples, porticoes, and all public buildings, were turned into workhouses, where men and women were continually employed in making arms. As they encouraged one another in their work, and lost no time in procuring to themselves the necessaries of life, which were brought to them at stated hours, they every day made 144 bucklers, 300 swords, 1000 darts, and 500 lances and javelins. As to balistæ and catapultæ, they wanted proper materials for them; but their industry supplied that defect. Where iron and brass were wanting, they made use of silver and gold, melting down the sta-

The Carthaginians resolve to sustain a siege.

Carthage. tues, vases, and even the utensils of private families; for on this occasion even the most covetous became liberal. As tow and flax were wanting to make cords for working the machines, the women, even those of the first rank, freely cut off their hair and dedicated it for that purpose. Without the walls, Asdrubal employed the troops in getting together provisions, and conveying them safely into Carthage; so that there was as great plenty there as in the Roman camp.

In the mean time the consuls delayed drawing near to Carthage, not doubting but the inhabitants, whom they imagined destitute of necessaries for sustaining a siege, would, upon cool reflection, submit; but at length, finding themselves deceived in their expectation, they appeared before the place and invested it. As they were still persuaded that the Carthaginians had no arms, they flattered themselves that they should easily carry the city by assault.

The city attacked, and the Romans repulsed.

Accordingly they approached the walls in order to plant their scaling ladders; but to their great surprise they discovered a prodigious multitude of men on the ramparts, shining in the armour which they had newly made. The legionaries were so terrified at this unexpected sight, that they drew back, and would have retired, if the consuls had not led them on to the attack, which, however, proved unsuccessful; the Romans, in spite of their utmost efforts, being obliged to abandon the enterprise, and lay aside all thoughts of taking Carthage by assault. In the mean time Asdrubal, having collected from all places subject to Carthage a prodigious number of troops, came and encamped within reach of the Romans, whom he soon reduced to great straits for want of provisions. As Marcius, one of the Roman consuls, was posted near a marsh, the exhalations of the stagnant waters, and the heat of the season, infected the air, and caused a general sickness among his men.

The Roman fleet destroyed.

Marcius, therefore, ordered his fleet to draw as near the shore as possible, in order to transport his troops to a healthier place. But Asdrubal being informed of this movement, ordered all the old barks in the harbour to be filled with faggots, tow, sulphur, bitumen, and other combustible materials; and then, taking advantage of the wind, which blew towards the enemy, let them drift against their ships, which were for the most part consumed. After this disaster, Marcius was recalled in order to preside at the elections; and the Carthaginians looking upon the absence of one of the consuls as a good omen, made a brisk sally in the night, and would have surprised the consul's camp, had not Æmilianus, with some squadrons, marched out by the gate opposite to the place where the attack was made, and, coming round, fallen unexpectedly on their rear, which obliged them to return in disorder to the city.

Asdrubal having posted himself under the walls of a city named Nepheris, twenty-four miles distant from Carthage, and situated on a high mountain, which seemed inaccessible on all sides, made incursions thence into the neighbouring country, intercepted the Roman convoys, fell upon their detachments sent out to forage, and even caused parties to insult the consular army in their camp. The consul, therefore, resolved to drive the Carthaginian from his advantageous position, and with this view set out for Nepheris. As he drew near the hills, Asdrubal suddenly appeared at the head of his army in order of battle, and fell upon the Romans with incredible fury. The consular army sustained the attack with great resolution; and Asdrubal retired in good order to his position, hoping the Romans would attack him there. But the consul, being now convinced of his danger, resolved to retire; which Asdrubal no sooner perceived than he rushed down the hill, and falling upon the enemy's rear, cut a great number of them to pieces. But the whole Roman army was saved by the bravery of Scipio Æmilianus. At the head of 300 horse he sustained the attack of all the forces commanded by Asdrubal, and covered the legions while they passed a river in their retreat before the enemy; after which he and his companions threw themselves into the stream, and swam across it.

The Roman army saved by Scipio Æmilianus.

When the army had crossed the river, it was perceived that four manipules were wanting; and soon after they were informed that these companies had retired to an eminence, where they resolved to sell their lives as dearly as possible. Upon receiving this intelligence, Æmilianus, taking with him a chosen body of horse, and provisions for two days, crossed the river, and flew to the assistance of his countrymen. He seized a hill over against that on which the four manipules were posted, and, after some hours' repose, marched against the Carthaginians, who kept them invested; fell upon them at the head of his detachment with the boldness of a man determined to conquer or die; and, in spite of all opposition, opened a way for his fellow-soldiers to escape. On his return to the army, his companions, who had given him over for lost, carried him to his quarters in a kind of triumph; and the manipules he had saved gave him a crown of *gramen*. By these and some other exploits, Æmilianus gained such reputation, that Cato, who is said never to have commended any body before, could not withhold from him the praises he deserved; and, moreover, foretold that Carthage would never be reduced till Scipio Æmilianus was employed in that expedition.

The next year the war in Africa fell by lot to the consul L. Calpurnius Piso; and he continued to employ Æmilianus in several important enterprises, which, under the conduct of the latter, were attended with uncommon success. He took several castles; and in one of his excursions found means to obtain a private conference with Phameas, general, under Asdrubal, of the Carthaginian cavalry; and brought him over, together with 2200 of his horse, to the Roman interest. Under the consul Calpurnius Piso himself, however, the Roman arms were unsuccessful. He invested Clupea, but was obliged to abandon the enterprise, with the loss of a great number of men killed by the enemy in their sallies. He then proceeded to vent his rage against a city newly built, and thence called Neapolis, which professed a strict neutrality, and had even a protection from the Romans. The consul, however, plundered the place, and stripped the inhabitants of all their effects. After this he laid siege to Hippagretta, which occupied the Roman fleet and army the whole summer; and, on the approach of winter, he retired to Utica, without performing a single action worth notice during the whole campaign.

The next year Scipio Æmilianus being chosen consul, was ordered to proceed to Africa; and, upon his arrival, the face of affairs was soon changed. At the time of his entering the port of Utica, 3500 Romans were in imminent danger of being cut in pieces before Carthage. They had seized upon Megalia, one of the suburbs of the city; but, as they had not furnished themselves with provisions to subsist there, and could not retire, being closely invested on all sides by the enemy's troops, the prætor Mancinus, who commanded the detachment, seeing the danger into which he had brought himself, dispatched a light boat to Utica to acquaint the Romans in that place with his situation. Æmilianus received his letter a few hours after landing, and immediately flew to the relief of the besieged Romans, obliged the Carthaginians to retire within their walls, and conveyed his countrymen safely to Utica. Having then drawn together all the troops, Æmilianus applied himself wholly to the siege of the capital.

His first attack was upon Megalia, which he carried by assault, the Carthaginian garrison retiring into the citadel of Byrsa. Asdrubal, who had commanded the Carthagi-

Carthage.

nian forces in the field, and now acted as governor of the city, was so enraged at the loss of Megalia, that he caused all the Roman captives taken in the two years during which the war had lasted to be brought upon the ramparts, and thrown headlong from the top of the wall; after having, with an excess of cruelty, commanded their hands and feet to be cut off, and their eyes and tongues to be torn out. He was of a temper remarkably inhuman; and it is said that he even took pleasure in seeing some of these unhappy men flayed alive. Æmilianus, in the mean time, was busy in drawing lines of circumvallation and contravallation across the neck of land which joined the isthmus on which Carthage stood to the Continent. By this means all the avenues on the land side of Carthage were shut up, so that the city could receive no provisions from the interior. His next care was to raise a mole in the sea, in order to block up the old port, the new one being already blockaded by the Roman fleet; and this great work he effected with immense labour. The mole reached from the western neck of land, of which the Romans were masters, to the entrance of the harbour, and was ninety feet broad at the bottom, and eighty at the top. The besieged, when the Romans first began this surprising work, laughed at the attempt; but they were no less alarmed than surprised, when they beheld a vast mole appearing above water, and the port thereby rendered inaccessible to ships, and useless. Prompted by despair, however, the Carthaginians, with incredible industry, dug a new basin, and cut a passage into the sea, by which they could receive the provisions which were sent them by the troops in the field. With the same diligence and expedition they fitted out a fleet of fifty triremes, which, to the great surprise of the Romans, appeared suddenly advancing into the sea through this new canal, and even ventured to give the enemy battle. The action lasted the whole day, with little advantage on either side. The day after, the consul endeavoured to make himself master of a terrace which covered the city on the side next the sea; and on this occasion the besieged signalized themselves in a most remarkable manner. Great numbers, naked and unarmed, plunged into the water in the dead of the night, with unlit torches in their hands; and having, partly by swimming, partly by wading, got within reach of the Roman engines, they struck fire, lit their torches, and threw them with fury against the machines. The sudden appearance of these naked men, who looked like so many monsters that had started out of the sea, so terrified the Romans who guarded the machines, that they began to retire in the utmost confusion. The consul, who commanded the detachment in person, and had continued all night at the foot of the terrace, endeavoured to stop his men, and even ordered those who fled to be killed. But the Carthaginians, perceiving the confusion among the Romans, threw themselves upon them like so many furies; and having put them to flight by means of their torches alone, they set fire to the machines, and entirely consumed them. This, however, did not discourage the consul; he renewed the attack a few days after, carried the terrace by assault, and effected a lodgment upon it with 4000 men. As this was an important post, because it hemmed in Carthage on the sea side, Æmilianus took care to fortify and secure it against the sallies of the enemy; and then, winter approaching, he suspended all further attacks upon the place till the return of good weather. During the winter season, however, the consul was not inactive. The Carthaginians had a very numerous army under the command of one Diogenes, strongly encamped near Nepheris, whence convoys of provisions were sent by sea to the besieged, and brought in by the new basin. To take Nepheris, therefore, was to deprive Carthage of her chief magazine. This Æmilianus undertook, and succeeded in the attempt. He first forced the enemy's intrenchments, put 70,000 of them to the sword, and made 10,000 prisoners; all the inhabitants of the country who were prevented from retiring to Carthage having taken refuge in this camp. After this he laid siege to Nepheris, which was reduced in twenty-two days. Asdrubal, disheartened by the defeat of the army, and touched with the misery of the besieged, who were now reduced to the utmost extremity for want of provisions, offered to submit to such conditions as the Romans pleased to dictate, provided the city were spared; but this was absolutely refused.

Carthage blockaded by sea and land.

The besieged set fire to the Roman machines.

Great slaughter of the Carthaginians.

Early in the spring Æmilianus renewed the siege of Carthage; and in order to open a passage into the city, he ordered Lælius to attempt the reduction of Cotho, a small island which divided the two ports. Æmilianus himself made a false attack on the citadel, in order to distract the enemy, and withdraw them from the place where the main effort was to be made. The stratagem had the desired effect; for the citadel being a place of the greatest importance, most of the Carthaginians hastened thither, and made the utmost efforts to repulse the aggressors; and in the mean time Lælius having, with incredible expedition, built a wooden bridge over the channel which divided Cotho from the isthmus, entered the island, scaled the walls of the fortress which the Carthaginians had built there, and made himself master of that important post. The proconsul, who was engaged before Byrsa, no sooner understood, by the loud shouts of the troops of Lælius, that he had made himself master of Cotho, than he abandoned the false attack, and unexpectedly fell on the neighbouring gate of the city, which he broke down, notwithstanding the showers of darts that were incessantly discharged upon his men from the ramparts. The approach of night prevented him from proceeding farther, but he effected a lodgment within the gate, and waited there for the return of day, with the design of advancing through the city to the citadel, and attacking it on that side, which was but indifferently fortified. Pursuant to this design, at daybreak he ordered four thousand fresh troops to be sent from the camp; and having solemnly devoted to the infernal gods the unhappy Carthaginians, he began to advance at the head of his men through the streets of the city, in order to attack the citadel. Having advanced to the market-place, he found that the way to the citadel lay through three exceedingly steep streets; while the houses on both sides were of great height, and filled with Carthaginians, who overwhelmed the Romans as they advanced, with darts and stones. It therefore became necessary first of all to clear the houses and streets. With this view Æmilianus in person, at the head of a detachment, attacked the first house, and made himself master of it, sword in hand. His example was followed by the officers and soldiers, who went on from house to house, putting all whom they met to the sword. As fast as the houses were cleared on both sides, the Romans advanced in order of battle towards the citadel, but met with a vigorous resistance from the Carthaginians, who on this occasion behaved with uncommon resolution. From the market-place to the citadel two bodies of men fought their way step by step; one above on the roofs of the houses, the other below in the streets. The slaughter was inexpressibly horrible. The air rung with shrieks and lamentations. Some were cut in pieces, while others threw themselves down from the tops of the houses; so that the streets were filled with dead and mangled bodies. But the destruction was yet greater when the proconsul commanded fire to be set to that quarter of the town which lay next to the citadel. Incredible multitudes who had escaped the sword of the enemy perished in the flames or by the fall of the

Cotho taken.

The Romans enter the city, and set it on fire.

Carthagena.

houses. After the fire had lasted six days, and consumed a sufficient number of houses, Æmilianus ordered the rubbish to be removed, and a large area to be made, where all the troops might have room to act. He then appeared with his whole army before Byrsa; which so terrified the Carthaginians, who had fled thither for refuge, that first twenty-five thousand women, and then thirty thousand men, came out of the gates in such a condition as moved pity even in the Romans, and threw themselves prostrate before the general, asking no favour but life. This was readily granted, not only to them, but to all that were in Byrsa except the Roman deserters, whose number amounted to nine hundred.

Cruelty and cowardice of Asdrubal.

Asdrubal's wife earnestly entreated her husband to suffer her to join the suppliants, and carry with her to the proconsul her two sons, who were as yet very young; but the barbarian denied her request, and rejected her remonstrances with menaces. The Roman deserters seeing themselves excluded from mercy, resolved to die sword in hand, rather than deliver themselves up to the vengeance of their countrymen. Finding them all resolved to defend themselves to the last breath, Asdrubal committed to their care his wife and children, after which, in a most cowardly and mean-spirited manner, he went privately and threw himself at the conqueror's feet. The Carthaginians in the citadel no sooner understood that their commander had abandoned the place, than they threw open the gates and put the Romans in possession of Byrsa. They had now no enemy to contend with but the nine hundred deserters, who, reduced to despair, retreated into the temple of Æsculapius, which formed a sort of second citadel within the first. There the proconsul attacked them; and these unhappy wretches, finding there was no way to escape, set fire to the temple. As the flames spread they retreated from one part of the building to another, till they got to the roof. There Asdrubal's wife appeared in her best apparel, and having uttered the bitterest imprecations against her husband, whom she saw standing below with Æmilianus, "Base coward," she exclaimed, "the mean things thou hast done to save thy life shall not avail thee; thou shalt die this instant, at least in thy two children." Having thus spoken, she stabbed both the infants with a dagger, and, while they were yet struggling for life, threw them from the top of the temple, and then leaped down after them into the flames.

His wife destroys herself and two children.

Carthage plundered and rased.

Æmilianus delivered up the city to be plundered, but in the manner prescribed by the Roman military law. The soldiers were allowed to appropriate to themselves all the furniture, utensils, and brass money, they should find in private houses; but all the gold and silver, the statues, pictures, and the like, were reserved in order to be put into the hands of the quæstors. On this occasion the cities of Sicily, which had often been plundered by the Carthaginian armies, recovered a number of statues, pictures, and other valuable monuments; amongst which the famous brazen bull which Phalaris had ordered to be cast, and used as the chief instrument of his cruelty, was restored to the inhabitants of Agrigentum. As Æmilianus was greatly inclined to spare what remained of this stately metropolis, he wrote on the subject to the senate, from which he received the following orders; 1. The city of Carthage, with Byrsa and Megalia, shall be entirely destroyed, and no traces of them left. 2. All the cities which have lent Carthage any assistance shall be dismantled. 3. The territories of those cities which have declared for the Romans shall be enlarged with the lands taken from the enemy. 4. All the lands between Hippo and Carthage shall be divided among the inhabitants of Utica. 5. All the Africans of the Carthaginian state, both men and women, shall pay an annual tribute to the Romans at so much per head. 6. The whole country formerly subject to the Carthaginian state shall be reduced into a Roman province, and be governed by a prætor, in the same manner as Sicily. Lastly, Rome shall send commissioners into Africa, there to settle jointly with the proconsul the state of the new province. Before Æmilianus destroyed the city, he performed those religious ceremonies which were required on such occasions; he first sacrificed to the gods, and then caused a plough to be drawn round the walls of the city. After this the towers, ramparts, walls, and all the works which the Carthaginians had raised in the course of many ages, and at a vast expense, were levelled with the ground; and, lastly, fire was set to the edifices of the proud metropolis, which were all consumed, not a single house escaping the flames. Though the fire began in many quarters at the same time, and burnt with incredible fury, it continued for seventeen days before all the buildings were consumed.

Thus fell Carthage, about 146 years before the birth of Christ; a city whose destruction ought to be attributed more to the intrigues of an abandoned faction, composed of the most profligate part of its citizens, than to the power of its rival. The treasure which Æmilianus carried off, even after the city had been delivered up to be plundered by the soldiers, was immense, amounting, according to Pliny, to 4,470,000 pounds weight of silver. The Romans ordered Carthage never to be inhabited again, denouncing dreadful imprecations against those who, contrary to this prohibition, should attempt to rebuild any part of it, especially Byrsa and Megalia. Notwithstanding this, however, about twenty-four years afterwards, C. Gracchus, tribune of the people, in order to ingratiate himself with the multitude, undertook to rebuild it, and for that purpose conducted thither a colony of 6000 Roman citizens. The workmen, according to Plutarch, were terrified by many unlucky omens at the time they were tracing the limits and laying the foundations of the new city; and the senate being informed of the circumstance, wished to suspend the attempt. But the tribune, little affected with such presages, continued to carry on the work, and finished it in a few days. Hence it is evident that only slight huts were erected in the first instance; but whether Gracchus executed his design, or whether the work was entirely discontinued, it is certain that Carthage was the first Roman colony ever sent out of Italy. According to some authors, Carthage was rebuilt by Julius Cæsar; and Strabo, who flourished in the reign of Tiberius, affirms, that in his time it was equal, if not superior, to any other city in Africa. It was looked upon as the capital of Africa for several centuries after the commencement of the Christian era. Maxentius laid it in ashes about the sixth or seventh year of Constantine's reign. Genseric, king of the Vandals, took it A. D. 439; but about a century afterwards it was re-annexed to the Roman empire by the renowned Belisarius. At last, towards the close of the seventh century, the Saracens, under Mahommed's successors, so completely destroyed it that there is now scarcely any trace or vestige of it remaining. (J.B—E.)

Rebuilt.

Utterly destroyed by the Saracens.

CARTHAGENA, a famous seaport and naval arsenal of Spain, in the province of Murcia. N. Lat. 37. 36.; W. Long. 1. 1. It occupies the site of the ancient *Carthago Nova*, the foundations of which were laid by Hasdrubal, the son-in-law and successor of Hamilcar Barca in Spain. It was the Carthaginian head quarters in Spain during the

Punic wars; and when taken at last by Scipio (B.C. 210), it received the name of *Colonia Victrix Julia Nova Carthago*, and continued to be a place of considerable importance under the Romans. For their cordage, they made copious use of the *spartum* or broom, which formerly supplied ropes for the navies of Spain, and still grows abundantly in the province. Its mines were wrought both by the Carthaginians and the Romans. To the Goths its maritime advantages presented few attractions, and accordingly the town was allowed by them to fall into decay. It was a flourishing port before the revolt of the Spanish colonies in America, but since that time its trade has been almost entirely destroyed; and the arsenals, from which the finest ships in the Spanish navy used to be equipped, have long been utterly deserted. The town itself is walled, and stands on the declivity of a hill, the centre of which is occupied by the ruins of an old Moorish castle. The houses are built of a fine red marble, and are mostly in the old Moorish style. The streets and pavements are generally very dilapidated, and the friable nature of the stone adds much to their ruinous appearance. Carthagena, being the see of a bishop, contains a cathedral, several churches and schools, hospitals, barracks, &c., but all of them partake of the general decay. The only feature that remains intact is the noble bay, land-locked on either side by high hills, and closed by the island *La Islota*, called also *La Escombrera*, from the mackerel (*scombri*) which are caught on the shore. The entrance is thus rendered very narrow, and is easily defended by forts planted on both heights and on the island. The trade of Carthagena is confined to the produce of the mines and fisheries, and the exportation of barilla. The abundance of raw material for the manufacture of glass induced an English company recently to start a factory. The town is rendered unhealthy by the existence of swamps in the neighbourhood, which breed fever and pestilence. Pop. 28,000.

CARTHAGENA, the capital of the republic of New Granada, South America. N. Lat. 10. 25.; W. Long. 75. 34. It is situated on a sandy island, on the shore of a large and very commodious bay more than two leagues in length. It contains a handsome cathedral, besides several churches, convents, and monasteries. The bay is closed in by another island, called Tierra Bomba, and to the eastward the city is joined by a bridge to a large suburb called Xiximani, which is connected with the continent by another bridge. The city and suburbs are well laid out, and the streets, though narrow, are straight and uniform. The houses are for the most part built of stone. They consist chiefly of one story above the ground floor. All of them have balconies and lattices of wood, which in that climate is more durable than iron. The climate is excessively hot, and the city suffers much from the ravages of yellow fever. In former times, this city was the scene of frequent contests, and in the late war of independence it was taken and retaken by both parties. The narrowness of the entrance to the harbour renders it easily defensible, and the fortresses on the islands are massive and well mounted with artillery. Its commercial facilities are great; but since the revolution its commerce has dwindled down to a mere transit trade, consisting of produce exported from the neighbouring districts, and the importation of manufactured goods in return. Pop. nearly 20,000.

CARTHUSIANS, a religious order, founded by St Bruno in the year 1084. (See BRUNO.) The Carthusians, so called from the desert of Chartreuse near Grenoble, the place of their institution, are remarkable for the austerity of their rules. They may not quit their cells, except to go to church, nor speak to any person without leave of their superior. Their beds are of straw, covered with a felt; their clothing consists of two hair-cloths, two cowls, two pairs of hose, and a cloak, all of coarse texture. In the refectory they are enjoined to keep their eyes on the dish, their hands on the table, their attention on the reader, and their hearts fixed on God. Bruno had given no particular rule to his disciples. Their code was first established in 1228, and was printed, with various additions and modifications, in 1581, under the title of *The Rule of Chartreux*. It was reprinted a century afterwards, and confirmed in 1682 by Innocent XI. In the middle of the eighteenth century, this order possessed in the several states of Europe 172 houses, divided into 16 provinces, each of which had two visitors. In this number were included four nunneries. There have been several canonized saints of this order, six cardinals, two patriarchs, fifteen archbishops, forty-nine bishops, and a great many very learned writers. They are a branch of the great order of Benedictines. The Charter House in London was a Carthusian monastery.

CARTOON (Italian *cartone*, pasteboard), in *Painting*, is a design drawn on thick paper, or other material, which is used as a model for a large picture in fresco, oil, or tapestry. It was also formerly employed in glass and mosaic work. Cartoons are employed in fresco-painting in the following manner: the back of the design is covered with black-lead or other colouring matter; and this side of the picture being applied to the wall, the artist passes over the lines of the design with a point, and thus obtains an impression. The following method has also been practised. The outlines of the figures are pricked with a needle, and the cartoon being placed against the wall, a bag of black colouring matter is drawn over the perforations, and the outlines are thus transferred to the wall. In fresco-painting, the figures were formerly cut out and fixed upon the moist plaster. Their contour was then traced with a pointed instrument, and the outlines appeared upon the plaster after the cartoon was withdrawn. In the manufacture of tapestries upon which it is wished to give a representation of the figures of cartoons, these figures are sometimes cut out, and laid behind or under the woof, to guide the operations of the artist. In this case the cartoons are coloured.

Cartoons have been executed by some of the most distinguished masters; but the greatest performances in this line of art are those of Raphael. They are seven in number, and at present adorn the palace of Hampton Court. With respect to their merits, they were allowed by Barry to be the best of Raphael's productions; and Lanzi pronounces them to be in beauty superior to anything the world has ever seen. Not that they are all endowed with features of perfect loveliness, and limbs of faultless symmetry; but in harmony of design, in the universal adaptation of means to one great end, and in the grasp of soul which they display, they stand unrivalled. The history of these extraordinary works is curious. In Catholic countries, particularly in Italy and Spain, the balconies are generally hung with ornamental tapestries upon festival days, when processions pass through the streets. This custom, which is still preserved, is of very old date. Leo X., that distinguished patron of the arts, employed Raphael in designing a series of Scriptural subjects, which were first to be finished in cartoons, and then to be imitated in tapestry by Flemish artists, and used for the purpose above mentioned. Two principal sets were accordingly executed at Arras in Flanders, but it is supposed that neither Leo nor Raphael lived to see them. The set which went to Rome was twice carried away by invaders, first in 1526, and afterwards in 1798. In the first instance they were restored in a perfect state; but after their return in 1814, one was wanting—the cupidity of a Jew having induced him to destroy it for the sake of the precious metal which it contained. Authorities differ as to their original number, but there appears to have been twenty-five of them. The cartoons after which the tapestries were woven were not, it would seem, restored to Rome, but remained as lumber about the manufactory till after the revolution of the Low Countries, when seven of them which had escaped destruction were purchased by Charles I., on

the recommendation of Rubens. They were found much injured, "holes being pricked in them for the weavers to pounce the outlines, and in other parts they were almost cut through by tracing." It has never been ascertained what became of the other cartoons. Of the seven which remain, various copies have been painted. Among the best are those by Sir James Thornhill in the Royal Academy. They have also been engraved.

CARTOUCHE (French, from the Latin *carta*), in *Architecture* and *Sculpture*, an ornament representing a scroll of paper. It only differs from a modillion in that the latter is set under the cornice in wainscotting, and the former under the cornice at the eaves of a house.

CARTOUCHE, in the military art, a case of wood, about three inches thick at the bottom, girt with marline, and containing about 400 musket balls, besides six or eight iron balls of a pound weight, to be fired from a howitzer, for the defence of a pass, &c.

A cartouche is sometimes made of a globular form, and filled with a ball of a pound weight: sometimes it is made for guns, and filled with balls of half or a quarter of a pound weight (according to the size of the gun), tied in the form of a bunch of grapes on a tompion of wood, and coated over. Cartouche likewise denotes a portable box for charges. (See CARTRIDGE-BOX.) Also a military pass given to a soldier going on furlough.

CARTOUCHE, in hieroglyphics, is the term applied by the French savans to the elliptical ring or oval which incloses every proper name in a monumental inscription. In the hieratic and demotic, enchorial, or civil forms of writing, the cartouche or oval degenerates into rude brackets.

CARTRIDGE, in the military art, a case of pasteboard or parchment, holding the exact charge of a fire-arm. The cartridges for muskets, carabines, and pistols, contain both the powder and ball. Those made for cannon and mortars are cases of pasteboard or tin, sometimes of wood; and simple flannel bags have been found convenient in practice.

CARTRIDGE-BOX, a case of wood or turned iron, covered with leather, with cells for holding a dozen or more cartridges. It is worn upon a belt thrown over the left shoulder, and hangs a little below the pocket-hole on the right side.

CARTWRIGHT, EDMUND, D.D., the inventor of the weaving machinery termed *The Power-loom*, was born April 24, 1743, at Marnham in Nottingham. He was educated at Magdalen College, Oxford, and was successively clergyman of Brampton in Derbyshire, and of Goadly Marwood in Leicestershire. He does not appear to have turned his attention to machinery until the year 1784, when he first conceived the idea of weaving by machinery; yet in April 1785 he produced his first *power-loom*, which he subsequently brought to perfection by numerous improvements. He took out no less than ten different patents connected with this process, one of which, dated in April 1790, was for the combing of wool. The first mill on his plan, which contained 500 of his looms, was destroyed by a wilful fire; and for 19 years, after a large expenditure, this great mechanical genius scarcely derived any advantage from his important inventions; but in 1809 parliament voted him a grant of L.10,000, as expressed in the act, "for the good service Dr Cartwright had rendered the public by his inventions for weaving." Though this sum was less than the money he had actually expended in perfecting his inventions, it rendered his latter days unembarrassed and comfortable. He died October 30, 1823, at the age of 80. It may be mentioned that he was the younger brother of Major John Cartwright, the well-known English Reformer of the reign of George III., to whose memory a bronze statue is erected in Burton Crescent, London.

CARTWRIGHT, *Thomas*, a celebrated Puritan divine, was born in Hertfordshire about the year 1535. He studied divinity at St John's College, Cambridge, but during the reign of Mary was compelled to adopt the legal profession. On the accession of Elizabeth, he resumed his theological studies, and was soon afterwards chosen Fellow of Trinity College. In 1570, he was chosen Margaret divinity professor; and it was during his occupation of this chair that his sentiments on ecclesiastical polity provoked the hostility of Sir William Cecil and Dr Whitgift, by the latter of whom he was deprived of his post in 1571. Immediately after this he removed to the continent, and officiated as clergyman to the English residents, first of Antwerp and afterwards of Middleburg. On his return, he became still further embroiled with Dr Whitgift and the government, and was several times thrown into prison, but always released at the intercession of his friends. He was finally liberated in 1592 and allowed to preach, but the hardships which he had previously endured brought on his death in 1603.

He wrote *A Confutation of the Rhemish translation, glosses, and annotations on the New Testament; Commentaria practica in totam Historiam Evangelicam; A Directory of Church Government; A Body of Divinity;* and also two expository works on Proverbs and Ecclesiastes.

CARTWRIGHT, *William*, a divine and poet of some eminence, was born at Northway, near Tewkesbury in Gloucestershire, in September 1611. He finished his education at Oxford, afterwards went into holy orders, and became a popular preacher in the university. In 1642 he obtained the place of succentor in the church of Salisbury, and was afterwards chosen junior proctor, and metaphysical reader in the university. His wit, judgment, elocution, combined with a graceful person and behaviour, elicited from Dr Fell the remark, "that he was the utmost that man could come to." He was an expert linguist, a good orator, and a respectable poet. His poems and plays were published in 1651. He died in 1643 of the fever called camp disease, which then prevailed.

CARUCATURIUS, in ancient law-books, he who held land in soccage, or by plough tenure.

CARUPANO, a seaport-town of Venezuela, in the province of Cumana, on the Caribbean Sea, not far from Cariaco. It is a place of some trade. Pop. about 8000.

CARVAGE (*carvagium*), the same with CARRUCAGE. Henry III. is said to have taken carvage, that is, two marks of silver for every knight's fee, towards the marriage of his sister Isabella with the emperor. Carvage could only be imposed on tenants *in capite*.

CARVAGE also denoted a privilege by which a person was exempted from the service of carrucage.

CARVER, a cutter of figures and other devices, especially in wood. In this sense carvers correspond to the Roman *sculptores*, who were distinct from the *cœlatores* or engravers, who wrought in metal. See CARVING.

CARVER also denotes one who cuts up the meat at table. The word is formed from the Latin *carptor*, which signifies the same. The Romans also called him *carpus*, *scissor*, and *structor*. In the great families at Rome the carver was an officer of some consequence; and there were masters to teach them the art regularly, by means of figures of animals cut in wood. The Greeks had also their carvers, or distributors. In primitive times the master of the feast carved for all his guests. Thus in Homer, when Agamemnon's ambassadors were entertained at Achilles's table, the hero himself carved the meat. In later times the same office was on solemn occasions performed at Sparta by some of the chief men. Some persons would derive the custom of distributing to every guest his portion from those early ages when the Greeks first learned the use of corn. The new diet was so great a delicacy that, to prevent the guests from quarrelling, it was found necessary to make a fair distribution.

CARVING, the art or act of cutting or fashioning any hard body, by means of a knife or chisel; but it is more particularly applied to the art of engraving or cutting figures.

in wood—in which sense, according to Pliny, it was prior both to statuary and painting.

CARWAR, a town of Hindustan, in the province of North Canara, presidency of Madras, situated in a bay at the mouth of a navigable river. It was formerly a noted seat of European commerce, and exported great quantities of cloth, but has lately fallen into decay. An English factory was established here in the year 1663, from which a contribution was levied in 1665 by Sevajee, the renowned founder of the Mahratta sway. During the reign of Tippoo the town fell completely into decay. Carwar was ceded to the British in 1779. It is 54 miles south by east of Goa. Long. 74. 16. E., Lat. 14. 49. N.

CARY, Lucius, second Viscount Falkland, a nobleman of great accomplishments, was born about 1610 at Burford in Oxfordshire, but as his father was lord-deputy of Ireland, he received his education at Trinity College, Dublin. He left the university to serve in the Low Countries; but being disappointed in obtaining promotion, he returned to England, and became an ardent student of literature. He made great progress in the study of the Greek and Latin historians and fathers, and lived in terms of intimacy with Johnson, Suckling, Cowley, and other celebrated literary men of the day. In 1633 he succeeded to his father's title, and was appointed gentleman of the privy-chamber to Charles I. In 1640 he took his seat in the House of Commons as member for Newport, Isle of Wight, and joined the parliamentary party in their resistance to the arbitrary measures of the king. He took a prominent part in the impeachment of Lord Finch, and in the endeavours to deprive the bishops of their seats in the House of Lords. On the breaking out of the civil war he raised and headed a troop in defence of the king, whom he attended at the battle of Edgehill, at Oxford, and the siege of Gloucester. He fell by a musket-shot in the battle of Newbury, leaving behind him a large collection of poems and political writings, which have since been published.

Cary, *Robert*, LL.D., a learned English chronologer, was born in Devonshire about the year 1615. On the restoration of Charles II., he was preferred to the archdeaconry of Exeter; but was ejected soon after, and spent the remainder of his days at his rectory of Portlemouth, where he died in 1688. He published *Palæologia Chronica*, a chronology of ancient times, in three parts, didactical, apodeictical, and canonical; and translated the church hymns into Latin verse.

CARYA or Caryatis, in Grecian antiquity, a festival celebrated yearly at Caryæ, a village of Laconia, in honour of Diana surnamed *Caryatis*. The chief ceremony was the performance by Lacedæmonian maidens of a lively kind of dance, said to have been first instituted by Castor and Pollux. When Xerxes invaded Greece, the Laconians did not appear before the enemy for fear of displeasing the goddess by omitting to celebrate her festival as usual; but the neighbouring swains assembled at the place and sung pastorals or *bucolismi;* to which circumstance some have referred the origin of bucolic poetry.

CARYATIDES, or Caryates. See Architecture.

CARYL, John, an English poet, was secretary to Queen Mary, the wife of James II., and followed the fortunes of his abdicated master, by whom he was rewarded with the honorary titles of Earl Caryl and Baron Dartford. He was in England in the reign of Queen Anne, and recommended the subject of the Rape of the Lock to Pope, who dedicated it to him. The last of his works, which consisted of a translation of the Psalms, was published in 1700; and he was still alive in 1717.

Caryl, *Joseph*, a nonconformist divine (1602–1673), was educated at Oxford, and held for some time the office of preacher to the society of Lincoln's Inn. He frequently preached before the long parliament, and held several important offices among the nonconformist clergy. He was a licenser of their theological books, one of the assembly of divines, and one of the board for the approbation of ministers. On the restoration of Charles II. he was silenced by the Act of Uniformity, but continued to preach privately in London, where, besides other works, he wrote an *Exposition of the Book of Job*.

CARYOTA, a genus of plants of the order of Palmæ, of which two species are described—*C. urens*, a native of India, and *C. horrida*, of South America. The *C. urens* is described by Dr Roxburgh as a very valuable tree. The yellow berry, which is about the size of our plum, is intensely acrid if applied to the skin; but the stem, during the hot season, yields *Toddy*, the material from which palm wine is made; and the pith affords an excellent sago, much used by the Indians.

CASA, Santa, the chapel of the Holy Virgin at Loretto. The *Santa Casa* is properly the chamber in which the blessed Virgin is said to have been born, where she was betrothed to Joseph, where the angel saluted her, and where the Son of God was incarnated. Of this building the Catholics relate many wonderful legends. See Loretto.

CASAL MAGGIORE, a town of Lombardy, in the delegation of Cremona, on the Po, twenty-two miles E.S.E. of Cremona. It has a gymnasium, hospital, two orphan asylums, theatre, and manufactures of glass, earthenware, and cream of tartar. Pop. 5000.

CASALE, one of the provinces into which the kingdom of Sardinia is divided. It is bounded north and east by Vercelli and Mortara, south by Alessandria, and west by Asti and Turin. It has an area of 340 square miles, and a population (1848) of 120,425, most of whom are engaged in the culture of the vine, the tending of sheep, and the production of silk.

Casale, the capital of the above province, is situated on the right bank of the Po, 38 miles east from Turin. It was anciently a strong fortress, but has been recently (1849) still further strengthened and improved. It is the see of a bishop, and contains a very ancient cathedral. Its churches are possessed of several fine works of art; and that of San Domenico, in which is the tomb of the Paleologhi, is remarkable for the elegance of its design. Among its other buildings are an ancient clock-tower, several palaces of the nobility, a college, and a theatre. The courts of justice for the province are held here. The only manufacture is that of silk. The population is rather more than 20,000.

CASALNUOVO, a town of Naples, province of Calabria Ultra I., 18 miles E.S.E. of Gioja. It is pleasantly situated at the foot of the mountains in a rich olive district, and has about 8000 inhabitants. The town was almost totally destroyed by an earthquake in 1783.

CASAR-de-Caceres, a Spanish town in the province of Estremadura, with 5000 inhabitants, who enjoy a partial freedom, and have among themselves rather a democratical constitution. The tanning of leather is the chief employment here.

CASAS, Bartolommeo de Las, bishop of Chiapa in Mexico, was born of a noble family at Seville in 1474. At the age of nineteen he went to St Domingo with his father, who had accompanied Columbus in his first voyage. Soon after his return he entered the order of Dominicans, with the view of being employed as a missionary to the Indians. In 1533 we find him residing in the island of St Domingo, where, as we learn from Oviedo Valdes, he was successful in putting an end to the wars which had raged between the Spanish settlers and the Indians in consequence of an outrage committed on the wife of their chief in 1519. This peace, however, proved but of short duration, and was followed by the massacre of nearly all the natives.

Before this time Las Casas had presented to Charles V. several memoirs in favour of the Indians; but finding his

efforts in this direction fruitless, he proposed to found a colony, and prevailed on the emperor to appoint him governor of Cumana. He set sail with 300 Castilian emigrants, whom he distinguished by the badge of the white cross, and arrived at Porto Rico in 1519, but immediately after sailed for Cumana. On his arrival there, Gonzalo Ocampo, commandant of the place, refused to recognise his authority, and Las Casas was compelled to repair to St Domingo to lay his case before the governor-general. In his absence the Indians massacred all the colonists except a few who escaped to the small island of Cubagna, and the colony became extinct. His zeal on behalf of the Indians led him several times to Spain, and provoked a hostile attack from Sepulveda, canon of Salamanca, and historiographer to Charles V. The emperor prohibited the publication of this memoir; but it was nevertheless printed at Rome, and circulated throughout Spain by the monks. It was refuted by Las Casas, then bishop of Chiapa, in a work entitled "Brevissima Relacion de la Destruccion de las Indias;" and although Sepulveda still pressed his accusation before the emperor, he procured no decision.

The devotion of Las Casas to the cause of the Indians gave rise to the accusation which has been revived by modern historians, that he recommended to the Spaniards the trade in negroes, in order to substitute the blacks for the Indians in the labours of the colonies. But M. Grégoire, in a memoir entitled *Apologie de B. de Las Casas*, inserted in the fourth volume of the *Mémoires de la Classe des Sciences Morales et Politiques de l'Institut*, has refuted this imputation. In addition to this, there are still extant three manuscript volumes in folio containing the memoirs, official and familiar letters, political and theological works, of Las Casas, which show that the author deeply compassionated the sufferings of the African race.

The works of Las Casas are, 1. *Brevissima Relacion de la Destruccion de las Indias;* 2. *Principia quædam ex quibus procedendum est in disputatione, ad manifestandam et defendendam justitiam Indorum;* 3. *Utrum reges et principes, jure aliquo vel titulo et salva conscientia cives ac subditos a regia corona alienare et alterius dominii particularis ditioni subjicere possint?* Frankfort, 1571; 4. Various tracts and pieces on theology and morals. The original edition of *Las Obras de D. Barth. de Las Casas*, Seville, 1552, was printed in Gothic characters, and is very scarce.

CASATI, Paul, a learned Jesuit (1617–1707), born at Placentia. After having taught mathematics and divinity at Rome, he was sent into Sweden to Queen Christina, and prevailed on her to embrace the popish religion. He afterwards presided over the university of Parma. He wrote, 1. *Vacuum proscriptum;* 2. *Terra machinis mota*, Rome, 1668, 4to; 3. *Mechanicorum libri octo;* 4. *De Igne Dissertationes*, Parma, 1686 and 1695, 2 vols. 4to; 5. *De Angelis Disputatio Theologica;* 6. *Hydrostaticæ Dissertationes;* 7. *Opticæ Disputationes.* The last mentioned treatise he wrote at the age of 88, and after he was blind.

CASAUBON, Isaac de, was born at Geneva, on the 18th February 1559; his family, which was originally from Dauphiné, having taken refuge in that city after embracing the Reformed religion. He received the rudiments of his education from his father, who was latterly minister of Crest; and his progress was so rapid that at the age of nine he spoke Latin with correctness and fluency. At the age of nineteen he entered upon his academical course at Geneva; and having devoted himself to the study of jurisprudence, theology, and the oriental languages, in 1582 he succeeded his master, Francis Portus, in the chair of Greek. He married Florence, daughter of M. Etienne; and in 1596 accepted the chair of Greek and belles-lettres at Montpellier, where, however, as his salary was ill paid, he remained only two years. He was soon after appointed by Henry IV. to a similar situation in Paris; but his religion, the jealousy of the other professors, and perhaps also his untractable temper, produced misunderstandings and occasioned inconveniences, for which, however, he was indemnified by being appointed librarian to the king, with a salary of four hundred francs. He was one of the commissioners at the conference of Fontainebleau, between Cardinal Du Perron and Duplessis-Mornay, and gave his opinion in favour of the former and against the latter. It is known, indeed, that on various important points he dissented from the tenets of the Reformed church; and he was even suspected of a disposition to reconcile himself to the ancient religion; a suspicion which was strengthened when his son embraced the Romish religion, and became a Capuchin. After the death of Henry IV. Casaubon went to England with Sir Henry Wotton, ambassador extraordinary of King James I., and was received with great favour by that monarch, who gave him two prebends, one at Canterbury and the other at Westminster, and also conferred on him a pension of L.200. Casaubon now established himself in England, and died at London on the 1st of July 1614. He was buried at Westminster, where a monument was erected to his memory. The Protestants of France always doubted the sincerity of his attachment to their party: and Pierre Dumoulin, writing to Montague bishop of Bath, said that Casaubon had a great inclination towards popery, and predicted that he would end by changing his religion. This prediction, however, was not verified. Casaubon was an able theologian, a scholar of the first order, a good translator, and an excellent critic. Pithou, De Thou, Heinsius, Grævius, Duperron, and other learned men, have all given him the same character. His Latin is slightly deformed by Gallicisms, and his historical works are not free from inaccuracies. A complete list of his works would of itself fill several columns.

The principal are, 1. *In Diogenem Laërtium Notæ*, 1583, 8vo; 2. *Polyæni Stratagematum, Gr. et Lat. cum Notis Casauboni*, Lyons, 1589, 8vo; 3. *Aristotelis Opera, Gr. et Lat.* Lyons, 1590; 4. *Theophrasti Characteres, Gr. et Lat.* Lyons, 1622; 5. *Suetonii Opera, cum animadversionibus*, Paris, 1606, 4to; 6. *Persii Satyræ, cum Comment.* Paris, 1608, 8vo; 7. *Polybii Opera, Gr. et Lat.* Paris, 1609; 8. *De Satyrica Græcorum Poesi et Romanorum Satyra, libri duo*, Paris, 1605, 8vo; 9. *Exercitationes contra Baronium*, London, 1614, folio; 10. *De Libertate Ecclesiastica, liber singularis*, 1607; 11. *Ad Frontonem Ducæum Epistola*, London, 1611; 12. *Casauboni Epistolæ*, the best edition of which is that of Ameloveen, Rotterdam, 1709.

Casaubon, *Meric*, son of the preceding, was born at Geneva on the 14th of August 1599. He commenced his studies at the Protestant academy of Sedan, but when his father settled in England, he was sent to Christ College, Oxford, and took the degree of M.A. in 1621. He was successively appointed curate of Bledon, Somersetshire, prebendary of Canterbury, and rector of Wickham, and obtained the degree of D.D. from Oxford; but was stripped of his preferments at the Revolution. Cromwell wished him to engage in writing a history of the civil wars, and offered him a gratuity of L.400 to assist him in the undertaking; but Casaubon, whose sentiments were unfavourable to the protector, rejected both the proposal and the gift. He refused also a proposal from Queen Christina, who was anxious to appoint him to a high professional office in her dominions. At the Restoration he was rewarded for his fidelity by being reinstated in all his benefices, which he enjoyed till the period of his death in July 1671. He was interred in the cathedral of Canterbury, where a monument was erected to his memory. Casaubon was a pious man, charitable to the poor, of an honest and affable character, and ever ready to communicate the result of his researches. He applied himself principally to criticism, and his erudition was varied, though far from being so profound as that of his father. To the philosophy of Descartes he ascribed the decline of the taste for the belles-lettres, which formed one of the characteristics of his time.

His principal works are, 1. *Optati Milevitanti libri vii., cum notis et emendationibus*, London, 1631, 8vo; 2. *Notæ et Emendationes in*

M. Antonini libros xii., ibid. 1643, 8vo: 3. *De Verborum Usu et accurata eorum Cognitionis utilitate Diatribe*, 1647, 12mo; 4. *De quatuor Linguis Commentationis pars prior*, 1650, 8vo; 5. *De la Necessité de la Réformation au temps de Luther*, London, 1664; 6. *De la Crédulité et de l'Incrédulité*, 1668 and 1670, 8vo; 7. *La Cause première des Biens et des Maux qui arrivent en ce Monde*, 1642, 4to; 8. *Traité de l'Enthousiasme*, 1655, 8vo; 9. *Veritable et fidèle Rélation de ce qui s'est passé entre Jean Dée et certains Esprits*, 1659, folio; 10. *Défense de l'Oraison Dominicale*, 1669, in reply to Dr Owen. He was also the author of several productions on ecclesiastical subjects, and of notes on Terence, Epictetus, Hierocles, Florus, Diogenes Laertius in the edition of Meibomius, Polybius in the edition of Gronovius, and Persius in the London edition, 1647, 8vo. He left a great number of manuscripts, which are preserved at Oxford.

CASBIN, or CASWEEN, a city of Persia, in the province of Irak. It is situated on a large sandy plain or valley to the S.W. of the lofty ridge of the Elburz. Although the greater portion of it was thrown down by an earthquake, it is still regarded as one of the largest and most populous towns in the kingdom, and carries on a great trade with Ghilan. It is built in the form of a square, each side of which is about a mile long, and surrounded by a wall. There is a palace here built by Nadir Shah, adjoining an old one erected by Shah Abbas the Great. It became the capital of Persia during the reigns of the immediate predecessors of this latter monarch; and when visited by Chardin in 1674, contained many magnificent buildings, which are now mostly in ruins. It has manufactures of carpets of different colours, which are in high repute, and also of sword blades; and still carries on a considerable trade with Georgia, Azerbijan, Ghilan, and the Caspian Sea. The population is estimated at 60,000. E. Long. 49. 33., N. Lat. 36. 12.

CASCADE (French *cascade*, Italian *cascáta*, from *cascáre*, to fall, from the Latin *cadere*), a waterfall, either natural or artificial. The word is applied to falls that are less than a cataract.

CASCAES, a small seaport-town of Portugal, in the province of Estremadura, 15 miles west of Lisbon. Pop. about 3000, principally fishermen.

CASCARILLA, a bitter tonic bark, the produce of *Croton Eleuteria*, and probably of other species of Croton.

CASE (Latin *casus*, from *cado*, I fall), in *Grammar*, the inflection of nouns, or a change of termination, serving to express the different relations they bear to each other, or to the things they represent. All cases except the nominative are called oblique cases.

CASE, in *Printing*, a large flat oblong frame or box, placed aslope, and divided into numerous little square compartments, each containing a number of types of the same kind, whence the compositor takes the particular letters he requires in composing his matter. See PRINTING.

CASE-Shot, in the military art, musket-balls, stones, old iron, &c., put into cases, and shot out of great guns.

CASE-HARDENING, the process of converting the superficies or outer part of iron into steel. This is effected by placing the article in a box with some animal or vegetable charcoal, and exposing it to a red heat. It differs only from the making of steel in the shorter duration of the process. Iron tools, &c., when thus treated, combine the toughness of iron with the hardness of steel.

CASERTA, a town of Naples, capital of the province of Terra di Lavoro, stands in a fine plain 17 miles N.E. of Naples, and 6 miles E.S.E. of Capua. It has about 5000 inhabitants, and is principally noted for its palace and aqueduct, both constructed by Vanvitelli for Charles III. The palace, which is reputed one of the most magnificent royal residences in Europe, is a rectangular building, in the richest style of Italian architecture. The length of the front on the south side is about 780 feet, and the height 125 feet, with five stories, each with a row of 37 windows; the gardens are adorned with numerous cascades supplied with water by an aqueduct upwards of 21 miles long from the skirts of Monte Taburno.

CASHAN, or KASHAN, a flourishing city of Persia, 92 miles north of Ispahan, situated in a stony plain, and very ill supplied with water. N. Lat. 33. 55., E. Long. 51. 20. The manufactures of silks, carpets, cottons, and gold and silver articles, are extensive. It has a palace, and many fine mosques, bazaars, and caravanserais. Pop. probably 30,000.

CASHEL, an inland city and parliamentary borough in the county of Tipperary, Ireland, with a population in 1851 of 4798. The town is rather handsome, with a wide and well built main street, but has been far from prosperous, probably for want of the requisite means of communication with other parts of the country. The chief object of interest is the "Rock of Cashel," which may be seen from a distance of many miles, and which commands a beautiful prospect over the city and the county of Tipperary. This rocky elevation, covered with the most beautiful grass, rises abruptly out of the plain, and stands close to the town. On its summit is the finest assemblage of ruins in Ireland. They consist of the ancient cathedral, the largest and most remarkable ecclesiastical remains in the country; Cormack's chapel, considered to be the oldest stone building in Ireland; and a round tower which differs in the material of which it is composed from all that surrounds it—the other ruins and the rock itself being of limestone, whilst the round tower is built of freestone. The chief buildings in the city are the new cathedral, a spacious modern church; the palace attached to the see, now converted into a deanery house; the Roman Catholic chapel; the market-house; court-house, &c. Cashel, formerly an archiepiscopal see, was reduced to a bishopric by the Church Temporalities act in 1833; and the bishop now resides at Waterford. It returns one member to parliament, and was formerly a corporate town, but the corporation was extinguished by the Municipal Reform act. Constituency in 1853, 126. The Great Western railway passes within 6 miles of the town, which is distant 108 miles S.W. from Dublin. (H. S—R.)

CASHEW (*Anacardium occidentale*), a tree of the West Indies, bearing a kidney-shaped nut attached to the apex of the receptacle, which is as large as an orange. The nut contains an acrid oil, which renders it uneatable till it has been well roasted in the fire. This oil or juice is used as a black dye; and as a marking-ink for linen it is very durable.

CASHIER, a cash-keeper; he who receives and pays the debts of a society. In the generality of foundations the cashier is called *treasurer*. In a banking institution the cashier is the officer who superintends the books, payments, and receipts of the bank. He also signs or countersigns the notes, and superintends all the transactions, under the order of the directors.

CASHMERE, a kingdom in northern India, so called from its principal division, the celebrated valley of that name; and comprehending within its limits the various territories which constitute the dominions of Gholab Singh. Its boundaries are the Karakorum mountains on the north; Thibet on the east; the British possessions of Spiti, Lahoul, and the Punjaub on the south; and the Huzareh country on the west. It extends from Lat. 32. 17. to Lat. 36., and from Long. 73. 20. to Long. 79. 40.; its extreme length from east to west being 350 miles, and its breadth about 270. Area about 25,000 square miles. The population has been estimated at 750,000. Within its limits are included the valley of Cashmere, and the provinces of Jamoo, Ladahk, Bulti or Iskardoh, Chamba, and some others.

The valley of Cashmere is a tract of oval form, surrounded by lofty mountains. Its extent from the snowy Panjal on the S.E. to the Durawar ridge on the north measures 120 miles, with a breadth of 65 miles in the direction of the opposite angles. This country is universally celebrated in the east for its romantic beauties, its fertile soil, and tempe-

 rate climate. According to ancient tradition, the valley, inclosed by mountains rising above the limit of perpetual snow, was the bed of a great lake, into which flowed all the streams from the adjacent hills, carrying with them large quantities of soil. The lake at last opening itself a passage through the mountains, left the valley covered with a rich alluvial deposit, an admirable field for human industry. The valley of Cashmere is not exposed to the periodical rains which deluge the rest of India, the clouds being shut out by the height of the mountains; and it has only light showers. These, however, are in sufficient abundance to feed some thousands of cascades, which roll down into the valley from every part of the lofty barrier that encircles it. The Behut or Jhelum, the Hydaspes of Alexander, is the chief river: it runs through the whole length of the valley with a remarkably smooth current from east to west, and receives numerous tributary streams from every quarter. The plains of Cashmere being abundantly supplied with moisture, yield rich crops of rice, which form the common food of the inhabitants. On the higher grounds, among the hills, all the European grains, namely, wheat, barley, and other species, arrive at maturity. In this elevated region are also found most of the plants, fruit and forest trees, and flowers, common to Europe, such as violets, roses, narcissuses, and other flowers, which grow wild and perfume the air; and of fruits, the apple, the pear, the plum, the apricot, and the nut, with abundance of grapes; and many kitchen herbs peculiar to cold countries. The seeds of the nelumbo growing in the lakes affords an article of food to the lower classes. A superior sort of saffron is also produced in some parts; and iron of excellent quality is found in the high lands.

Some of the mountains which surround Cashmere are of great elevation; and, ascending from the plains, we find various climates and the productions of distant regions concentrated within a short space. The lower ridges of these mountains, which are of a moderate height, are covered with trees and verdure, and afford excellent pasturage for cattle of various species, as well as for wild animals; while they are entirely unfrequented by the ferocious beasts, such as lions and tigers. Above these fertile and romantic regions, the increasing cold gradually stunts the vegetation; and the traveller reaches that highest range of mountains which tower above the clouds into the regions of perpetual snow. Among these mountains are interspersed many fruitful and well-watered valleys; and they afford shelter to a rude and bold class of inhabitants, who, in these deep recesses, bid defiance to conquering armies, and who have little intercourse with the inhabitants of the plains, their poverty offering as little inducement to the visits of merchants as of warriors.

Cashmere has been long famed for the manufacture of shawls, which are distributed all over northern and western Asia, and are exported in great quantities to Europe. These shawls owe their peculiar beauty and fine texture to the wool which is brought from Thibet, lying at a distance of a month's journey to the N.E. The wool forms the inner coat with which the goat is covered, and the breed is peculiar to Thibet; all attempts to introduce it into India or Persia having invariably failed. The wool, which is originally of a dark gray colour, is bleached in Cashmere by the help of a preparation of rice-flour. The process of manufacture is very slow; not more than one inch being added to the finest shawls in the course of a day. It is estimated that about 16,000 looms were at one time employed in this manufacture; but of late years the demand has declined, owing to the decay of the Persian and Ottoman empires, and the desolation and poverty of the eastern countries. When Cashmere was tributary to Afghanistan, a great portion of the public revenue was exacted in shawls. The yarn into which the wool is spun is dyed with various colours, and after being woven, the piece is once washed, and the border, in which is displayed a variety of figures and colours, is attached to the shawls in so dexterous a manner that it is hardly possible to discover the junction. The price varies in proportion to the quality. A species of writing-paper is also made in Cashmere, which is highly praised throughout the East, and was formerly a great article of traffic; as were also its lacquered ware, cutlery, and sugar. A wine resembling Madeira is manufactured, and a spirituous liquor is distilled from the grape. The internal intercourse of the country is chiefly maintained by means of the numerous streams which intersect it, and which are navigated in long and narrow boats moved by paddles.

The aborigines of Cashmere are a distinct nation of the Hindu stock, and differ in appearance, language, and manners from their Tartar neighbours. The men are remarkably stout, active, and industrious; while the females have been celebrated for their beauty and complexion, which approaches to the brunette. They have been on this account much sought after for wives by the Mogul nobility of Delhi. They are naturally a gay and lively people, excessively addicted to pleasure, and notorious for falsehood and cunning all over the East. They are eager in the pursuit of wealth, and are considered as much more acute and intriguing than the natives of Hindustan generally are. They are said to be addicted to literature and poetry, which is probably limited to a few popular songs. The country, although fertile, has but a scanty population, the total number of inhabitants not exceeding 200,000. Of this amount, a considerable proportion consists of Mohammedans, partly Soonies, and partly also of the sect of Ali. All Cashmere is reckoned holy land; and miraculous fountains abound in all parts. There are numerous temples dedicated to the various objects of Hindu superstition, as Siva, Vishnu, Brahma, &c.; though many of these monuments of Brahminical superstition have been destroyed by Mohammedan invaders. The country is subject to the dreadful evil of earthquakes; and, to guard against their effects, all the houses are built of wood, which is abundant. The author of the Ayeen Acbery dwells with rapture on the romantic beauty of the valley of Cashmere, which was said to be the favourite retreat of the Mogul emperors when they relaxed from the cares of government; and this description is so far confirmed by Bernier, who, in 1663, visited this country in the suite of Aurungzebe.

As far as the history of Cashmere can be collected from imperfect traditions, the people appear originally to have been Hindus. The period of its subjugation to its Mohammedan conquerors is uncertain. About the year 1012 Mahmoud of Ghizni invaded and plundered the country, but does not appear to have taken permanent possession of it. In the year 1323 it was invaded by an army of about 70,000 Tartars, whose commander established himself as sovereign of the country, and was soon after converted to Mohammedanism by a priest, who in return was made his prime minister. His descendants reigned in Cashmere till the year 1541, when it was conquered by Mirza Hyder, on the part of the Emperor Humayon, and was annexed by Acbar to his empire in 1588. It was ruled by the house of Timour for 160 years, after which it was betrayed by the Mogul governor, about 1754, to Ahmed Shah Duranny, and constituted a province of the Afghan sovereignty. In 1819 it was conquered by the Sikhs, from which time till the year 1845 it was ruled by a viceroy appointed by Runjeet Singh of the Punjaub. The wanton irruption of the Sikh army into British territory at the close of the last-mentioned year, gave rise to the first Punjaub war, upon the termination of which the hill country between the Beas and the Indus, including the valley of Cashmere, was ceded to the British as indemnification for its expenses. The greater part of the territory thus ceded, the British transferred to Gholab Singh, under the treaty of Umritsur in 1846, in consideration of the payment of £750,000. By the provisions of that treaty, Gholab Singh acknowledges the supremacy of the paramount power, which in return is bound to aid him in defending himself from external aggression.

Cashmere, the capital of the above province, is a large city, which extends 4 miles on each side of the river Jhelum, over which there are seven wooden bridges. It is of un-

equal breadth; but in some places it is nearly 2 miles wide. North of the city, on the summit of the Kohi Maran, a hill rising 250 feet above the bed of the Jhelum, is the citadel, and in the south-eastern quarter is the small fort of Shore Ghur, where the governor resides. The houses are mostly built of wood, with partition walls of brick and mortar. They are high, being many of them three stories, with sloping wooden roofs covered with a bed of fine earth, which in summer is sown with flowers, and exhibits a lively appearance. The town, like most of those in the East, is dirty in the extreme, its narrow streets being covered with the filth of the inhabitants, who, even in the East, are proverbially unclean. The river is, notwithstanding, covered with baths. The public buildings in the city are not remarkable; the most celebrated being the Jama Musjid, or Great Mosque, and the mosque of Shah Hamedan. There is a beautiful lake near the town, which extends from the N.E. quarter in an oval circumference of 5 or 6 miles, and communicates with the Jhelum by a narrow channel near the suburbs. On the east side of the lake is a detached hill called Tukhti Suliman, and on the west an eminence designated Huri Parbut. The verdant and level margin of this beautiful piece of water was the favourite resort of the Mogul emperors, and is still in many places overspread with the relics of their pleasure-grounds and palaces. Of these the most celebrated is the Shalimar, laid down by the Emperor Jehangir, and which has been selected by Moore for the closing scene of Lalla Rookh. The city of Cashmere is generally considered to have been founded by Pravarasena, who reigned from A.D. 128 to 176. Its elevation above the sea is about 5500 feet. Cashmere is also called Sirinagur. Lat. 34. 5., Long. 74. 58.

CASHY, a town and district in Northern Hindustan, tributary to the rajah of Nepaul, and situated between the 28th and 29th degrees of N. Lat., and about the 83d of E. Long. The country is mountainous, and little more is known of it than that it is one of the confederated states called the country of the twenty-four rajahs. The town is situated in E. Long. 82. 49. and N. Lat. 28. 42.

CASIRI, MICHAEL, a learned Maronite, was born at Tripoli in 1710. He studied at Rome, where he afterwards for ten years taught Arabic, Syriac, and Chaldee, and gave lectures in philosophy and theology. In 1748 he went to Spain, and was employed in the royal library at Madrid. He was successively named a member of the royal academy of history, interpreter of oriental languages to the king, and joint librarian of the Escurial, with a royal pension of 200 piastres. In 1763 he became principal librarian, a situation which he appears to have held till his death in 1791.

Casiri published a work entitled *Bibliotheca Arabico-Hispana Escurialensis*, 2 vols. fol., Madrid, 1760–1770. It is a catalogue of above 1800 Arabic MSS. contained in the library of which he was keeper. They are arranged under the heads of Grammar, Rhetoric, Poetry, Philology, and Miscellanies, Lexicons, Philosophy, Politics, Medicine, Natural History, Jurisprudence, Theology, Geography, and History. The last two classes, with a copious index, occupy the whole of the second volume. A full view of its contents, with some political comments, is given in the first appendix to Harris's *Philological Inquiries*, and in the second appendix to Barington's *Literary History of the Middle Ages*.

CASK, a vessel for holding liquors, sugar, &c. It consists of staves and headings, bound together by hoops. Casks are often made by machinery.

CASLON, WILLIAM, an eminent letter-founder, was born in 1692, in Hales Owen, Shropshire. When a boy, he served an apprenticeship to an engraver of ornaments on gun-barrels, and afterwards carried on this business on his own account in Vine Street, near the Minories. He also employed himself in making tools for bookbinders, and for the chasing of silver plate. While engaged in this business, the lettering of a book from tools cut by him attracted the attention of Mr Bowyer, who induced him to take the superintendence of a type-foundry, and lent him L.500 to begin the undertaking. In 1720 the Society for promoting Christian Knowledge engaged Mr Caslon to cut the fount for an edition of the New Testament and Psalter in Arabic. This undertaking he accomplished successfully; and in his subsequent productions he made so great improvement that the importation of type from Holland entirely ceased, and many of his founts were extensively used on the continent. He died in January 1766.

CASPE, a rich and populous city of Spain, in the province of Aragon, containing 8200 inhabitants. It is situated on the banks of the river Martin, which runs into the Ebro. Its prosperity has risen from the mines of iron and of coal which abound in its vicinity, and which have given rise to many manufactories; few, however, in proportion to the mineral wealth of the district and the requirements of the other provinces of Spain.

CASPIAN SEA, the Mare Hyrcanum of the ancients, derives its name from the Caspii, a tribe who settled on its shores. Among the Orientals it is known under a variety of names; by the Russians it is called the Sea of Astracan, and by the Turks Bahri-Ghong. It is situated between 36. 35. and 47. 25. N. Lat., and 46. 15. and 55. 10. E. Long., is the largest inland lake in the world, and has no outlet to the ocean. It is surrounded by the Russian governments of Astracan and Orenburg, the Caucasian countries, Persia, and Tartary; its greatest length is about 760 miles, and its greatest breadth about 400 from east to west; generally, however, only half that breadth, and where narrowest, not more than 120 miles across. Its estimated area is from 120,000 to 140,000 square miles.

The eastern coast of the Caspian Sea, with the exception of the projecting promontory of Tuk-karagan and a few gulfs, extends nearly in a direct line more than 10° in length from north to south, between the parallels of 37 and 47. The small gulf of Aster-âbâd forms its southern limit, whilst its northern boundary is marked by a very large bight at its N.E. extremity, which receives the waters of the Emba. The principal branch of this river expands, before it reaches the sea, into a great many shallow basins like lakes, the northern branch of it being nearly choked up with sand. All this part of the coast, as well as that adjoining to the N. and N.W., is extremely flat and shallow, as the large rivers, namely, the Aral, the Volga, and the Tuck, which here empty themselves into the sea, are constantly bringing along with them a quantity of sand which accumulates on the shores. The whole of the northern part of the Caspian Sea, which, like the adjoining eastern coast, is exceedingly low, is thus rendered so shallow, that for the distance of several miles from the shore the water is only a few feet in depth; and an immense number of small sand-hills and banks of sand, make it difficult to land on any part of it. Similar sand-hills occupy also the shore itself, and extend to a considerable distance inland among the steppes; but it cannot be said that they form a continuous ridge. At the very commencement of this Sinus Mortuus (Mertooi Kultuk) there rises a small chain of calcareous hills, called the Chink, which forms, as it were, the rampart of a remarkable high level, named Ustürt, which extends under the 45th parallel, between the Aral and Caspian Seas, with a breadth of about 160 miles. This high plain is so steep towards both those seas, that it rises above the Caspian 639 English feet; and its fall towards the side of the Aral is not less. The elevation of this plain is never less than 550 feet, and is in some places more than 727 feet above the level of the Caspian; it extends nearly in a direct line between the two seas; and it sinks so insensibly, that there is nowhere to be observed anything like a continuous chain

of hillocks, and it can only be considered in the light of one elevated plain. The extreme headlands of this high plain, namely, the Aksakál, the Sarak, the Kará-úl, and the Kará-tâu, form so many small connected hill-tops round the bight of Tuk-kará-sú, which is the southern branch of the Sinus Mortuus. This continuous range of hills incloses the whole coast from this spot to Alexander's Bay, and extends nearly straight from north to south, with the exception of a small divergence to the east. They consist throughout of a recent tertiary calcareous formation. The depth of this coast is very remarkable; it is seldom so little as 6 fathoms, generally between 10 and 18. This gulf, as in Alexander's Bay, is connected with a large bight, the entrance of which is formed by a precipitous rocky bank, from which the bight widens considerably, and receives several rivers descending from the high plateau, namely, the Sirbâsh, the Kichik and the Kumbenska. Further east, and a little to the south, where we come upon the gulf of Kenderlui, the land shelves off, but as it is entirely surrounded by hillocks, it seems to receive no stream. Here, however, the hills of Kenderlui form again small chains connected with the larger hilly chain of the Karakhteh; and further inland, they are quite lost in the elevated plateau. A coast stream, the Turakhth, here empties itself into the sea, between the Kenderlui and Karâ-hóghâ gulfs. The narrow entrance into this supposed very deep gulf is confined by a number of rocks, forming some dangerous eddies, and is surrounded in all directions by a steep bank; along the whole of its coast there is but one inconsiderable stream, the Makranda. To the east it is bounded by some small hilly knolls, which extend from north to south; but these are less remarkable for their height than for the great number of salt lakes, most of them very small, which are in the lower valleys. Finally, under N. Lat. 40. the gulf of Balkân is bounded by the extreme points of this elevated plateau; here also the hills rise steep and precipitous from the bank, and present at the top porphyritic formations, which in remote times have broken through beds of granite which occur also round the gulf of Krasnovedsk, at the entrance of the bay of Balkân, and in some of the islands in the bay. Here, likewise, this plateau consists of a tertiary calcareous formation which, towards the Balkân, crops out in single protuberances. The Búlân mountain, which shuts in to the east the bay of Balkân, so that the Amu-daryâ, whose old bed Dr Eichwald followed up for 5½ miles, could only fall into the bay between the great and little Balkân, whilst it wound round the southern point of the great Balkân and thus emptied itself into the bay in a direction from south to north. In consequence of the confined outlet of this old river, the bay is continually more and more choked up with sand, and has scarcely a depth of a few feet. Indeed, all this part of the coast is very much sanded up, and is very flat.

On the west shore the whole space between this sea and the Euxine is filled by the immense masses of the Caucasus. From this region the Caspian receives rivers which have their sources nearly 300 miles distant, the principal of which are the Rouma, the Terek, and the Kur; and it is remarkable, that between the Volga and the Terek, a distance of nearly 200 miles, there is only one river mouth, that of the Rouma, in consequence of the land at a little distance from the sea being so elevated as either to leave the running water to be absorbed in the soil, or to direct it towards the Don or the Euxine. The rivers that fall into the basin of the Euxine, Baltic, and Arctic ocean have their sources in this region at so small a distance from each other that a short canal has been cut uniting the Tvertza and Schlina, and connecting the Caspian with the Baltic through the Volga. Much of the timber used in the imperial yard at Petersburg is cut in the woods of Kazan and conveyed by this route up the Volga to its destination. This canal was the work of Peter the Great; and the same prince projected the union of the Caspian and Euxine Seas by connecting two small streams, affluents of the Volga and Don, which in the neighbourhood of Tzaritzen approach each other within two miles.

There are no tides in this sea, nor are there any regular currents; but the high winds which occasionally blow over its large surface cause considerable and irregular agitations in its motions.

The mean depth of the Caspian Sea is from 400 to 600 feet, and in some places is found to be 2700 feet; but its waters are everywhere very shallow near the shore, especially towards the west. Vessels drawing 9 or 10 feet water are thus compelled to unload far from the shore, excepting near Bakou and some other parts of the lake. Navigation is, in general, dangerous, owing to the frequency and violence of the east and west winds; and the contracted space forces the navigator to beat about in order to avoid the sand-banks concealed near its shores. The waters of the Caspian have a slightly bitter taste, communicated by the naphtha which abounds in the surrounding countries, and is carried into it by the streams which it receives; but they are not so salt as those of the ocean, in consequence of the great volume of water poured into it by the Volga and its other tributaries. Horses do not refuse to drink along the shores and near the mouths of the rivers.

Colonel Monteith says, "while in the habit of bathing in the Caspian, I found along the whole of the coast that for 100 yards the sea was not more than three feet deep, which increased like a step to 6, and at a short distance to 10, the intermediate space being perfectly level and the sand hard."

This sea is distinguished by a remarkable phenomenon. It appears to increase and decrease in actual bulk—in periods, according to native report, of about thirty years each. It is difficult to assign any cause for this phenomenon proportionate to the effect.

Monteith found the extra pressure of the atmosphere to be equivalent to a column of 390 feet in height; Burnes, some four or five years later, to one of 800 feet. It is therefore not improbable that the varying level depends in some degree on the varying pressure of the atmosphere. But whatever may be the variations in the surface of this lake, there can be little doubt that it was formerly much more extensive on three sides, north, west, and east, and it seems to be still diminishing. The fact that it never increases nearly in the ratio of the water poured into it, combined with its want of outlet to discharge that water, has led to the most extravagant hypotheses to account for a phenomenon apparently so paradoxical. But the diminution of the waters of this sea may be most reasonably accounted for by the evaporation, which is incredibly great in these regions; not from the temperature, which is lower than might be expected in these latitudes, but from the extreme dryness of the atmosphere. On the E. and N.W. shores the land rises in terraces like the present bed of the lake, and presents incontestible proofs of having been formerly covered with sea-water. The surface abounds in sea-salt, sea-weed, marshes, and salt-pits, together with innumerable shells exactly resembling those of the Caspian Sea, and which are not found in any of the rivers. Towards the east the whole country has the same appearance of a deserted sea-bed. Hence it is inferred that at no distant period the Black Sea, the Caspian, and the Aral formed one body of water. This conclusion is strengthened by the presence of the same species of fish, seals, &c., in the three seas.

It has always been evident that the bed of the Caspian was very low; and in the beginning of the present century Messrs Engleherdt and Parrot, with the view of ascertaining the fact, performed a series of barometric levellings between its shores and those of the Baltic, the result of which gave a depression of 333 feet for the surface of the

Caspian Sea.

Caspian. The accuracy of this measurement was however suspected by Humboldt and others: and to determine the question, the Russian government despatched an expedition, which after two years' labour, completed in 1838 a series of trigonometrical levellings, which were commenced on the 31st October 1836 by Messrs G. Fuss, Sadler, and Sawitsch, at the town of *Kagalnik*, a little to the south of Azov, at the mouth of the Kagalnika, which falls into the Sea of Azov, between Lat. 47. 4. 26·3. N., and Long. 2. 27. 59·5. E. from Paris. Thence they were continued by Stawropol (where the expedition passed the winter), Georgijewsk, Motdock, and Kisljar, to the town of Tschemoi Rynok, on the shore of the Caspian, a little to the north of the mouth of the Terek, where the operations were terminated. The whole extent of this line is about 800 versts (about 600 English miles).

The measurements were of two kinds—trigonometrical and barometrical: the results obtained from six different measurements varied from 73 feet 1 inch to 83 feet 3 inches. The discrepancies in these results arise from the way in which the observers have calculated the measurements for the purpose of removing the effect of terrestrial refraction. We cannot decide as to which of these results is most probably the correct one; but it is evident, that as the uncertainty amounts only to a few feet, we shall not be very far wrong in assuming, as the number most nearly approaching the truth, the mean of the last four (which are those that agree the best with one another), viz., 81·3 English feet. Even should this number not be regarded as a definitive result, yet, at all events, by means of this first trigonometrical survey of the Caucausian isthmus, the fact is established *that the surface of the Caspian Sea is actually at a lower level than that of the ocean*, an opinion which has been lately disputed; and it is likewise ascertained, *that the depression is only about one quarter so great as the older measurements led us to believe.*[1]

Considering the latitude, the temperature of this sea is extremely low. The northern part is frequently frozen, and the ice at the mouth of the Volga does not generally break up till April. The following table shows the temperature at Leukoran, on the west shore of the Caspian (in 38° 44′), Palermo, and Trèves.

Seasons.	Leukoran. 38° 44′.	Palermo. 38° 7′.	Trèves. 49° 46′.
Winter	38·16	52·5	36·1
Spring	55·9	59·0	50·
Summer	76·8	74·3	64·
Harvest	62·1	66·2	50·1
Mean	57·2	62·9	50·

The surrounding country abounds with forests of fine trees, many of them covered with vines and hops, which frequently extend over three and four trees: almost every kind of fruit grows wild in abundance, and this is perhaps the country from which the greater part were originally brought. The largest class of vessels that navigate the Caspian vary in burden from 90 to 100, and sometimes 150 tons burden. Small fisheries are established on most of the rivers, and salmon are taken in large quantities. This fish is found in great abundance in all the clear mountain streams, but never in those proceeding from the swamps. Herrings, although taken in considerable quantities in the Terek and Aras, are never found to the south of the last-mentioned river. The fishermen do not ply their vocation in the open sea, nor have they nets fit for the purpose. Steamboats have been introduced into the Caspian, and the trade of the sea is entirely in the hands of Russia. (Hanway's *Travels;* MacCulloch's *Geograph. Dict.; Edinburgh Philosophical Journal; Journal of the Royal Geograph. Society;* Humboldt's *Central Asia;* Pallas's *Travels;* Eichwald.)

Casque ‖ Cassano.

CASQUE, or CASK, a piece of defensive armour for the head and neck; otherwise called *head-piece* and *helmet.* The word is French, *casque*, from *cassicum* or *cassicus*, a diminutive of *cassis*, a helmet. Le Gendre observes, that anciently in France the gens d'armes all wore casques. The king wore a casque gilt, the dukes and counts silvered, gentlemen of extraction polished steel, and others plain iron. There were great varieties in its form and fashion. F. Joubert makes it the most ancient of all the coverings of the head, as well as the most universal.

CASSANA, NICOLO, called NICOLETTO, an eminent Italian painter, was born at Venice in 1659, and became a disciple of his father Giovanni Francesco Cassana, a Genoese, who had been taught the art of painting by Bernardino Strozzi. Having painted portraits of some of the English nobility, Nicoletto was invited to England and introduced to Queen Anne, who sat to him for her likeness, and conferred on him many marks of favour. He died in London in 1713.

CASSANDER, king of Macedon after Alexander the Great, was the son of Antipater. He made many conquests in Greece, abolished democracy at Athens, and intrusted the government of that state to the orator Demetrius. Olympias, the mother of Alexander, having slain Aridæus and his wife Eurydice, with many others, Cassander besieged Pydna, whither the queen had retired, took it by stratagem, and caused her to be put to death. He married Thessalonica, the half sister of Alexander the Great; and murdered Roxana and Alexander, the wife and son of that conqueror. Ultimately he formed an alliance with Seleucus, Ptolemy, and Lysimachus against Antigonus and Demetrius, over whom he obtained a decisive victory near Ipsus in Phrygia, B. C. 301. Cassander died of dropsy three years after, in the nineteenth year of his reign. See MACEDONIA.

CASSANDRA, in Grecian story, daughter of Priam and Hecuba, was beloved of Apollo, who promised to bestow on her the spirit of prophecy if she would comply with his desires. Cassandra accepted the proposal; but no sooner had she obtained that gift than she laughed at the tempter, and refused to fulfil her promise. Apollo revenged himself by ordaining that her predictions should be discredited; and hence she prophesied in vain the ruin of Troy. On the capture of that city she was ravished by Ajax the son of Oileus, in the temple of Minerva. In the distribution of the booty, Cassandra fell to the lot of Agamemnon, who loved her deeply; but in vain did she predict that he would be assassinated in his own country. Both perished through the intrigues of Clytemnestra, who was herself afterwards slain by Orestes, to avenge his father's death.

CASSANO, a town of Naples, in the province of Calabria Citra, 7 miles E.S.E. of Castrovillari. It stands in a concave recess of a steep mountain, round an isolated rock on which are the ruins of an ancient castle. It has hot sulphureous baths of great local reputation, and is surrounded by beautiful scenery. Pop. 4400, engaged in the manufacture of maccaroni, stamped leather, table-linens, and cotton and silk stuffs. Corn, fruits, timber, &c., are raised in the vicinity.

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[1] From Poggendorff's *Annalen*, 1840; and it is there stated that the information contained in the article is derived partly from the *Bulletin Scientifique de l'Académie de St Petersburg*, vol. ii. p. 254; vol. iii. pp. 27, 117, 366; vol. iv. p 241; partly from the dissertation by M. Alexis Sawitsch, entitled *Ueber die Höhe des Caspichen Meeres und der Hauptspitzen des Caucasichen Gebirges* (Dorpat, 1839), and partly from M. G. Sadler's dissertation, entitled *Beobachtungen über die irdische Strahlenbrechung und über die Gesetze der Veränderung derselben* (Dorpat, 1839).—EDIT.

CASSAVA, a species of starch obtained from the roots of *Jatropha manihot*, which is made into a kind of bread by the natives of Africa and the West Indies. It is the celebrated *manioc* of the negroes, and the *tapioca* of Brazil.

CASSEL, a walled town of Western Germany, capital of the electorate of Hesse-Cassel and of the province of Lower Hesse, stands on the river Fulda, 124 miles N.N.E. of Frankfort-on-the-Main, with which it has lately been connected by railway. N. Lat. 51. 19., E. Long. 9. 35. Pop. (1846) 32,516. The town is pleasantly situated on both sides of the Fulda, which here is navigable. The old town and upper new town, with the Wilhelmshöhe and Frankfort suburbs, lie on its left or western side; and the lower new town, with the Leipzig suburb, on the east bank. The streets of the old town, which lies low, are narrow, crooked, and dirty; but the upper or *French* new town (so called from having been laid out by French refugees) is one of the handsomest towns of Germany. The Elector's palace, an edifice nowise remarkable, stands in the *Friedrichsplatz*, the largest square in any German town, being 1000 feet in length, and 450 in breadth. In its centre there is a marble statue of the Elector Frederick II., by whom the town was much improved and embellished. Its finest street is *Königs-strasse*, 5100 feet in length, and 60 in breadth. The handsomest building in Cassel is the museum, which contains a library of 90,000 volumes, with collections of natural history, antiquities, coins, physical and mathematical instruments, &c. St Martin's church, a Gothic edifice, contains the burial-vault of the electoral family. The other chief buildings are the town-hall; the Bellevue palace; the unfinished palace of the Cattenburgh, now overgrown with weeds; the observatory; picture-gallery, with portraits by Rembrandt, Vandyk, Rubens, and others; the arsenal, barracks, mint, opera-house, electoral stables, and riding-school; besides several churches, schools, and hospitals. Cassel has numerous literary and scientific institutions. The manufactures, which are on a small scale, are almost exclusively confined to the wants of the state. The principal of these are, cotton, silk, and woollen goods, leather, earthenware, jewellery, chemicals, tobacco, &c. &c. During the brief reign of Jerome Bonaparte, Cassel was the capital of the kingdom of Westphalia. From the Wilhelmshöhe gate an avenue of lime-trees 3 miles in length leads to the summer palace of the elector, situated in the midst of beautiful gardens, adorned with statues and water-works, which have acquired for it the name of the German Versailles.

CASSEL, a town of France, department of Nord, stands on an isolated hill in the middle of an extensive plain, 28 miles N.W. of Lille. Though only 800 feet high, this hill, from the flatness of all the adjacent country, commands a most extensive view. Pop. 4000. Manufactures—lace, thread, hosiery, oil, soap, earthenware, &c.

CASSIA BARK, the bark of *Cinnamomum Cassia*, is one of our most common species, and is very generally sold in the shops under the name of common cinnamon. In European commerce this bark is known by the name of cassia lignea, and is imported into England from Singapore, Malabar, Mauritius, Bombay, Calcutta, Batavia, and Canton. The bark is imported into this country in bundles, which are from 18 to 24 inches in length, and weigh from $1\frac{1}{2}$ to 3 lb. The bundles consist of quills of bark from $\frac{1}{2}$ to 1 inch in diameter, generally single, rarely double. The bark is much thicker than that of true cinnamon, and the taste is more pungent and less sweet, though somewhat similar to that of cinnamon. The properties of cassia bark depend on the presence of a volatile oil—the oil of cassia, which is imported in a pretty pure state as an article of commerce from Singapore. The comparative cheapness of this agreeable aromatic causes it to be largely used instead of cinnamon. In the year ending 5th January 1852, there were imported into Britain 267,462 lb. of cassia lignea; in 1853, 496,833 lbs.; and in 1854, 220,733 lbs. The oil of cassia is largely sold to the cook and confectioner under the name of oil of cinnamon.

CASSIA BUDS come to us from Singapore, and are probably the flower-buds of the same tree which yields the cassia bark, though this is not precisely known. They possess the same pungency of taste as the cassia bark, and may be substituted for it. The duties on cassia lignea from British possessions from 9th July 1842 have been $\frac{1}{20}$d. per lb., and on that from foreign countries $3\frac{3}{20}$d. per lb. Cassia buds pay no duty.

CASSIANUS, otherwise called JOANNES EREMITA, and JOANNES MASSILIENSIS, a celebrated solitary, and one of the first founders of monastic institutions in western Europe, was probably born about A.D. 360, and is supposed to have died about the year 448. The place of his nativity has been much disputed; but he spent the early part of his life in the monastery of Bethlehem, with his friend Germanus. In company with that monk he visited Egypt, and dwelt for several years among the ascetics of the desert near the banks of the Nile. In 403 he repaired to Constantinople, where he received ordination as deacon from the hands of Chrysostom. Cassianus was afterwards at Rome; and proceeding thence to Marseilles, he there founded two religious societies—a convent for nuns, and the abbey of St Victor, which last is said to have numbered, during his time, 5000 inmates. He was eventually canonized; and a festival in honour of St John Cassian long continued to be celebrated at Marseilles on the 25th of July.

Cassianus left *Collations*, or conferences of the fathers of the desert; *Institutions*, in twelve books; and seven books upon the *Incarnation*. Of these works, which are all written in Latin, various editions have appeared. The most complete and best edition of his collected works is that published at Frankfort, 1722, folio, and reprinted at Leipzig, 1733, folio. Cassianus is reckoned among the first of the Semi-Pelagians; a sect that was condemned by some synods, and rejected by the church. (See *De Joanne Cassiano Massiliensi*, &c., Rostochii, 1824, 1825, 4to, by G. F. Wiggers.)

CASSIMIRE, or CASHMIRE. See CASHMERE.

CASSINI, JOHANNES DOMINICUS, an excellent astronomer, born at Piedmont in 1635; died at Paris in 1712 For the history of his observations and discoveries, see article ASTRONOMY, pp. 802–3.

CASSINI, *James*, the only son of the former, was born at Paris in 1677, and died in that city in 1756. See article ASTRONOMY, pp. 805–6.

CASSINI, *de Thury*, *Cæsar François*, was the second son of James Cassini, and was born in 1714, at Paris, where he died in 1784. See article ASTRONOMY, pp. 805–6.

CASSIODORUS, MAGNUS AURELIUS, secretary of state to Theodoric the Great, was born at Scylacium (Squillace), of an ancient and wealthy Roman family, about A.D. 468. His genius and great attainments were conspicuous at a very early age, and were fully appreciated by Theodoric; under whom and his successors Cassiodorus was successively appointed to the highest offices of state. Having continued for a long series of years to conduct the government of the Ostrogothic kingdom with singular ability and success, at the age of seventy he retired to the monastery of Viviers, in his native province of Bruttium (Calabria); and in this retreat, of which he had been the founder, he devoted the remaining thirty years of his life to study, and the composition of treatises on history, metaphysics, the seven liberal arts, and divinity. He was assiduous also to elevate the standard of education among the ecclesiastics, and particularly encouraged them to make transcripts of ancient works. In his leisure hours, too, he exercised his mechanical ingenuity in the construction of a variety of philosophical toys, such as sun-dials, water-clocks, and perpetual lamps. The writ-

ings of Cassiodorus evince great erudition; but his Latin style partakes much of the corruptions of the age. The best edition of his collected works is that of Father Garet, in 2 vols. folio, published at Rouen in 1679, and reprinted at Venice in 1729. Of these works the most valuable is his *Variarum Epistolarum, libri* xii., a series of state papers drawn up by the command of Theodoric and his successors.

CASSIOPEIA, or CASSIOPE, in fabulous story, was the wife of Cepheus king of Æthiopia, and the mother of Andromeda, whose beauty (or as others say, her own) she extolled above that of the Nereids. At their instigation, Neptune chastised the presumption of Cassiopeia by inundating the country, and sending a sea monster to ravage the land. In order to appease the god, Andromeda was chained to a rock to be devoured by the monster; but she was rescued by Perseus. (See PERSEUS.) Cassiopeia, after death, was placed among the stars; and hence the constellation of that name. (Ov. *Met.* v.; Hyg. *Fab.* 64; Arat. *Phæn.* 187.)

CASSIOPEIA, in *Astronomy*, a constellation in the northern hemisphere, situated near to Cepheus. In 1572 there appeared a new star in this constellation, which in magnitude and brightness surpassed even Jupiter; but it diminished by degrees, and it had at the end of eighteen months disappeared. Several astronomers of that age, as Tycho Brahe, Kepler, Maurolycus, Lycetus, and Gramineus, wrote dissertations on it. Beza the landgrave of Hesse, Rosa, and others wrote to prove it a comet, affirming that it was the same which had appeared to the Magi at the birth of our Saviour, and that it came to declare his second coming. On this subject they were answered by Tycho.

CASSIS, in antiquity, a plated or metallic helmet, different from the *galea*, which was of leather.

CASSIS, a small seaport-town of France, department of Bouches-du-Rhône, stands in a narrow valley on the Mediterranean, 10 miles S.E. of Marseilles. Its harbour is small; but it has some building yards, and a considerable trade in fruits and muscatel wine. The Abbé Barthélémy was born here in 1716. Pop. 2000.

CASSIUS, LONGINUS, or L. CASS. LONGINUS RAVILLA, was tribune of the people in B.C. 137, when he proposed the vote by ballot, which was strenuously resisted by the patricians. In B.C. 127 he was made consul; and two years afterwards censor. Though equitable as a judge, he was so inflexible that his tribunal was called the "Rock of the Impeached." From the judicial severity of this Cassius, very severe judges have been called *Cassiani*.

CASSIUS, *Spurius* (whose full name was *Sp. Cassius Viscellinus*), a renowned Roman general and consul, and the proposer of the first agrarian law; in consequence of which he was accused of aspiring to regal power and condemned to death as a traitor, B.C. 485. He thrice enjoyed the consular dignity, was general of the horse under the first dictator created at Rome, and twice received the honour of a triumph. See ROMAN HISTORY.

CASSIUS, *C. Longinus*, a celebrated Roman jurist, and governor of Syria, A.D. 50, wrote ten books on the civil law, and commentaries on Vitellius and Urseius Ferox, which are quoted in the Digest.

CASSIUS, *Caius*, or *C. Cass. Longinus*, one of the murderers of Julius Cæsar. After his defeat by Antony at the battle of Philippi, he ordered his freedman to put him to death with his own sword, B.C. 42. See ROMAN HISTORY.

CASSIUS, *Powder of* (so named from the inventor), is a beautiful purple colour used in the arts, especially in the staining of glass and porcelain-painting. It is a precipitate obtained by adding solution of protochloride or sesquichloride of tin to solution of gold.

CASSOCK (French *casaque*, a cloak), a kind of robe or gown, worn over the other garments, particularly by the clergy. The modern cassock is a close garment which clergymen wear under their gowns.

CASSOON. See ARCHITECTURE, p. 508.

CASSOWARY. See ORNITHOLOGY.

CAST, a figure or small statue of bronze, plaster, &c.

CASTAGNO, ANDREA DEL, an early painter of the Florentine school, who died about 1477. He imitated Massaccio in boldness of attitude, but was deficient in grace and colouring. His name is rendered infamous by his base assassination of his friend Domenico Veneziano, from whom he had obtained the Flemish secret of *oil-painting*.

CASTALIUS FONS, or *Castalia*, a celebrated fountain at the foot of Mount Parnassus, sacred to Apollo and the Muses, who were thence called *Castalides*. According to some, it was named after the nymph Castalia, who threw herself into the fountain when pursued by Apollo. Its murmurs were deemed prophetic.

CASTANEA, the genus to which the sweet chestnut, *C. vulgaris* vel *vesca*, belongs. See BOTANY.

CASTANET (Spanish *castaneta*, or rather *castañuela*, probably from *castaña*, a chestnut), an instrument much used by the Spaniards and Moors as an accompaniment to their dances and guitars. It is composed of two small pieces of ebony, or other well-dried hardwood, shaped like spoons, which are placed together with the concavities inwards, fastened by a string to the thumb, and beat with the middle finger, so as to produce a rattling sound. This instrument is very similar to the ancient *crotalum*, which appears to have consisted, in its original form, of two pieces of reed, which made a clattering noise when shaken with the hand.

Definition.

CASTE. By this term is here meant the classification and distribution of the members of a community into certain classes or orders, for the performance of certain functions, with the enjoyment of certain privileges, or the endurance of certain burthens; and the establishment of hereditary permanence in these orders, the son being ordained to perform the functions, to enjoy the privileges, or sustain the burthens, of the father, and to marry only in his own tribe, without mixture of classes, in regular succession, throughout all ages.

Origin of the term.

The term *Caste* is borrowed from the Portuguese. It was the term applied by that people, who first of the European nations formed establishments in India, to the classes which they found established upon this principle among the inhabitants of that portion of the globe; and from them, as it was owing to their intercourse that the rest of the nations of modern Europe first derived their familiarity with the manners and institutions of the people of India, the term made its way, and became established in the other languages of Europe.

The institution itself appears to have been very extensively introduced even in the early ages of society.

This institution widely diffused.

In regard to the ancient Egyptians, the fact is universally and familiarly known. The President de Goguet, who, with singular industry, and no ordinary judgment and sagacity, explored the remains of ancient times, comprises a great body of history in a few words. "We may farther observe," says he, "that, in the Assyrian empire, the people were distributed into a number of tribes, and that professions were hereditary, that is to say, children were not permitted to quit their father's occupation and embrace another. We know not the time nor the author of this institution, which from the highest antiquity prevailed over almost all Asia, as well as in several other countries." It is not necessary here to surcharge the reader with the authorities which he quotes. The passage itself (p. i. b. i. ch. i. art. 3) will be consulted by all who distrust the legitimacy of his inference, or desire to prosecute the inquiry.

It is stated in the common histories of Greece that Cecrops distributed into four hereditary classes or tribes all

the inhabitants of Attica. And we are informed by Plutarch, in his Life of Theseus, that by this prince the class of priests, and that of nobles, in other words, the magistrates or military leaders, were united into one, and therefore the society was composed of three classes: 1, The sacerdotal, legislating, and ruling class; 2, the class of husbandmen; and, 3, the class of tradesmen. "To the nobility," says the illustrious biographer, "he committed the choice of magistrates, the teaching and dispensing of the laws, and the interpretation of all holy and religious things; the whole city, as to all other matters, being as it were reduced to an exact equality; the nobles excelling the rest in honour, the husbandmen in profit, and the artificers in number. And Theseus was the first who, as Aristotle says, out of an inclination to popular government, parted with the regal power; which Homer also appears to attest in his catalogue of the ships, where he gives the name of PEOPLE to the Athenians alone." There is a passage near the beginning of Plato's *Timæus*, which, though in a work of fancy, is not without some weight, as evidence either of conclusions which were drawn by men of research, or of traditions which were current among the people. In this passage not only is it asserted, that in the primeval state of the inhabitants of Attica they resembled the Egyptians in their division into hereditary classes and professions, but a very accurate description is given of those classes, five in number, viz. 1, The class of priests; 2, The class of handicrafts; 3, The class of shepherds and hunters; 4, The class of ploughmen; 5, The military class. Πρωτον μεν το των ἱερεων γενος, απο των αλλων χωρις αφορισμενον· μετα δε τουτο το των δημιουργων, ὁτι καθ' ἁυτο ἑκαστον, αλλῳ δε ουκ επιμεμιγμενον, δημιουργει· το τε των νομεων και των θηρευτων· το τε των γεωργων· και δη το μαχιμον γενος, απο παντων των γενων κεχωρισμενον, ὁις ουδεν αλλο πλην τα περι τον πολεμον ὑπο του νομου προσεταχθη μελειν.

We are informed by Aristotle, that the people of Crete were divided into castes, after the manner of the Egyptians, by the laws of Minos. Εοικε δε ου νυν ουδε νεωστι τουτ' ειναι γνωριμον τοις περι πολιτειας φιλοσοφουσιν, ὁτι δει διηρησθαι χωρις κατα γενη την πολιν, και το τε μαχιμον ἑτερον ειναι, και το γεωργουν· εν Αιγυπτῳ τε γαρ εχει τον τροπον τουτον ετι και νυν· τα τε περι την Κρητην. Τα μεν ουν περι Αιγυπτον, Σεσωστριος, ὡς φασι, ὁυτω νομοθετησαντος· Μινω δε τα περι Κρητην. *Polit.* vii. 1.

It is worthy of observation that certain vestiges at least of that ancient institution are still visible in Egypt. "La distinction par familles," says General Reynier (*De l'Egypte*, p. 56), "se retrouve encore dans les villes: l'éxercise des arts et metiers est hereditaire: le fils imite les procedés de son père, et ne les perfectionne pas."

We have a remarkable passage to prove that among the ancient Persians the same division into castes existed which still obtains among the Hindus. In the *Zendavesta*, as translated by M. Anquetil Duperron, it is said,—"Ormusd declared, there are three measures (literally weights, that is, tests or rules) of conduct, four states, and five places of dignity. The states are, that of the priest; that of the soldier; that of the husbandman, the source of riches; and that of the artizan or labourer." "We are told," says Sir John Malcolm (*Hist. of Persia*, i. 205), "that Jemsheed divided his subjects into four classes, and that he allotted to each a separate and fixed station in life, which seems to imply that the condition of the ancient Persians was like that of the modern Hindus; and that the extraordinary institution of cast which now exists in India was once known in Persia." Sir John proceeds to state some reasons which induce him to doubt the reality of the fact; in not one of which, however, is there a particle of weight.

Sir John quotes and translates for us a passage from Strabo, which asserts that a similar institution existed in Iberia. "Four kinds or classes of people inhabited that country. From what they consider the first class, they appoint their kings, according to nearness of kindred and seniority; these administer justice, and head their armies. The second is of priests, who take charge of their political rights with respect to their neighbours; the third of soldiers and husbandmen; the fourth of the people in general, who are slaves of the king, and perform every menial office." This account of the distinctions of the castes is evidently incorrect, and by a man who was not well informed. The fact of the Iberians being distributed in a remarkable and uncommon manner he knew, otherwise there would have been no occasion to single out the fact in the description of this particular people. He knew also that they were divided into four principal classes. With regard to the matters of detail, however, his words bear internal evidence that either his information had been vague and inaccurate, or that his recollection had become so.

From a dissertation of Mr Joinville on the religion and manners of the people of Ceylon (*Asiatic Researches*, vii. 430), we find that there is sufficient evidence to prove the existence of a similar institution anciently among the Buddhists of Ceylon, and by consequence to infer it among the other Buddhists spread over so large a portion of Asia.

After this evidence of the general diffusion of the institution of castes in the rude ages of the world, especially in Asia, there is a temptation, from the following passage of Herodotus (lib. i. cap. 101), to infer its existence among the Medes at the commencement of the monarchy. Εστι δε Μηδων τοσαδε γενεα, Βουσαι, Παρητακηνοι, Αδιζαντοι Βουδιοι, Μαγοι. There is nothing in the passage which serves to fix the meaning of the word γενεα; and the names, it is plain, are words of the ancient Median language. But we know that the Μαγοι were the priests; and hence there is reason to conclude that the other words also are names of classes and professions; in other words, of hereditary castes.

The institution of castes may be traced in places with which we are more intimately connected. Mr Millar, to whom the world is indebted for almost the first lessons which it received, in tracing the facts of history up to the general laws of the human mind, has called our attention to the fact, that in the ancient condition of our Saxon ancestors they were divided into four classes: 1, The artificers and tradesmen; 2, the husbandmen; 3, those who exercised the honourable profession of arms; and, 4, the clergy. Mr Millar adds (*Historical View of the English Government*, b. i. ch. ii.), "From the natural course of things, it should seem, that in every country where religion has had so much influence as to introduce a great body of ecclesiastics, the people, upon the first advances made in agriculture and in manufactures, are usually distributed into the same number of classes or orders. This distribution is accordingly to be found, not only in all the European nations formed upon the ruins of the Roman empire, but in other ages and in very distant parts of the globe. The ancient inhabitants of Egypt are said to have been divided into the clergy, the military people, the husbandmen, and the artificers. The establishment of the four great *castes*, in the country of Indostan, is precisely of the same nature."

Human nature is very uniform in the phenomena which it exhibits. The new world displays a striking resemblance to the old. The same stage of society presents nearly the same results. There is reason to conclude that something which resembled the institution of castes existed among the ancient inhabitants of Peru and Mexico. The Count Carli, the celebrated author of the *Lettres Americaines*, when treating (Lett. xiii. and xiv.) of the

laws of the Peruvians, says, "Les citoyens furent distribués en classes ou tribus.——Il n'étoit pas permis, ni par mariage, ni par changement d'habitation, de confondre une classe avec l'autre; car la loi defendoit de se marier dans une autre famille que celle d'où l'on sortoit.—— N'oublions pas le soin qu'on avoit de l'éducation des enfans. C'étoit toujours le père qui élevoit son fils. L'éducation consistoit à apprendre aux enfans rôturiers le metier que chaque père de famille exerçoit," &c. We are informed by Clavigero (*Hist. of Mexico*, b. iv. § 5), that "the sons in general learned the trades of their fathers, and embraced their professions; thus they perpetuated the arts in families, to the advantage of the state."

Such is the extent to which this institution has existed on the surface of the globe. We shall next endeavour to ascertain the state and condition of the human mind, to which it may be considered as owing its origin.

Origin and causes of the diffusion of this institution.

The lowest and rudest state in which the human race are found to exist, may, in a certain general way, be described as the hunter state. That of the shepherd is the next stage in the progress toward the advantages of civilized life. The agricultural state succeeds; when men begin to cultivate the ground for the means of subsistence, and experience the benefit of fixed habitations. As long as they continue in the condition of hunters or of shepherds, the division of labour is unknown, and all the multitude of blessings which it brings. Every family is itself the author of all the simple accommodations which it knows. The tent or hovel, the waggon or cart, is constructed by the men; the coarse garment is spun and even woven by the women. In this situation of things, the accommodations with which it is possible for human beings to supply themselves are few and imperfect, and life is a scene of privation.

When population has so far multiplied as to render the produce of flocks and herds insufficient for the means of subsistence, and the cultivation of the land has become necessary, the inconveniences arising from the want of the division of labour become still more sensible and oppressive. The labours of the field are neglected while the family are engaged at the loom or in repelling the incursions of an enemy. The accommodations of lodging, of clothing, of taste, and fancy, are wretchedly supplied, when the business of extracting the means of subsistence from the soil requires the greater part of their time and attention.

The progress, however, of human improvement, though not necessarily, is commonly, in point of fact, at least in the more uncultivated ages, exceedingly slow. Men continue to suffer under the inconveniences which their present condition imposes upon them, complaining of their miseries, but unable to form a clear conception of the means of exemption, and doubtful of all the remedies which are pointed out to their attention. In the mean time, as the human mind is essentially progressive, and, unless in very extraordinary circumstances, never fails to make progression, the uneasiness which is felt under the inconveniences of a state to which the mind has become superior, and above which it is rising higher and higher every day, is continually increasing, and at last rises to such a height that some change is unavoidable; and the society are prepared to welcome the most plausible of the schemes which are proposed to them.

The grand steps which are made in improving the condition of mankind, though essentially the result of a progression in the minds of the society taken as a whole, are commonly the immediate suggestion of some one individual, or small number of individuals, whose conception of the necessity of a change, and of the means of relief, is more clear and determinate than that of the rest of the community.

In the earliest stages, when the human mind is weak, and prone to superstition, the individuals who project the great improvements in the state of society endeavour to accelerate the consent of the people, and overcome their reluctance to innovation, by giving to their projects the character of a divine revelation and command. The first legislators of almost every country we find to have represented themselves as depositaries of the divine will, and intrusted with a revelation from heaven.

If we take the Hindus as a model, the people divided into castes with whom our acquaintance is the most complete, we shall conclude that some individual, wise enough to perceive the cause of the inconveniences under which men suffer while the division of labour is unknown, and placed in circumstances which enabled him to clothe himself with a divine authority, overcame in most places the reluctance of the people to so great a change of their manners and habits, and accelerated the date of their improvement, by persuading them that the divine power or divine powers now commanded them to be divided into classes for the performance of certain offices.

In the early stages of society, however, the wants of men are few; and the ideas of the legislator himself are incapable of extending to a great variety of cases. In such periods the power of superstition is always exceedingly great. Unacquainted with the laws of nature, and exposed to the most dreadful vicissitudes, which they are altogether unable to foresee, human life appears to men in that situation to hang altogether upon invisible powers. The human mind is incessantly occupied with conjectures respecting what those unknown powers will produce, and with tormenting apprehensions that they will produce evil rather than good. The persons who, in this state of things, are skilful enough to create a persuasion that they are better acquainted than others with the will of these powers, more especially if accompanied with a persuasion that they have an influence over that will, and can turn it more or less whichever way they please, become an object of supreme regard. Nothing can be done without them. They are the most important class in the community. When society is first divided into classes for the sake of the division of labour, the priests, therefore, are always a separate class, and always in the place of highest distinction.

After the evils to which men in the rude state of society conceive themselves liable from the unknown and invisible authors of physical events, the evils to which they are liable from the incursions of hostile men appear the next in magnitude. While the institutions of society are imperfect, and the human mind is weak, these evils are very great, and present a terrific picture to an imagination perpetually haunted with fear; and, in the same circumstances, the advantages derivable from hostile incursions upon others appear the greatest. In the rude ages of society, therefore, the soldier is always a character of great importance. He is the barrier against those evils which rank next in order after the evils against which the priest affords relief. When classes are first formed, the military are, therefore, always a separate class, and next in rank and veneration to the class of the priests. It is remarkable that the rank and consequence of both classes are chiefly founded upon fear. It is also remarkable, though a natural consequence, that, in all ages, they are most apt to be venerated by the most timid persons, the most timid sex, for example, over whose imagination the priest and the soldier have a proverbial sway. It is further observable, and a necessary consequence, that since the fears with respect to invisible powers, and with respect to the incursions of hostile men, gradually decline as society advances, and have less and less effect upon the imaginations even of those who are most apt to be governed by

the passion of fear, the respect for the castes of priest and soldier are destined to sink in relative importance as the institutions of society are improved, and the human mind becomes strong.

After provision is made, in that early stage of society which we are endeavouring to describe, against the two classes of fears to which the priest and the soldier oppose their respective shields, the care of subsistence is the object of greatest importance. A class of husbandmen, therefore, is a necessary and never-failing institution; and, in the scale of rank and consequence, this order follows immediately after the sacerdotal and the military castes.

Besides the means of subsistence, other accommodations are required. But at first very few are so much as known, and, by consequence, very few are demanded. One class of the community are, therefore, supposed to be sufficient for the supply of all other wants, and the performance of all other services.

It is obvious, that reflection upon the laws of human nature would lead us to draw a picture nearly the same with this, if we were called upon to describe the state of society at the time when the division of labour is first introduced, even if we had no specific facts to direct our inquiries. In a remarkable passage in Plato, in his second book *De Republica*, he ascribes the origin of political association and laws to the benefits which are sought for by the division of labour. *Γιγνεται πολις, ὡς εγ᾽ ὠμαι. επειδαν, τυγχανει ἡμων ἑκαστος, ουκ αυταρχης, αλλα πολλων ενδεης.* As men cannot be supplied with accommodations in any tolerable degree but by the division of labour and employments, one man producing one thing, another producing another, and every man getting what he wants, by exchange with other men, an association of a certain number of men is necessary for the common well-being; and hence society and laws. In exact coincidence with the deduction which we have presented above, he says that the simplest form of a society would consist of four or five orders of men. *Αλλα μεν πρωτη γε και μεγιστη των χρειων ἡ της τροφης παρασκευη, δευτερα δε οικησεως, τριτη εσθητος και των τοιουτων* . . . . . . *Ειη δ᾽ αν ἡ γε αναγκαιοτατη πολις εκ τετταρων η πεντε ανδρων.* The coincidence is very nearly complete between the speculation and the practice; between what is in this manner inferred, and what is recorded of ancient nations, and witnessed among the Hindus.

Amidst all the difficulties under which, especially in rude ages, human society and the human mind make progress, small are the steps which can be taken at once. When professions were separated, and the vast benefits derived from the separation began to be felt, the human mind was not sufficiently strong to perceive that there was no danger whatsoever that they should ever again be combined and confounded. No; it was imagined to be another grand effort of the same wisdom which had made the separation, to take care of its permanence, and to make provision for securing the benefits of it throughout all ages. With this view it was thought necessary to ordain and sanction, by divine authority, that the son should follow the profession of the father, and be subject to the severest punishment if he engaged in any other occupation. To secure also, in each profession, the due succession of sons to fathers, it was necessary that marriage should be strictly regulated; and the method which obviously enough suggested itself for that purpose was, that the members of each class, male and female, should be compelled, under the severest penalties, to marry only among themselves, and never, by intermarriage, to ruin and confound the separate castes.

So far the aim, at any rate, was good. The benefit of the whole society was the object which all these regulations were accounted useful to promote; and no degradation of any of the classes was either intended by any of these enactments, or necessary for the ends which they were destined to serve.

The degradation of one set of the castes, in comparison of another, was the result of an after-thought, and in the pursuit of ends of a different description. When one of the castes, as that of the priests, or the soldiers, found itself possessed of an influence over the minds of the rest of the community, such that it could establish certain points of belief in its own favour, it was never long before it availed itself of that advantage, and pushed it to the utmost. If it could inspire the belief that it was more noble, and worthy of higher privileges and greater honour, than the rest of the community, it never failed to get this point established as an incontrovertible right, not the result of the mere will of the community, but of an absolute law of nature, or even a revelation and command from God.

As every elevation of one class implies a correspondent degradation of another, and as there is no end to the elevation which one class will aim at, there is no end to the degradation which will be imposed upon another, if the state of the human mind is sufficiently weak to give to one class an unbounded influence over the belief of another. How naturally this extreme degradation is grafted upon the institution of castes, will immediately appear.

Of the Indian castes in particular.

As we derive our most minute and practical acquaintance with the shape into which society is moulded by the establishment of castes, from our intercourse with the Hindus, the particulars which are at this day exhibited in Hindustan, and provided for by their laws, afford the most certain means of acquiring precise and specific ideas concerning this remarkable institution.

According to the sacred law book, entitled the *Ordinances of Menu*, the Creator, "that the human race might be multiplied, caused the Brahmin, the Cshatriya, the Vaisya, and the Sudra (so named from *scripture, protection, wealth*, and *labour*), to proceed from his mouth, his arm, his thigh, and his foot." "For the sake of preserving this universe, the Being, supremely glorious, allotted separate duties to those who sprung respectively from his mouth, his arm, his thigh, and his foot. To Brahmins he assigned the duties of reading the Veda, of teaching it, of sacrificing, of assisting others to sacrifice, of giving alms if they be rich, and, if indigent, of receiving gifts; to defend the people, to give alms, to sacrifice, to read the Veda, to shun the allurements of sensual gratification, are, in a few words, the duties of a Cshatriya; to keep herds of cattle, to bestow largesses, to sacrifice, to read the Scripture, to carry on trade, to lend at interest, and to cultivate land, are prescribed or permitted to a Vaisya. One principal duty the Supreme Ruler assigns to a Sudra, namely, to serve the before-mentioned classes, without depreciating their worth." Such is the employment of the castes, and such the authority whence it is derived.

The next great peculiarity is, the degree of elevation which one set of the castes was enabled to usurp, and the correspondent degradation of the others.

Priests.

1. The Brahmins, or the priests. "Since the Brahmin sprung from the most excellent part," says the same divine code immediately quoted, "since he was the first born, and since he possesses the Veda, he is by right the chief of this whole creation. Him the Being who exists of himself produced in the beginning, from his own mouth, that having performed holy rites, he might present clarified butter to the gods, and cakes of rice to the progenitors of mankind, for the preservation of this world. What created being, then, can surpass him, with whose mouth the gods of the firmament continually feast on clarified butter, and the manes of ancestors on hallowed cakes? Of created things, the most excellent are those which are ani-

mated; of the animated, those which subsist by intelligence; of the intelligent, mankind; and of men, the sacerdotal class. When a Brahmin springs to light he is born above the world, the chief of all creatures. Whatever exists in the universe, is all in effect the wealth of the Brahmin; since the Brahmin is entitled to it all by his primogeniture and eminence of birth."

As the Brahmin exclusively, or at least to a supreme degree, engrosses the regard and favour of the deity, so he is entitled to the respect and veneration of mortals. Kings themselves, and the most exalted of men, are infinitely inferior to the meanest of the Brahmins. "Let the king," we again quote the ordinances of Menu, "having risen at early dawn, respectfully attend to Brahmins learned in the three Vedas, &c.... and by their decision let him abide. Constantly must he show respect to Brahmins who have grown old, who know the Scriptures, who are pure." "The king must appoint seven or eight ministers, &c..... To one learned Brahmin, distinguished among them all, let the king impart his momentous counsel. To him, with full confidence, let him intrust all his transactions; and with him, having taken his final resolution, let him begin all his measures." "Let him not, although in the greatest distress, provoke Brahmins to anger, by whom Brahma, the all-devouring fire, was created, the sea with waters not drinkable, and the moon with its wane and increase. What prince would gain wealth by oppressing those who, if angry, could frame other worlds, and agents of worlds,—could give being to new gods and mortals? What men desirous of life would injure those by the aid of whom worlds and gods perpetually subsist,—those who are rich in the knowledge of the Veda? A Brahmin, whether learned or ignorant, is a powerful divinity, even as fire is a powerful divinity, whether consecrated or popular. Thus, though Brahmins employ themselves in all sorts of mean occupations, they must invariably be honoured; for they are something transcendently divine."

The least disrespect shown to one of the sacred order is the most atrocious of crimes. "For contumelious language to a Brahmin," says the code of Menu, "a Sudra must have an iron style, ten fingers long, thrust red-hot into his mouth; and for offering to give instruction to priests, hot oil must be poured into his mouth and ears."

The laws give to the Brahmins the most remarkable advantages over the other classes of the community. Neither the person, nor so much as the property of the Brahmin, can ever be touched, in awarding punishment for the most atrocious crimes. "Never shall the king," says one of the ordinances of Menu, "slay a Brahmin, though convicted of all possible crimes; let him banish the offender from his realm, but with all his property secure, and his body unhurt." This privileged order was entirely exempt from taxes. One of the most important of all duties is to bestow wealth upon the Brahmins, by incessant gifts and donations. See article Brahmin.

Military caste.

2. The Cshatriyas, or the military caste. Though the Brahmins look down upon this class, they are looked up to by all the rest of the classes with a veneration inferior only to that with which the Brahmins are regarded. The difference of rank in India is not a mere ceremonial distinction. The advantages which are conferred by it, or the injuries endured, are immense, and to the suffering party unspeakably degrading. Any infringement, even of the external marks of the abjectness of the degraded party, is punished as a heinous crime. "If a man of an inferior caste," says Halhed's *Gentoo Code*, "proudly affecting an equality with a person of superior caste, should speak at the same time with him, the magistrate in that case shall punish him to the extent of his abilities." It is unnecessary, under this head, to enter into details, which would occupy a disproportionate space.

Agricultural caste.

3. The Vaisyas, the agricultural and commercial class. It is still less necessary to multiply particulars under this head. When the two extremes are sufficiently explained, what modifications of respect or disrespect belong to the intermediate stages may be easily inferred.

Servile caste.

4. As much as the Brahmin is an object of intense veneration, so much is the Sudra an object of contempt, and even of abhorrence, to the other classes of his countrymen. The business of the Sudras is servile labour, and their degradation inhuman. The most abject and grovelling submission is imposed upon them as a religious duty, and enforced by the most dreadful punishments. They are so completely deprived of an equal share in the advantages of the social union, that few of those advantages are reserved to them. The classes above them are restrained from injuring them, even in the case of the greatest crimes, by punishments far slighter than those which are appointed for injuries done to the superior classes. The crimes which they commit are punished with much heavier inflictions than equal crimes committed by individuals of the classes above them. Neither their persons nor their labour is free. "A man of the servile caste," says the sacred ordinance of Menu, "whether bought or unbought, a Brahmin may compel to perform servile duty; because such a man was created by the Self-existent for the purpose of serving Brahmins."

According to the principles of the same code, the Sudra was excluded from the benefits of property. "No collection of wealth must be made by a Sudra, even though he has power, since a servile man who has amassed riches gives pain even to Brahmins." "A Brahmin may seize without hesitation the goods of his Sudra slave; for as that slave can have no property, his master may take his goods."

The degradation of the wretched Sudra extends not only to every thing in this life, but even to religion, and the prospect of future happiness. "Let not a Brahmin," says the above code, "give advice, nor what remains from his table, nor clarified butter of which part has been offered, nor let him give spiritual counsel to such a man, nor inform him of the legal expiation for his sin; surely he who declares the law to a servile man, and he who instructs him in the mode of expiating sin, sinks with that very man into the hell named Asamvrita." Not only are the Sudras not allowed to read any of the sacred books; but, "if," says the *Gentoo Code*, "a man of the Sooder reads the Beids of the Shaster, or the Pooran, to a Brahman, a Chehteree, or a Bice" (Halhed's mode of spelling the names of the four castes), "then the magistrate shall heat some bitter oil, and pour it into the aforesaid Sooder's mouth; and if a Sooder listens to the Beids of the Shaster, then the oil, heated as before, shall be poured into his ears, and arzeez and wax shall be melted together, and the orifice of his ears shall be stopped up therewith. If a Sooder gets by heart the Beids of the Shaster, the magistrate shall put him to death. If a Sooder gives much and frequent molestation to a Brahman, the magistrate shall put him to death." From this specimen of particulars a judgment may be formed with regard to the rest.

Inconveniences of this institution as society advances.

Though this is the primary and original formation of castes, the institution, unless where it happens to be early broken up, does not rest here. The distribution of the members of the community into four classes only, and the appropriation of their services to four species of employment, though a great step in improvement at the time they were instituted, must have become productive of many inconveniences as the wants of society multiplied. The bare necessaries of life, with a few of the rudest accommodations, are all the means of gratification which it af-

fords, or is capable of affording, to mankind. As the desires of mankind, however, speedily extend beyond such narrow limits, a struggle must have early ensued between the first principles of human nature and those of the political establishment.

And this was not the only evil to which, under this primary institution, society was exposed. The different castes were strictly commanded to marry with those exclusively of their own class and profession; and the mixture of the classes by the union of the sexes was guarded against by the most sanguinary laws. This, however, was a result which laws were not sufficiently powerful to prevent. Irregularities occurred, and children were born who belonged to no caste, and for whom there was no occupation. A more calamitous event could not fall upon human society. Unholy and infamous, on account of that violation of the sacred law to which they owed their unwelcome birth, these wretched outcasts had no resource for subsistence except two; either the bounty of the regular classes, to whom they were objects of contempt and abhorrence, not of sympathy; or the plunder of those classes by whom they were oppressed—a resource to which they would naturally betake themselves with all the ingenuity of necessitous, and all the ferocity of injured men.

When a class of this description became numerous, they must have filled society with the greatest disorders. The nature of the case would have drawn the philosophical mind to this conclusion had no testimony existed. It so happens, however, that this is one of the few facts in the ancient history of the Hindus which can be ascertained from their record. In the preface to that compilation of the *Hindu Laws* which was translated by Mr Halhed, it is stated that, after a succession of good kings, who secured obedience to the laws, and under whom the people enjoyed felicity, came a monarch, evil and corrupt, under whom the laws were violated, the mixture of the classes was perpetrated, and a new and impious race were produced. The Brahmins put this wicked king to death, and, by an effect of miraculous power, created a successor, endowed with the most excellent qualities. Nevertheless the kingdom did not prosper, by reason of the Burren Sunker (so were the impure and irregular brood denominated); and it required all the wisdom of this sage and virtuous king to devise a remedy. He resolved to form a classification of the mixed race, and to assign them occupations. This accordingly was the commencement of arts and manufactures. The Burren Sunker became all manner of artizans and handicrafts. Of the classes into which they were distributed, one was appointed to the weaving of cloth, another to works in iron, and so in all other cases, till the subdivisions of the race were exhausted, and the wants of the community were provided for. Among the Hindus thirty-six castes of the impure race are enumerated, all inferior in rank and privileges even to the Sudra. To proceed farther in the detail would be inconvenient and useless. By this supplement to the institution of the four primary castes, two great evils were remedied at once; the increasing wants of an improving society were supplied, and a class of men, who had been the pest of the community, were converted to its service.

How nearly the actual state of things among the Hindus did ever correspond with the written accounts of the institution of castes, we do not know. But even at the time when Europeans first became acquainted with them, many points of the separation were disregarded; and this has been in constant progress; so that at present the principal interruptions to the business of life, occasioned by the niceties of caste, are removed; and the distinctions are felt on certain limited occasions only.

The only remaining inquiry with respect to the institution of castes, which seems appropriate to this article, is that of its utility or inutility as a part of the social establishment. And a few words will, we think, suffice to convey clear and determinate ideas upon this subject.

General view of the effects of this institution.

It is the distinction of man's nature, that he is a progressive being. It is by this grand characteristic that he is separated so widely from the inferior animals. When found in circumstances and situations in which the benefits of progression seem not to have been reaped, he is raised but a slight degree above the condition of some of the more perfect of the inferior animals. His peculiarity is, that he is susceptible of progression, and, unless when he is placed in circumstances which impose extraordinary restraints upon the principles of his nature, does invariably and incessantly make progress. Even when he originates in a state little above that of the inferior animals, he rises, and gradually ascends from one stage to another, till his elevation above all the other inhabitants of this globe is immense; nor is there any limit which our knowledge permits us to set to his final attainments and felicity. In whatever state the other animals originate, in that state they remain throughout all ages, and seem altogether incapable of improvement.

In regard to man, therefore, considered as a class of beings or an order of existence, every thing is to be considered as beneficently important in proportion as it favours his progression; every thing is to be considered as mischievously important in proportion as it obstructs and impedes that progression. And it is by this grand test of all that is good and evil in human institutions that we shall endeavour to estimate the effects of the establishment of castes.

We shall not here adduce the elevation of one set of the classes, and the correspondent degradation of another, obviously the cause of infinite evil; because it may be with justice maintained, that this horrid elevation, and equally horrid depression, are not essential parts of the institution of caste, but arise from other causes, and may, in fact, be separated from that institution.

First of all, it is evident, that at the time when the number of castes and professions is established, unless it could be foreseen what are all the species of operations or arts by which the desires of man, in all their possible varieties, are capable of being gratified, and what are all the possible divisions of labour from which any good can arise, the appointment of fixed, unalterable castes and professions must oppose an insuperable barrier to human advancement in these two grand instruments of progression, the division of labour and the practice of new arts, as invention may suggest them, or the multiplying desires of an improving society may create the demand. Since it is obviously impossible that all these things can be foreseen, it is abundantly certain that the institution of any fixed number of arts and trades is exactly an institution for preventing the progression of mankind. This deduction appears to be conclusive, and, if there were no other argument, affords a complete answer to the question respecting the utility of castes.

Even in the trades and arts which are known and provided for at the time of the institution, it is by no means certain that this fixed order of the persons who are to practise them is a contrivance well adapted for carrying these arts themselves, whether large in number or small, to their highest state of perfection. It by no means follows that a man will do any thing better than any other man, because his father did it before him. To establish a caste for any particular art or profession, is giving a sort of monopoly to that particular description of men. It is a wide monopoly, to be sure; but, as far as the

appropriation of the art to one class is calculated to have any effects, they must so far be such as it is of the nature of a monopoly to produce, and hence unfavourable to the progress of the art. The way which presents itself to the reasoning mind, as that which is best calculated for improving every branch of human industry or skill, is to open, as widely as possible, the doors to competition; not to exclude any man, of whatever origin, who may appear to have an extraordinary genius for any particular thing, but to allow him, through competition, to reap the reward of his superiority, and hence to feel all the motives that can prompt him to excel. The acquirements of one generation are not transmitted to another more surely when they are transmitted from father to son, than when they are transmitted in the way of promiscuous instruction. Nor does it necessarily, or even commonly, happen, that the learner gets more careful instruction from his father, than he would from a man who is not his father; or that he himself is more intent in his application, and careful to learn, because it is his father who instructs him.

In the sciences and the fine arts, the power of excelling in which depends upon rare combinations of circumstances, to limit the number of competitors, and shut up the field from all but the members of a particular tribe, is obviously a powerful expedient for diminishing the chance of progression. In regard to literature and knowledge the case is clear and decisive. To confine the prosecution of it to a particular tribe. is to insure a perpetuity of ignorance and misery to the human race. It will be decidedly the interest of the knowing class to maintain as much ignorance as possible among the rest of the community, that they may be able the more easily to turn and wind them conformably to their own purposes; and, for that end, to study, not real knowledge, nor the means of making mankind wiser and happier, but the means of deluding and imposing upon them the arts of imposture. With this clear and incontrovertible inference, how exactly does the historical fact correspond? How truly and faithfully have the Brahmins acted up to that rule? They have made it a law revealed from heaven to keep the great bulk of the community in ignorance. And what branch of knowledge have they ever studied but the science of delusion? There is first their theology; a mass of absurd fictions, to chain the imagination of ignorant and foolish men. And then there is astrology, which concludes the circle of all their studies, and may be justly styled the second part of the act of imposture; even their mathematics, in which they made some little progress, being studied in no other shape than as a part of the business of astrology.

Another circumstance appears to merit no slight regard. The institution of castes is calculated to multiply the evils, so dreadful in magnitude, which are apt to arise from the principles of population, and is opposed to the measures which are calculated to lessen or prevent them. The evils which are apt to be produced by an occasional superabundance of people in any one of the departments of industry and subsistence, are exceedingly diminished when the greatest possible facility is given to the supernumerary individuals, of distributing themselves through all the other departments of industry and subsistence. And these evils, it is obvious, are all raised to the greatest height when the possibility of that distribution is taken away; and individuals, in whatsoever degree superabundant, are still confined to their own department. As this is a topic, the elucidation of which it is easy to carry on, we shall content ourselves with the bare hint which has thus been given, and leave the development to the reflections of the reader.

It may be added, as a supplement to what was said about the obstruction which, by the institution of castes, is given to progression, not only in the division of labour and the multiplication of arts, but even in perfecting the arts which are known and practised, that the strict confinement of one tribe of men to one tribe of operations must have a strong tendency to create a habit of routine, and hence an aversion to all innovation; a disposition to acquiesce in what has constantly been done, and hence to deaden that activity of mind which is on the alert to catch at every chance of improvement,—that admirable temper, on which the greatest rapidity in the march of human amelioration essentially depends.

It was intended, after thus presenting the reasons on which we conclude that the institution of castes is an arrangement altogether opposite to the interests of human nature, to have stated and answered the reasons which have been advanced by Dr Robertson, in the appendix to his *Historical Disquisition concerning India*, and more recently by the Abbé Dubois in his *Description of the Character, &c. of the People of India*, to prove that the institution of castes is really beneficial. But after looking over these reasonings with a view to that answer, they have appeared to us to be so weak and insignificant as to be altogether unworthy the trouble of transcription. A sufficient answer to every point which they adduce will be found in the considerations which we have already urged upon the subject; and we doubt not that we may safely intrust the decision to the judgment of the reader. (J. M—L.)

CASTEL, Louis Bertrand, a learned mathematician, was born at Montpellier in 1688, and entered the order of the Jesuits in 1703. At first he was a student of literature, but afterwards devoted himself entirely to mathematics and natural philosophy. He wrote a *Traité de la Pésanteur Universelle*, Paris, 1724; *Mathématique Universelle; Le plan du Mathématique abregé*, and other works. But the work which attracted most attention at the time was his *Optique des Couleurs*, or treatise on the melody of colours, a subject which he endeavoured to illustrate by a *Clavelin Oculaire*, or ocular harpsichord. The treatise and the illustration were, however, quickly forgotten. He also published a critical account of the system of Sir Isaac Newton in French. Castel died in 1757.

CASTEL-A-MARE, or Castellamare, a city and seaport on the gulf of Naples, 17 miles S.E. of the city of that name. It is pleasantly situated on the lower slopes of a hill, and along a sheltered beach, commanding an extensive view of the Bay of Naples from Vesuvius to Misenum. It stands near the site of the ancient *Stabiæ*, destroyed by Sulla in the social war, but which continued to exist as a small place till A.D. 79, when it was overwhelmed along with Pompeii and Herculaneum by the great eruption of Vesuvius. It was here that the elder Pliny met his death on that occasion. The city takes its name from the castle which was erected by Frederick II., surrounded by walls and towers in the thirteenth century by Charles I. of Anjou, and strengthened by additional fortifications by Alfonso I. of Aragon. It is the seat of a bishopric, and has a royal palace, cathedral, several churches and convents, military hospital, barracks, handsome quay, royal arsenal, and dockyard, where the large ships of the Neapolitan navy are built. There are manufactures of linen, silk and cotton goods, and leather. The port is small, and divided by two forts. The hill immediately above the town is covered with villas and casini; among which is the royal Casino of Quisisana, more remarkable for its fine prospect than for its magnificence as a palace. The town is connected by railway with Naples. Pop. 18,000.

Castel-a-Mare, a seaport-town of Sicily, on the gulf of the same name, in the province of Trapani. It is a small dirty town, but has a considerable export trade in wine, fruit, grain, &c. Pop. 6000.

CASTEL GRANDOLFO, a small village of Italy, standing on an eminence above the N.W. margin of Lake Albano, 14 miles from Rome, and chiefly remarkable for its palace, the summer residence of the pope. Pop. 1200.

CASTEL-NAUDARY, a town of France, capital of an arrondissement of the same name, in the department of Aude, 21 miles west by north of Carcassonne. It is pleasantly situated on an elevation near the Canal du Midi; but is very indifferently built, having few public buildings worthy of notice except the church of St Michael, said to be the finest in the department. There are manufactures of woollen and cotton goods, leather, earthenware, and a considerable trade. It was founded by the Visigoths on the site of the ancient *Sostomagus*, and took the name of *Castrum Novum Arianorum*—of which the present is a corruption. It suffered severely in the crusade against the Albigenses; but is chiefly noted in history for the battle fought there in 1632 between the forces of Louis XIII. and of Gaston Duc d'Orleans, in which the Duc de Montmorency was wounded and made prisoner, and soon after conveyed thence to Toulouse and executed. Pop. (1851) 9712.

CASTEL SARRASIN, a town of France, capital of an arrondissement of the same name, in the department of Tarn et Garonne, pleasantly situated on the Songuine, near its influx into the Garonne, 12 miles west of Montauban. The walls which formerly surrounded the town have been converted into promenades. It has manufactures of serges and other woollen stuffs, hats, leather, &c., and some trade in corn grown in the vicinity. Pop. (1851) 6950.

CASTEL VETRANO, a town of Sicily, near the S.E. extremity of the island, 12 miles east of Mazzara. It is well and regularly built, and has a population of about 14,000. Near it are the ruins of the ancient city Selinus, which was destroyed by the Carthaginians, B.C. 409.

CASTELL, DR EDMUND (1606–1685), a learned English divine and orientalist. He was educated at Cambridge, where he became master of Catharine Hall and Arabic professor; and was afterwards appointed canon of Canterbury. He had a large share in the publication of the London Polyglott, and wrote the *Lexicon Heptaglotton* or dictionary of seven languages. On this latter work, which occupied a great part of his life, he expended no less than L.12,000. When printed, the copies remained unsold, and were afterwards destroyed by vermin so as to be utterly unsaleable. He obtained several ecclesiastical preferments; and at the time of his death was rector of Higham Gobyon, in Bedfordshire. He bequeathed his oriental MSS. to the university of Cambridge, on condition that his name should be written on every copy.

CASTELLAN, a governor or constable of a castle. Also the name of a dignity or function in Poland. The castellans were senators of the lower class, who in diets sat on low seats behind the palatines. They were a kind of lieutenants of provinces, and commanded a part of the palatinate under the palatine.

CASTELLATION, the act of fortifying a house and rendering it a castle; which by the ancient English laws required the king's license.

CASTELLI, BERNARDO (1557–1629), a Genoese portrait and historical painter, was the intimate friend of Tasso, and took upon himself the task of designing and etching the figures of the *Gierusalemme Liberata*.

Valerio Castelli, son of the preceding (1625-1659), surpassed his father, and particularly excelled in painting battle-scenes. He painted the *Rape of the Sabines* for the ducal palace at Florence, and decorated the cupola of the church of the Annunciation at Genoa. In these works he is regarded as combining the fire of Tintoretto with the fine taste of Paolo Veronese.

CASTELLI, *Giovanni Battista* (1500-1570), an eminent Italian historical painter, was employed to decorate the Nunziata di Portoria in Genoa, the saloon of the Lanzi Palace at Gorlago, and the Pardo Palace of Charles V. of Spain. His best known works are the *Martyrdom of St Sebastion*, and the picture of our *Saviour as Judge of the world.*

CASTELLIO, SEBASTIAN, was born about the year 1515. Chatillon, Dauphiny, and Savoy, are mentioned by different authors as the place of his birth. He early gained the esteem of Calvin, who lodged him in his own house at Strasburg, and procured him a regent's place in the college of Geneva. In this office Castellio continued till 1544, when he was forced to quit it on account of his peculiar opinions concerning Solomon's Song and Christ's descent into hell. He retired to Basle, where he was made Greek professor; and died in great poverty in 1564. He incurred the displeasure of Calvin and Beza by differing from them in his doctrines concerning predestination and the punishment of heretics. His works are numerous. In 1545 he printed at Basle four books of dialogues, containing the principal histories of the Bible, in elegant Latin; but his principal work is a Latin and French translation of the Scripture.

The Latin translation he began at Geneva in 1542, and finished at Basle in 1550. It was printed at Basle in 1551, and dedicated to Edward VI. king of England. The French version was dedicated to Henry II. of France, and printed at Basle in 1555. The translation is greatly disfigured by the affectation of using only classical terms. Besides these Castellio wrote a Latin translation of the Sibylline verses, a Greek poem on John the Baptist, a translation of several treatises of Bernardo Ochino, and notes on the Epistle to the Romans.

CASTELLON DE LA PLANA, a town of Valencia, Spain, about 4 miles from the sea, and 40 miles N.N.E. of Valencia. N. Lat. 39. 57; W. Long. 0. 4. It derives its name from an extensive plain in which it is situated, and which is watered artificially by an aqueduct brought for the most part through solid rock from the Mijares, a stream about 5 miles distant. It is walled, and contains several excellent churches, in which there are paintings by Ribalta a native artist. The climate is mild and salubrious, and the soil fertile. There are no manufactures of any consequence, but it possesses a brisk local trade. Pop. estimated at 16,000.

CASTELLORUM OPERATIO, castle-work, or service and labour done by tenants for the building and upholding of castles. This was one of the three necessary charges to which all lands among the Anglo-Saxons were subjected.

CASTELO BRANCO, a town of Portugal, in the province of Beira, on a hill near the Liria, 64 miles east by south of Coimbra. It is surrounded by walls flanked by towers, and has a ruined castle on the summit of the hill. Pop. about 6000.

CASTELO DE VIDE, a walled town of Portugal, in the province of Alemtejo, 10 miles north of Portalegre. Pop. 5000.

CASTELVETRO, LUDOVICO (1505–1571), was a native of Modena, and the author of a *Commentary on Aristotle's Poetics*. At the instance of his rival Annibale Caro, he was cited before the inquisition to answer for a certain book of Melancthon which he had translated into Italian. Being afraid of the issue of his trial he fled to Basle, where he spent the rest of his days.

CASTI, GIAMBATTISTA, an Italian poet, born of humble parents in 1721, at Montefiascone, in the States of the Church. There, too, he commenced his studies, in which he made such progress that he was appointed in early youth professor of Greek and Latin in an academy of that town. He soon, however, quitted this obscure situation, and repaired to Rome, where his learning, acuteness, and agreeable disposition, recommended him to the notice and friendship of many eminent individuals. He was admitted a member of the academy *Degli Arcadi;* and might easily have risen from a canonship in the cathedral of Montefiascone, which he had already obtained, to much higher pre-

ferment in the church, had such been his ambition. But his love of freedom and restless disposition interfered with his ecclesiastical advancement. He gladly accepted the invitation of Prince Rosenberg (tutor to the Grand Duke Leopold) to accompany him to Vienna, where he was presented to the Emperor Joseph. He then visited most of the capitals of Europe, from Petersburg to Lisbon, and from Constantinople to Stockholm. On his return to Vienna he was appointed *Poeta Cesario* or poet-laureate, in the room of Metastasio; a situation which he held till some time after the death of the Emperor Leopold, when he resigned it, and retired to Florence in 1796. After two years' residence in that city, during which period he composed a great number of his works, he took up his residence at Paris; and though now far advanced in life, neither his habitual gaiety nor his ardour of literary composition were in any degree abated. Scarcely a day passed that he did not add something to his principal poem *Gli Animali Parlanti*, or write one of his poetical novels. At the same time he was the delight of society from the liveliness of his conversation, which was rendered yet more entertaining by his knowledge of the world. Though in 1803 he had passed the age of eighty-two, his strength both of mind and body afforded the promise of a yet longer life; but he died during that year, from a severe cold caught in returning home at a late hour. His funeral was attended by a great concourse of persons distinguished by literary eminence; and an eloquent funeral oration was pronounced on the occasion by Corona, an Italian physician.

The chief work of Casti is *Gli Animali Parlanti, Poema Epico, Diviso in XXVI. Canti.* In 1792 and 1793 the French revolution had attracted the attention and speculations of all Europe; and in this work Casti resolved to exhibit, under an allegorical veil, what he conceived to be the predominant feelings of the multitude, their avowed hopes, and secret designs. With this view, as he himself has expressed it, "he contrived a grand apologue, in which, through the medium of animals as speakers and actors, a complete political story might be exhibited, exposing the defects and absurdities of various political systems."

This work, which raised Casti to a very high rank among the modern poets of his country, was begun at Vienna in 1794. His situation, however, as poet-laureate, was unfavourable to the freedom of political satire, and this obstacle may have been one inducement to his resignation of that office. The poem was continued at Florence without interruption, and completed at Paris, where it was published in 1802, in 3 vols. 8vo; an impression which has been followed by various editions in Italy. It was translated into French, Spanish, and German, and there is also a free and abridged English version, executed with considerable spirit. To most of the Italian editions four apologues have been added; but these have no relation to the subject of the *Animali Parlanti.*

Casti now directed his attention to the composition and publication of poetical novels. As far back as 1778 he had written eighteen of these *Novelle Galanti;* but his poetical avocations at the imperial court had interrupted his progress; and meanwhile those which he had composed were surreptitiously printed, both in Italy and France, in a manner so inaccurate and disfigured, that they could scarcely be recognised by the author. Some, too, as *La Bella Circassa*, and *La Figlia che non ha giudizio*, which were not his, were added to the collection.

Under these circumstances, the injured poet resolved to collect his whole works in an edition to be printed under his own superintendence. He was prevented, however, by his sudden death; but his novels, which at the period of his decease amounted to forty-eight, were published by one of his Parisian friends, in 3 vols. 8vo, 1804, accompanied by a prefatory memoir of the author. The practice of tale-writing, which commenced with the author of the *Cento Novelle Antiche*, and was brought to such perfection by Boccaccio, had prevailed in Italy for nearly five hundred years before the age of Casti. The Italian novelists invariably copied from each other, as well as from those inexhaustible stores of fiction, the *Fabliaux* of the Trouveurs. The merit of Casti does not consist in the invention of his stories; his novels are founded either on mythological stories, or on preceding Italian tales. To the first class belong *Aurora, L'Origine di Roma, Diana ed Endimione, Prometeo e Pandora.* Almost all the rest are poetical versions from Boccaccio, Massuccio di Salerno, and other Italian novelists. The longest, *La Papessa*, is founded on the old story of Pope Joan. These tales are much admired by the Italians for purity of language and harmony of versification, and they contain many ingenious and sarcastic reflections on the hypocrisy, errors, and vices of men in every age and condition of life. They are disfigured, however, by an unpardonable licentiousness. Some of them also terminate rather flatly; and the *ottava rima* in which they are all written, and which has a certain degree of heaviness, even in the hands of Ariosto and Berni, is ill adapted to the gaiety and levity of the lightest of all species of composition. One cannot mention the tales of Casti without being naturally led to compare them with those of Fontaine, which are founded on similar originals, and written in something of the same spirit. But, if there be more asperity and caustic raillery in Casti, he is infinitely inferior to the French poet in ease, naïveté, and grace.

Casti is also author of the *Poema Tartaro*, a satiric poem, in twelve cantos, on the court of Catherine II. The scene of action, however, is laid in Asia, and all the names are fictitious. The first sketch of this mock heroic poem was made by the author during his visit to St Petersburg, in the train of Count Kaunitz, the Austrian ambassador. On his return to Vienna, Casti new-modelled the composition, struck out whatever might be likely to prove offensive to crowned heads in general, and inserted a complimentary episode on the celebrated journey of his imperial patron into the Crimea.

In the capacity of poet-laureate, it was his duty to provide new dramatic entertainments at stated periods; and Casti, whose genius was diametrically opposite to that of his celebrated predecessor Metastasio, conscious that he could not vie with him in the serious opera, applied himself to the *Opera Buffa*, in which he obtained great success. His *La Grota di Trofonio* is intended to ridicule the pretensions of false philosophers. The *Il Re Teodoro in Venezia*, suggested by an episode in Voltaire's *Candide*, was assigned to him by the emperor himself, who is said to have been much entertained with the lines

Senza soldi e senza regno
Brutta cosa è l'esser Re.

A third burlesque opera, of which Cicero is the principal character, is founded on the plot of Catiline. Although neither the novel nor the apologue was by any means a new species of composition among the Italians, yet Casti may be regarded as an original author, in so far as he has bestowed a new form on the first, and has given to the second an extent which it had not yet received, as well as directed it to an object to which it had not previously been applied. (J. C. D.)

CASTIGATION (Latin, *castigatio*, from *castus*, chaste), punishment, discipline, emendation, restraint. Among the Romans it denoted a military punishment inflicted on offenders by beating with a wand or switch, commonly of vine.

CASTIGATORY, an engine of correction formerly used to punish arrant scolds. It was called the *trebucket castigatory* or *cucking stool*, which in Saxon signifies *scolding stool;* afterwards corrupted into *ducking stool*, because the offender was plunged in water.

CASTIGLIONE, the name of numerous towns and villages of Italy, the principal of which is the Castiglione della Stiviere, in the Austrian delegation of Mantua, 22 miles N.W. of the town of that name. It is chiefly noted for the victory gained here by the French over the Austrian forces 5th August 1796. It has several churches, a ruined castle, and about 5000 inhabitants.

Castiglione, *Baldassare*, an eminent Italian nobleman, was born at Casalico in the duchy of Mantua, in 1478. He studied painting, sculpture, and architecture, and excelled so much in these arts that Raphael and Michael Angelo never thought their works complete without the approbation of Count Castiglione. He first distinguished himself in military service under the Duke of Milan, and was afterwards employed in a diplomatic capacity at the courts of Pope Julius II., Louis XII. of France, and Henry VII. of England. On his return he began his celebrated work entitled the *Corteglano*, which he completed at Rome in 1516. This work is full of moral and political instruction, and is written in a style of classic elegance and purity. A version of this work, together with the original Italian, was published at London in 1727, by A. P. Castiglione, a relative of the author. Count Castiglione was sent by Clement VII. as delegate to the court of the emperor Charles V., and died at Toledo in 1529. His death was probably hastened by an accusation which had been raised against him after the sack of Rome of having neglected the interests of his country.

Castiglione, *Giovanni Benedetto*, a celebrated painter, was born at Genoa, and studied for some time under Vandyk. He painted portraits, historical pieces, and landscapes; but is said chiefly to have excelled in fairs, markets, and rural scenes. His paintings are to be found at Rome, Venice, Naples, and Florence. He also executed a great number of etchings, which are spirited, free, and full of taste. His son, Francesco, excelled in the same subjects; and it is thought that many paintings which are ascribed to Benedetto are only copies after him, or perhaps originals by his son.

CASTILE (in Spanish *Castilla*), an ancient kingdom occupying the central districts of the Spanish peninsula. The history of Castile as a separate kingdom will be found under Spain. The northern part of the kingdom which was first rescued from the dominion of the Moors is called *Castilla la Vieja*, or Old Castile; the southern, which was a more recent acquisition, is called *Castilla la Nueva*, or New Castile. They are separated from each other by a lofty chain of sierras which pass under different local names, and stretching in a south-westerly direction from Aragon to Estremadura form the great watershed between the valleys of the Tagus and the Douro. The name of both provinces seems to have been derived from the existence of numerous forts (*castillas*) erected on the frontiers of the recovered territory to protect them from the reprisals of the enemy.

Old Castile was bounded north by the Bay of Biscay and province of Vizcaya; east by Navarre and Aragon; west by Leon and Asturias; and south by New Castile. It is now divided into the provinces of Burgos, Logroño, Santander, Soria, Segovia, and Avila. These are described under their respective heads. Area, 30,800 square miles. Pop. (1849) 1,037,477.

New Castile was bounded north by Old Castile and Aragon; east by Aragon and Valencia; south by Murcia and Andalusia; and west by Estremadura. It is now divided into the provinces of Madrid, Toledo, Guadalajara, Cuenca and Ciudad Real (La Mancha). These are described under their respective heads. Area 17,720 square miles. Pop. (1849) 1,490,800.

CASTILLON, a town of France, in the department of Gironde, on the right bank of the Dordogne, 10 miles east by south of Libourne. Here in 1451 a battle was fought between the English and French, in which the latter were victorious; and near this is the chateau of Montaigne, where that celebrated essayist died in 1592.

CASTING, the running of liquid metal into a mould prepared for that purpose. See Foundery.

Casting *in Sand or Earth*, is the running of metals between two frames or moulds filled with sand or earth, in which the figure that the metal is to take has been impressed *en creux*, by means of the pattern.

Casting, among sculptors, implies the taking of casts and impressions of figures, busts, medals, leaves, or the like.

The method of taking casts of figures and busts is most generally by the use of plaster of Paris, that is, alabaster calcined by a gentle heat. The advantage of using this substance in preference to others is, that notwithstanding a slight calcination reduces it to a pulverized state, it becomes again a tenacious and cohering body by being moistened with water, and afterwards suffered to dry. By this means either a concave or a convex figure may be given by a proper mould or model to it when wet, and retained by the hardness it acquires when dry; and, from these qualities, it is fitted for the double purpose of making casts, and moulds for forming casts. The particular manner of making casts depends on the form of the subject to be taken. Where there are no projecting parts it is very simple and easy; as likewise where there are such as form only a right or any greater angle with the principal surface of the body; but where parts project in lesser angles, or form a curve inclined towards the principal surface of the body, the work is more difficult.

The first step to be taken is the forming of the mould. For this purpose, if the original or model be a bas-relief, or any other piece of a flat form, it must be placed (its surface being previously well greased) on a proper table, and surrounded by a frame, the sides of which must be at such a distance from it as will allow a proper thickness for the sides of the mould. As much plaster as will be sufficient to cover and rise to such a thickness as to give the necessary strength to the mould, as also to fill the hollow between the frame and the model, must be moistened with water, till it be just of such consistence as will allow it to be poured upon the model. This must be done as soon as possible; otherwise the plaster will concrete or set, so as to become more troublesome in the working, or unfit to be used. The whole must then be suffered to remain in this condition till the plaster has become hard; and then, the frame being taken away, the preparatory cast or mould thus formed may be taken off from the subject entire.

Where the model or original subject is of a round or erect form, a different method must be pursued, and the mould must be divided into several pieces; or if the subject consists of detached and projecting parts, it is frequently most expedient to cast such parts separately, and afterwards to join them together.

Where the original subject or mould forms a round or spheroid, or any part of such round or spheroid, more than one half the plaster must be used without any frame to keep it round the model, and must be tempered with water to such a consistence that it may be wrought with the hand like very soft paste; but though it must not be so fluid as when prepared for flat-figured models, it must yet be as moist as is compatible with its cohering sufficiently to hold together; and being thus prepared, it must be put upon the model, and compressed with the hand, or any flat instrument, that the parts of it may adapt themselves in the most perfect manner to those of the subject, as well as to be compact with respect to themselves. When the model is so covered to a convenient thickness, the whole must be left at rest till the plaster be set and firm, so as to bear dividing without falling to pieces, or being liable to be easily put out of its form: it must then be divided into pieces, in order to its being

taken off from the model, by cutting it with a knife with a very thin blade; and being divided, it must be cautiously taken off and kept till dry; but it must be always carefully observed, before the separation of the parts be made, to knotch them across the joints or lines of the division at proper distances, that they may with ease and certainty be conjoined again. The art of properly dividing the moulds, in order to make them separate from the model, requires more dexterity and skill than anything else in the art of casting, and does not admit of rules for the most advantageous conduct of it in every case. Where the subject is of a round or spheroidal form, it is best to divide the mould into three parts, which will then easily come off from the model; and the same will hold good of a cylinder or any regular curved figure.

The mould being thus formed and dried, and the parts put together, it must be greased, and placed in such a position that the hollow may lie upwards, and then filled with plaster mixed with water, in the same proportion and manner as was directed for the casting of the mould; and when the cast is perfectly set and dry, it must be taken out of the mould, and repaired where it is necessary; which finishes the operation.

This is all that is required with respect to subjects where the surfaces have the regularity above mentioned; but where they form curves which intersect each other, the conduct of the operation must be varied with respect to the manner of taking the cast of the mould from off the subject or model; and where there are long projecting parts, such as legs or arms, they should be wrought in separate casts. The operator may easily judge from the original subjects which parts will come off together, and which may require to be separated. The principle of the whole consists only in this, that where under-workings as they are called occur, that is, wherever a straight line drawn from the basis or insertion of any projection would be cut or crossed by any part of such projection, this part cannot be taken off without a division, which must be made either in the place where the projection would cross the straight line, or, as that is frequently difficult, the whole projection must be separated from the main body, and divided also lengthwise into two parts; and where there are no projections from the principal surfaces, but the body is so formed as to render the surface a composition of such curves that a straight line drawn parallel to the surface of one part would be cut by the outline in one or more places of another part, a division of the whole should be made, so as to reduce the parts of it into regular curves, which must then be treated as such. For casting figures in very high relief, the late Sir Francis Chantrey and Mr Steell of Edinburgh have formed the models for their moulds of fine well-tempered clay, and availed themselves of the plasticity of that material to draw carefully forward the parts of the subject intended to be most prominent; by which arrangement division of the model into parts is much obviated, and great boldness is communicated to the design.

In larger masses, where there would otherwise be a great thickness of the plaster, a core or body may be put within the mould, in order to produce a hollow in the cast, which both saves the expense of material, and renders the cast lighter.

This core may be of wood where the forming of a hollow of a straight figure or a conical one with the basis outward will answer the end; but if the cavity require to be round, or of any curve figure, the core cannot then be drawn while entire, and consequently should be of such matter as may be taken out piece-meal. In this case the core is best formed of clay, which must be worked upon wires to give it tenacity, and suspended in the hollow of the mould by cross wires lying over the mouth; and when the plaster is sufficiently set to bear handling, the clay must be picked out by a proper instrument.

Where it is desired to render the plaster harder, the water with which it is tempered should be mixed with parchment size properly prepared, which will make it very firm and tenacious.

In the same manner, figures, busts, and the like, may be cast of lead or any other metal in the moulds of plaster; only the expense of plaster, and the tediousness of its becoming sufficiently dry, when in a very large mass, to bear the heat of melted metal, render the use of clay, compounded with some other proper materials, preferable where large subjects are in question. The clay in this case should be kneaded and washed till it be perfectly free from gravel or stones, and then mixed with a third or more of fine sand, to prevent it cracking; or, instead of sand, coal ashes sifted fine may be used. Whether plaster or clay be employed for the casting in metal, it is extremely necessary to have the mould perfectly dry, otherwise the moisture, being rarefied, will cause an explosion that will blow the metal out of the mould, and endanger the operator, or at least crack the mould in such a manner as to frustrate the operation. Where the parts of a mould are large, or project much, and consequently require a greater tenacity of the matter they are formed of to keep them together, flocks of cloth, prepared like those designed for paper-hangings, or fine cotton plucked or cut till it is very short, should be mixed with the ashes or sand before they are added to the clay to make the composition for the mould. The proportion should be according to the degree of cohesion required; but a small quantity will answer the end if the other ingredient of the composition be good, and the parts of the mould properly linked together by means of the wires above directed.

There is a method of taking casts in metals from small animals, and the parts of vegetables, which may be practised for some purposes with advantage, particularly for the decorating of grottos or rock works with lizards, snakes, frogs, birds, or insects, which should be properly coloured to render the imitation complete.

This is to be performed by the following method: A coffin or proper chest for forming the mould being prepared of clay, or four pieces of boards fixed together, the animal or parts of vegetables must be suspended in it by a string, and the leaves, tendrils, or other detached parts of the vegetables, or the legs, wings, and other parts of the animals, properly separated and adjusted in their right position by a small pair of pincers; a due quantity of plaster of Paris and calcined talc, in equal quantities, with some fibrous native alum, must then be tempered with water to the proper consistence for casting, and the subject from which the cast is to be taken, as also the sides of the coffin, moistened with spirit of wine. The coffin or chest must then be filled with the tempered composition of the plaster and talc, putting at the same time a piece of straight stick or wood to the principal part of the body of the subject, and pieces of thick wire to the extremities of the other parts, in order that they may form, when drawn out after the matter of the mould is properly set and firm, a channel for pouring in the melted metal, and vents for the air, which otherwise, by the rarefaction it would undergo from the heat of the metal, would force its way out or burst the mould. In a short time the plaster and talc will set and become hard, when the stick and wires may be drawn out, and the frame or coffin in which the mould was cast taken away; and the mould must then be put first into a moderate heat, and afterwards, when it is as dry as it can be rendered by that degree of heat, removed into a greater, which may be gradually increased till the whole be red-hot. The animal or part of any vegetable which was included in the mould will then be burnt to a coal, and may be totally calcined to ashes, by blowing for some time gently into the channel and passages made for pouring in the metal, and giving vent to the air, which will

at the same time that it destroys the remainder of the animal or vegetable matter, blow out the ashes. The mould must then be suffered to cool gently, and will be perfect, the destruction of the substance of the animal or vegetable having produced a hollow of a figure correspondent to it; but it may be nevertheless proper to shake the mould, and turn it upside down, as also to blow with the bellows into each of the air vents, in order to free it wholly from any remainder of the ashes; or where there may be an opportunity of filling the hollow with quicksilver without expense, it will be found a very effectual method of clearing the cavity, as all dust, ashes, or small detached bodies, will necessarily rise to the surface of the quicksilver, and be poured out with it. The mould being thus prepared, it must be heated very hot when used if the cast be made with copper or brass; but a less degree will serve for lead or tin; and the matter being poured in, the mould must be gently struck, and then suffered to rest till it be cold, at which time it must be carefully taken from the cast, but without the least force; for such parts of the matter as appear to adhere more strongly must be softened by soaking in water till they be entirely loosened, that none of the more delicate parts of the cast may be broken off or bent.

Where the *alumen plumosum* cannot easily be procured, the plaster may be used alone; but it is apt to be calcined by the heat used in burning the animal or vegetable from which the cast is taken, and to become of too incohering and crumbly a texture; or, for cheapness, Stourbridge or any other good clay, washed till it be perfectly fine, and mixed with an equal portion of sand, and some flocks cut small, may be employed. Pounded pumice-stone and plaster of Paris, taken in equal quantities, and mixed with washed clay in the same proportion, is said to make excellent moulds for this and similar purposes.

Casts of medals, or such small pieces as are of a similar form, may be made in plaster by the method directed for bas-reliefs. Indeed nothing more is required than to form a mould by laying them on a proper board, and having surrounded them by a rim made by a piece of card, or any other pasteboard, to fill the rim with soft tempered plaster of Paris; which mould, when dry, will serve for several casts. It is nevertheless a better method to form the mould of melted sulphur, which will produce a sharper impression in the cast, and be more durable than those made of plaster. Casts are likewise frequently made of sulphur, which being melted, must be treated exactly in the same manner as plaster.

For taking casts from medals Dr Lewis recommends a mixture of flowers of brimstone and red lead. Equal parts of these are to be put over the fire in a ladle till they soften to the consistence of pap; then they are to be kindled with a piece of paper, and stirred for some time. The vessel being afterwards covered close, and continued on the fire, the mixture grows fluid in a few minutes. It is then to be poured on the metal, previously oiled and wiped clean. The casts are very neat, and their colours sometimes a pretty deep black, sometimes a dark gray. They are very durable; and when soiled, may be washed clean in spirits of wine.

Dr Lettsom recommends tin-foil for taking off casts from medals. The thinnest kind is to be used. It should be laid over the subject from which the impression is to be taken, and then rubbed with a brush, the point of a skewer, or a pin, till it has perfectly received the impression. The tin-foil should now be pared close to the edge of the medal, till it be brought to the same circumference. The medal must then be reversed, and the tin-foil will drop off into a chip-box or mould placed ready to receive it. Thus the concave side of the foil will be uppermost, and upon this plaster of Paris, prepared in the usual manner, may be poured. When dry the whole is to be taken out, and the tin-foil sticking on the plaster will give a perfect representation of the medal, almost equal in beauty to silver. If the box or mould is a little larger than the medal, the plaster running round the tin-foil will give the appearance of a white frame or circular border, and hence the new made medal will appear neater and more beautiful.

Casts may likewise be made with iron prepared in the following manner: "Take any iron bar, or piece of a similar form, and, having heated it red hot, hold it over a vessel containing water, and touch it very slightly with a roll of sulphur, which will immediately dissolve it, and make it fall in drops into the water. As much iron as may be wanted being thus dissolved, pour the water out of the vessel, and pick the drops formed by the melted iron from those of the sulphur, which contain little or no iron, and will be distinguishable from the other by their colour and weight." The iron will by this means be rendered so fusible that it will run with less heat than is required to melt lead, and may be employed for making casts of medals, and many other such purposes, with great convenience and advantage.

Impressions of medals having the same effect as casts may be made also of isinglass-glue, by the following means: Melt the isinglass, beaten, as when commonly used, in an earthen pipkin, with the addition of as much water as will cover it, stirring it gently till the whole be dissolved; then with a brush of camel's hair cover the medal, which should be previously well cleansed and warmed, and then laid horizontally on a board or table, greased in the part around the medal. Let them rest afterwards till the glue be properly hardened; and then, with a pin, raise the edge of it, and separate it carefully from the medal. The cast will be thus formed by the glue as hard as horn, and extremely light. In order to render the relief of the medal more apparent, a small quantity of carmine may be mixed with the melted isinglass; or the medal may be previously coated with leaf-gold by breathing on it, and then laying on the leaf, which will by that means adhere to it; but the use of leaf gold is apt to impair a little the sharpness of the impression.

Impressions of medals may likewise be taken in putty; but it should be the true kind, made of calx of tin and drying oil. These may be formed in the moulds, previously taken in plaster or sulphur; or moulds may be made in its own substance, in the manner directed for those of the plaster. These impressions will be very sharp and hard; but the greatest disadvantage that attends them is their drying very slowly, and being liable in the meantime to be damaged.

Impressions of prints or other engravings may be taken from copperplates, by cleansing them thoroughly, and pouring plaster upon them; but the effect in this way is not strong enough for the eye, and therefore the following method is preferable, where such impressions on plaster are desired: Take vermillion, or any other coloured pigment, finely powdered, and rub it over the plate. Then pass a folded piece of paper, or the flat part of the hand, over the plate, to take off the colour from the lights or parts where there is no engraving; the proceeding must then be the same as where no colour is used. This last method is also applicable to the making of impressions of copperplates on paper with dry colours; for the plate being prepared as here directed, and laid on the paper properly moistened, and either passed under the rolling press, or any other way strongly forced down on the paper, an impression of the engraving will be obtained.

Impressions may likewise be taken from copperplates, either on plaster or paper, by means of the smoke of a candle or lamp; if, instead of rubbing them with any colour, the plate be held over the candle or lamp till the whole surface become black, and then wiped off by the flat of the hand, or paper.

Castle.

These methods are not, however, of great use in the case of copperplates, except where impressions may be desired on occasions where printing ink cannot be procured. But as they may be applied likewise to the taking of impressions from snuff-boxes, or other engraved subjects, by which means designs may be instantly borrowed by artists or virtuosi, they may in such instances be very useful.

The expedient of taking impressions by the smoke of a candle or lamp may be employed also for botanical purposes in the case of leaves; as a perfect and durable representation not only of the general figure, but of the contexture and disposition of the larger fibres, may be extemporaneously obtained at any time. The same may be nevertheless done in a more perfect manner by the use of linseed oil, either alone, or mixed with a small proportion of colour, where the oil can be conveniently procured; but the other method is valuable on account of its being practicable at almost all seasons, and in all places, within the time that the leaves will keep fresh and plump. In taking these impressions it is proper to bruise the leaves, so as to take off the projections of the large ribs, which might prevent the other parts from plying to the paper.

CASTLE (Saxon *castel*, Latin *castellum*, from *castrum*), a fortress or place rendered defensible either by nature or art. It is also frequently applied to the principal mansion of a prince or nobleman. In the time of Henry II., there were no less than 1115 castles in England, each of which was a manor.

Castles walled with stone, and designed for residence as well as defence, are for the most part, according to Grose, of no higher antiquity than the Conquest; for although the Saxons, Romans, and even, according to some writers on antiquity, the ancient Britons, had castles built of stone, yet these were both few and so much decayed, that little more than their ruins remained. This is asserted by many of our historians and antiquaries, and assigned as a reason for the facility with which William the Norman made himself master of this country. This circumstance was not overlooked by so good a general as the Conqueror; who, in order effectually to guard against invasions from without, as well as to awe his newly-acquired subjects, immediately began to erect castles all over the kingdom, and likewise to repair and augment the old ones. Besides, as he had parcelled out the lands of the English amongst his followers, they, to protect themselves from the resentment of the despoiled natives, built strongholds and castles on their estates; and these were multiplied so rapidly, that towards the latter end of the reign of king Stephen, they amounted to the enormous number of 1115.

As the feudal system gathered strength, these castles became the heads of baronies. Each castle was a manor, and its castellan, owner, or governor, the lord of that manor. Markets and fairs were directed to be held there, not only to prevent frauds in the king's duties or customs, but also as these were esteemed places where the laws of the land were observed, and as such had a very particular privilege. But this good order did not last long, for the lords of castles began to arrogate to themselves a royal power, not only within their castles, but likewise in their environs; exercising judicature both civil and criminal, coining money, and arbitrarily seizing forage and provisions for the subsistence of their garrisons, which they afterwards demanded as a right. At length their insolence and oppression grew to such a pitch, that, according to William of Newbury, "there were in England as many kings, or rather tyrants, as lords of castles;" and Matthew Paris emphatically styles them "nests of devils and dens of thieves." Castles were not solely in the possession of the crown and the lay barons, but even bishops had such fortresses, though it seems to have been contrary to the canons, from a plea made use of in a general council in favour of king Stephen, who had seized upon the strong castles of the bishops of Lincoln and Salisbury. This prohibition, if such existed, was, however, very little regarded; and in the following reigns many strong places were held, and even defended, by the ecclesiastics; nor was greater obedience afterwards paid to a decree made by the pope at Viterbo, on the fifth of the kalends of June 1220, in which it was ordained that no person in England should keep in his hands more than two of the king's castles.

Castle.

The licentious behaviour of the garrisons of these places having become intolerable, it was agreed, in the treaty between Stephen and Henry II., when only duke of Normandy, that all the castles built within a certain period should be demolished; in consequence of which many were actually rased, but not the number stipulated.

The few castles in existence under the Saxon government were probably, on occasions of war or invasion, garrisoned by the national militia, and at other times slightly guarded by the domestics of the princes or great personages who resided in them; but after the conquest, when all the estates were converted into baronies held by knight's service, castle-guard, coming under that denomination, was among the duties to which particular tenants were made liable. From these services the bishops and abbots, who till the time of the Normans had held their hands in frank almoign, or free alms, were, by this new regulation, not exempted; they were not, however, like the laity, obliged to render personal service, it being sufficient that they provided fit and able persons to officiate in their stead. This was at first stoutly opposed by Anselm, archbishop of Canterbury, who being obliged to find some knights to attend king William Rufus in his wars in Wales, complained of it as an innovation and infringement of the rights and immunities of the church.

It was no uncommon thing for the kings of those days to grant estates to men of approved fidelity and valour, on condition that they should perform castle-guard in the royal castles, with a certain number of men, for some specified time; and sometimes they were likewise bound by their tenures to keep in repair and guard some particular tower or bulwark, as was the case at Dover Castle.

In process of time these services were commuted for annual-rents, sometimes styled *wardpenny*, and *waytfee*, but commonly *castle-guard* rents, payable on fixed days, under prodigious penalties called *sursizes*. At Rochester, if a man failed in the payment of his rent of castle-guard on the feast of St Andrew, his debt was doubled every tide while the payment was delayed. These were afterwards restrained by an act of parliament made in the reign of Henry VIII., and finally annihilated, with the tenures by knight's service, in the time of Charles II. Such castles as were private property were guarded either by mercenary soldiers, or by the tenants of the lord or owner.

Castles which belonged to the crown, or fell to it either by forfeiture or escheat (circumstances that frequently happened in the distracted reigns of the feudal times), were generally committed to the custody of some trusty person, who seems to have been indifferently styled governor and constable. Sometimes also they were put into the possession of the sheriff of the county, who often converted them into prisons. That officer was then accountable at the exchequer for the farm or produce of the lands belonging to the places intrusted to his care, as well as for all other profits; and he was likewise, in case of war or invasion, obliged to victual and furnish them with munitions out of the issues of his county, to which he was directed by writ of privy seal.

The situation of the castles of the Anglo-Norman kings and barons was most commonly an eminence, and near a river; a position on several accounts eligible. The whole site of the castle, which was frequently of great extent and irregular figure, was surrounded by a deep and broad

ditch, called the *fosse*, sometimes filled with water, and sometimes dry. Before the great gate was an outwork, called a *barbacan* or *antemural*, which was a strong high wall, surmounted with turrets, designed for the defence of the gate and drawbridge. On the inside of the ditch stood the wall of the castle, about eight or ten feet thick, and between twenty and thirty feet high, with a parapet, and a kind of embrasures called *crennels* on the top. On this wall, at proper distances, were built square towers of two or three stories high, which served for lodging some of the principal officers of the proprietor of the castle, and for other purposes; and on the inside were erected lodgings for the common servants or retainers, granaries, storehouses, and other necessary offices. On the top of this wall, and on the flat roofs of these buildings, stood the defenders of the castle, when it was besieged, who thence discharged arrows, darts, and stones on the besiegers. The great gate of the castle stood in the course of this wall, and was strongly fortified with a tower on each side, and rooms over the passage, which was closed with thick folding doors of oak, often plated with iron, and with an iron portcullis or grate let down from above. Within this outward wall was a large open space or court, called, in the largest and most perfect castles, the *outer bayle*, or *ballium*, in which stood commonly a church or chapel. On the inside of this outer bayle was another ditch, wall, gate, and towers, inclosing the inner bayle or court, within which the chief tower or *keep* was built. This was a large square fabric, four or five stories in height, having small windows in prodigiously thick walls, which rendered the apartments within it dark and gloomy. This great tower was the palace of the prince, prelate, or baron, to whom the castle belonged, and the residence of the constable or governor. Under ground were dismal dark vaults, for the confinement of prisoners, and sometimes called the *dungeon* or *donjon*. In this building also was the great hall, in which the owner displayed his hospitality, by entertaining his numerous friends and followers. At one end of the great halls of castles, palaces, and monasteries, there was a place raised a little above the rest of the floor, called the *dais*, where the chief table stood, at which persons of the highest rank dined. Though there were unquestionably great variations in the structure of castles, yet the most perfect and magnificent of them seem to have been constructed nearly on the plan here described. Such, for example, was the famous castle of Bedford, as appears from the account of the manner in which it was taken by Henry III., A.D. 1224. The castle fell after four assaults. In the first was taken the barbacan; in the second the outer ballia; in the third attack, the wall by the old tower was thrown down by the miners, where, with great danger, they possessed themselves of the inner ballia, through a chink; in the fourth assault the miners set fire to the tower, so that the smoke burst out, and the tower itself was rent so as to show some broad chinks; upon which the enemy surrendered.

Before the accession of James VI. to the throne of England, the situation of Scotland was such that every baron's house was more or less fortified, according to the power or consequence of its lord, or according to the situation of the castle. Near Edinburgh or Stirling, where the inhabitants were somewhat polished in their manners, and overawed by the seat of government, no more was necessary than towers capable of resisting the cursory attacks of robbers and thieves, who never durst stop to make a regular investment, but plundered by surprise, and, if repulsed, instantly fled. But, when further removed, as in Perthshire, Inverness-shire, or Aberdeenshire, then it was necessary to be better defended; and the aids of a peel or dungeon, with outer walls, moat, wet ditch, and barnakin, were added, to enable the lord of the keep to resist the formidable attack of his powerful adversary. The history of Scotland, so late as the reign of the Stuart family, affords a number of melancholy instances of inveterate feuds among the greater and lesser barons of that period, when every mode of fortification then in use was seldom adequate to the defence of the castle against the storm or blockade of the enraged chieftain. The third kind of fortresses which we meet with in Scotland consists of those situated on the borders of England, or on the sea-coasts of the kingdom, and in the Western Isles, and in very remote places. Many of the old castles in Scotland were situated on an island in a deep lake, or on a peninsula, which, by a broad deep cut, was made an island. This kind of fortress was only accessible in a hard frost, or by boats, which were not easily transported by a people destitute of good roads and wheel-carriages. In fact they could only be taken by surprise or blockade, the first of which was difficult, and the second tedious; so that, before the use of artillery, they might be deemed almost impregnable. On this account their situation was very desirable in the inland parts of Scotland. On the sea-coasts of Scotland we generally find the strongest and most ancient, as well as the most impregnable castles, since these had to defend themselves from the invasion of the foreign enemy, as well as the attacks of the domestic foe. Thus the barons whose lands extended to the sea-coast, perched, like the eagle, on the most inaccessible rocks that lay within their possessions.—(See Grose's *Antiquities;* King's *Munimenta Antiqua;* Roy's *Military Antiquities of the Romans in Britain;* Britton's *Architectural Antiquities;* Brayley's *Ancient Castles of England and Wales.*)

Castle, in old writers, is also used for a fortified town or village.

Castle-Stead an appellation given by the country people in the north of England to the Roman *castella*, as distinguished from the *castra stativa*, which they usually call *chesters*. Horsley represents this as a useful criterion by which to distinguish a Roman camp or station. There are several of these castella on Severus's wall. They are generally sixty feet square; their northern side is formed by the wall itself, which falls in with them; the intervals between them are from six furlongs and a half to seven; and they seem to have stood closest where the stations are widest apart.

CASTLEBAR, a town of Ireland, in the county of Mayo, pleasantly situated on the river of the same name, 159 miles west by north of Dublin. It consists chiefly of a main street upwards of half a mile in length, and a square There is a court-house, jail, parish church, Roman Catholic chapel, infirmary, two dispensaries, linen hall, savings-bank, artillery and infantry barracks, and workhouse. It has some breweries, and a considerable trade in linens. Pop (1851) 6020, including workhouse, infirmary, and jail.

CASTLEBLAYNEY, a pleasantly-situated and well-built town of Ireland, in the county of Monaghan, 14 miles S.E. of Monaghan, and 62 miles from Dublin. It has a church and several chapels, market-house, workhouse, hospital, bridewell, &c. Pop. (1851) including workhouse, 2841, principally engaged in the linen trade.

CASTLECARY, a station on the Edinburgh and Glasgow railway, 9 miles W.S.W. of Falkirk. Here was one of the principal stations of the wall of Antoninus; and in 1770 some workmen, while searching for stones for the canal which passes near it, discovered the foundations of eight apartments of stone, one of which contained a number of erect stones, probably the remains of the hypocaust of a bath, with marks of fire upon them. In a hollow of the rock near this place, about 100 quarters of wheat, black through age, were found in 1771, with some wedges and hammers supposed to be Roman. The formation of the Edinburgh and Glasgow railway has almost entirely obliterated this remarkable fort.—(See Stuart's *Caledonia Romana*, edited by David Thomson. 4to, 1852.)

Castlecary, in Somerset, a town of 1912 inhabitants.

CASTLECOMER, a town of Ireland, county of Kilkenny, on the river Deen, 10 miles north of Kilkenny. It is neat and well-built, and has a church, a Roman Catholic chapel, court-house, market-house, hospital, and infantry barracks. Pop. (1851) 1724, chiefly engaged in the extensive collieries about two miles distant.

CASTLE-DERMOT, or TRISTLE DERMOT, an ancient town of Ireland, county of Kildare, on the river Lerr, 6 miles N. by E. of Carlow, and 53 from Dublin. An abbey was founded here by St Diermid in 550. Among its antiquities are the remains of a large cathedral, part of which is now used as a parish church; a Franciscan monastery; a priory; a castle; a strong square tower; several crosses; and other ancient remains. It was the residence of the Dermots, kings of Leinster. Pop. (1841) 1416; (1851) 666.

CASTLE-DOUGLAS, a burgh of barony in Scotland, stewartry of and 9 miles N.E. of the town of Kirkcudbright. It is a neat and well-built modern town, and is indebted for its prosperity to the advancing agricultural wealth of the vicinity. The weekly corn and cattle markets formerly held at Rhone-house have been transferred to Castle-Douglas. Pop. (1851) 1992.

CASTLE-ISLAND, a small town of Ireland, county of Kerry, 11 miles E.S.E. of Tralee. Its principal edifices are the parish church, Roman Catholic chapel, session-house, and prison. The castle, from which the place derives its name, was erected by Geoffry de Mariscis, lord-justice of Ireland, in 1226, and was frequently the subject of violent contention. Pop. (1851) including workhouse, 2582.

CASTLEREAGH, a market-town of Ireland, county Roscommon, 17 miles W.N.W. from Roscommon. It is pleasantly situated on the river Suck, which is here crossed by two bridges. The town consists principally of one long, wide, and tolerably well-built street; and has a church, workhouse, bridewell, dispensary, and distillery. In the immediate vicinity is the extensive demesne of Castlereagh, the seat of Lord Mountsandford. Pop. in 1851 (including 1392 in workhouse), 2613.

CASTLETOWN, the capital of the Isle of Man, and seat of the Manx government, stands on the western side of Castletown bay, 11 miles S.W. of Douglas. It is a neat and regularly built town, and has a large square containing some handsome houses. Castle-Rushen, said to have been built about 960 by the Danish chief Guttred, and afterwards the residence of the kings of Man, stands in the centre of the town, and is now partly used as a prison and barracks. Castletown has a church, three chapels, market-house, college, bank, and literary society. Pop. 2579.

CASTOR. See BEAVER; and index to MAMMALIA.

CASTOR, a moiety of the constellation Gemini. It is also called Razalgenze, Apollo, Aphellan, Avellar, and Anelar. Its latitude northwards for the year 1700, according to Hevelius, was 10. 4. 23, and its longitude of Cancer 17. 4. 14.[1]

CASTOR-OIL is extracted from the seeds of the *Ricinus communis*, a plant belonging to the natural order *Euphorbiaceæ*, and to the Linnæan class and order *Monœcia Monadelphia*. This plant, common in Asia, Africa, West Indies, south of Europe, &c., is best known by the name of the Palma Christi, and is now recognised as the gourd (kikayon and kiki) mentioned in Scripture as sheltering the prophet Jonah. In temperate countries this plant is annual and herbaceous, and only reaches 6 or 8 feet in height. But in warmer countries it is more ligneous and perennial, and in India often attains the height of 40 feet. It is of rapid growth, and has large deeply-cut palmated leaves. It throws up a long spike of green flowers, which are succeeded by spiny capsules, each containing three beautifully marbled seeds. The kernel of the seeds contains about 46 per cent. of a fixed oil, which is the castor-oil of commerce. The oil was well known to, and was used by the ancient Egyptians, Greeks, and probably all the oriental nations. In India it is largely used at the present day; and though sometimes obtained by expression, is more commonly prepared by steeping the seeds for a night in cold water, boiling them for two hours, then drying them in the sun, and afterwards pounding or bruising them: the seeds thus bruised are then thrown into water and boiled till the whole oil is extracted, when it rises to the surface and is skimmed off. In the West Indies the seeds are not usually either steeped or boiled previous to bruising, but are bruised and boiled in water at once. At one time, both in India and in London (as still in America), the seeds were bruised, and the oil obtained by subjecting the mass to strong expression. When so prepared the oil requires to be boiled with water, or at least subjected along with water to a heat of 200°, in order to coagulate the albumen and dissolve out the mucilage which has been expressed along with the oil, and which, if not removed, would cause the oil soon to become rancid. When thus prepared by expression it is called *cold drawn* castor-oil, and used to be most in esteem; but oil so prepared has no advantages over that prepared carefully by boiling the bruised seeds. The chief supply comes from India. When good it should be a thickish fluid, either limpid or of a very pale yellow colour, with a peculiar nauseous odour, and an oily taste which is very permanent. This oil may be distinguished from almost every other fixed oil by being soluble in ether or in alcohol in all proportions. Hence one of the best tests of its purity is to mix it with its own volume of alcohol. If it be entirely dissolved it is pure; if impure, the oil mixed with it is left undissolved. Bussy and Lecanu regard the oil as composed of three fatty acids; but other chemists dissent from this, and seeing that it is not separable with margarine and elaine, like the other oils, and that it is totally soluble in alcohol and ether, regard it as composed of a single peculiar fatty principle. The principle, however, on which its purgative properties depend has not yet been discovered.

In all countries where the castor-oil plant grows, the oil is extensively used for burning; but it is best known for its use in medicine, as one of our best and safest purgatives. It is usually administered plain, or mixed with milk, coffee, port wine, brandy, or aromatic waters, to cover its nauseous taste; or is formed into a soapy emulsion with a few drops of solution of caustic potass. The castor-oil seeds are themselves powerfully drastic purgatives and irritants, so few as twenty seeds having even proved fatal to man. The kernels of from one to three of the fresh seeds suffice for an effectual dose.

Castor-oil pays no duty now; it is therefore difficult to procure late returns of its importations. In 1835 there were imported into Great Britain 1,109,307 lb., of which 670,205 lb. were retained for home consumption.

CASTOR and *POLLUX*. See DIOSCURI.

CASTOR and *POLLUX*, a fiery meteor, which at sea appears sometimes adhering to a part of the ship, in form of one, two, or even three or four fire-balls. When one is seen alone, it is properly called *Helena;* two are denominated Castor and Pollux, and sometimes Tyndaridæ. Castor and Pollux by the Spaniards are called San Elmo; by the French, St Elme, St Nicholas, St Clare, St Helene; by the Italians, Ermo; by the Dutch, Tree Vuuren.

Castor and Pollux are commonly believed to indicate a cessation of the tempest: Helena alone, to portend a severer storm.

CASTOREUM or CASTOR, a peculiar secretion of the *castor fiber* or beaver. It is used in medicine as an antispasmodic. See BEAVER.

[1] For some interesting observations on this double star, see *Mem. R. Astronom. Soc.* v. 196.

CASTRATION, the operation of depriving a male animal of the capacity of generation.

Castration is common in the East, especially among the Turks, who emasculate their slaves, particularly those attached to the harem. The Persians and others had various methods of making eunuchs; namely, by the administration of cicuta and other poisonous herbs, which, according to Paulus Ægineta, have the same effect; or leaving the organs entire, but dividing the vessels, so as to render the parts lax and weak.

Athenæus relates that Andramyles, king of Lydia, castrated women; and Hesychius and Suidas state that Gyges did the same. Dalecampius, however, remarking on the passage of Athenæus alluded to, maintains that it merely refers to an artificial kind of protection. The effect of castration on the voice is well known. It is said that within a very recent period *castrati* were found among the singers in the papal chapel; but if this still be the case, there seems every probability that the disagreeable effect of the association connected with this peculiarity of voice will soon render obsolete the practice of castration for such a purpose. See Eunuch.

By the civil law it is penal in physicians and surgeons to castrate, even with consent of the party, who is himself included in the same penalty, and his effects forfeited. The offence of mayhem by castration is, according to our old writers, felony, although committed upon the highest provocation. See a record of Henry III. to this purport, transcribed by Sir Edward Coke, 3 Inst. 62.

CASTRES, capital of an arrondissement of the same name in the department of Tarn, France, 23 miles S.E. of Alby, stands in a pleasant and fertile valley, on both sides of the Agout, here crossed by two bridges. The town is ill-built, and the streets are narrow and crooked; but it has of late been much improved. The principal buildings are the town-hall, formerly the episcopal palace, the churches of St Benoit and Notre-Dame, two hospitals, barracks, theatre, and exchange. It is the seat of tribunals of primary instance and commerce, and of a Protestant consistory. Castres is celebrated for its manufactures, among which are woollen, linen, silk and cotton stuffs, soap, leather, paper, and iron and copper wares. It has also a considerable trade. Dacier, Rapin, and Sabatier were natives of this town. Pop. (1851) 19,098.

CASTRO, a seaport-town of Naples, in the province of and 10 miles S.W. of the town of Otranto. It is the seat of a bishopric, and has an old castle, cathedral, and some export trade in corn, wine, fish, &c. The harbour, however, is accessible only to small vessels. Pop. 7000.

Castro *Giovanni*, the ancient *Enna*, a town of Sicily, province of Catania, on the summit of a lofty and nearly inaccessible mountain in the centre of the island, and about 4000 feet above the level of the sea. The principal edifice is the castle, which is fast going to decay. The town is well supplied with water, the atmosphere salubrious, and the surrounding country very fertile. In ancient times it was one of the chief seats of the worship of Ceres, and had a celebrated temple of that goddess. About 5 miles from the town, at the foot of the mountain, is the lake of Pergusa, from the banks of which it is said that Proserpine was carried off by Pluto. Pop. 11,000.

Castro *Nuovo*, a town of Sicily, in the intendancy of Palermo, 25 miles north of Girgenti. Pop. 6500. In the vicinity there are extensive quarries of fine marble.

Castro *Reale*, a city of the intendancy of Messina, in the island of Sicily situated on a triangular and rocky mountain. The climate is salubrious; and excellent wine and oil are produced here. This city is 150 miles from Palermo. Pop. about 11,000.

Castro *del Rio el Real*, a town in the province of Cordova, Spain. It is situated near the river Guadajocillo, about 16 miles S.E. from Cordova, and contains several churches, schools, and hospitals, a handsome town-house and prison. Its population is rather more than 9000, the great majority of whom are employed in agricultural pursuits. Its commerce is confined to the exportation of grain and oil, and its industry to coarse manufactures for domestic purposes.

Castro *Urdiales*, a seaport-town of Spain, in the province of Santander, is well known to sailors for the shelter which it affords from storms in the Bay of Biscay. It was destroyed by General Foy in 1813, but has been rebuilt, fortified, and greatly improved. The most remarkable buildings are the castle and the hermitage of Santa Ana. Its fisheries are considerable. Pop. 2936.

Castro *Villari*, a town of Naples, in the province of Calabria Citra, 8 miles W.N.W. of Cassano. It stands on an eminence surrounded by lofty mountains, and the modern portion contains several handsome streets. The massive castle is supposed to belong to the Norman period. It carries on a considerable trade in cotton, wine, fruits, &c., and has about 5000 inhabitants.

CASTRUCCIO Castracani, a celebrated Italian general, was born at Lucca in Tuscany in 1284. Being exposed as an infant in a vineyard, he was found by Dianora, a widow lady of the family of the Castracani, who brought him up and educated him as her own. She intended him for the priesthood; but he was scarcely fourteen years old when he began to devote himself to military sports and those athletic exercises which suited his great strength of body. The factions of the Guelfs and Ghibellines then shared all Italy between them; dividing not only popes and emperors, but those of the same town, and even members of the same family. Francis Guinigi, a leader of the Ghibelline party, observing Castruccio's spirit and ability, prevailed with Antonio, the brother of Castruccio's guardian, to permit him to become a soldier. Castruccio soon became an adept in military tactics, and was made lieutenant of a company of foot by Guinigi. In his first campaign the fame of his courage and conduct spread over all Lombardy; and soon afterwards Guinigi when dying committed to him the care of his son and the management of his estate. His exploits, however, provoked the envy of his commander-in-chief, who by stratagem procured his imprisonment in order to put him to death. He obtained his release; and the people of Lucca, in gratitude for his former services, chose him as their sovereign prince. The Ghibellines regarded him as the chief of their party; and those who had been banished from their country fled to him for protection, and unanimously promised that if he could restore them to their estates, they would serve him so effectually that the sovereignty of their country should be his reward. Flattered by these promises, he entered into a league with the prince of Milan; and kept his army constantly on foot, employing it as best suited his own designs. For the services he had rendered the pope, he was made senator of Rome with more than ordinary ceremony; but during his residence at the capital he received news which obliged him to hasten back to Lucca. The Florentines proclaimed war against him; but Castruccio routed their army, and the supreme authority of Tuscany was about to fall into his hands, when a period was put to his life. In May 1328 he gained a complete victory over his enemies, amounting to 30,000 foot and 10,000 horse; and 22,000 of them were slain, while the loss on his part fell short of 1600. But as he was returning from the field of battle, tired and heated with the action, he halted a while, in order to address his soldiers as they passed; an imprudence which proved fatal to him, for he was immediately seized with an ague, at first neglected, but which carried him off in a few days, in the forty-fourth year of his age. Machiavelli, who has written the life of Castruccio, says that he was not only an

extraordinary man in his own age, but that he would have been so in any other.

CASTRUM DOLORIS (i. e. *castle of grief*), a catafalco, or rather the chamber or chapel in which is erected a catafalque or lofty tomb of state, containing the coffin of a prince or other distinguished person, and decorated with armorial bearings, inscriptions, arms, &c., brilliantly illuminated with tapers. By the French the *castrum doloris* is termed *chapelle ardente*. This latter is to be distinguished from *chambre ardente*, which formerly in France was a chamber hung with black cloth, in which state prisoners of high rank were tried by torchlight.

CASUALTY, an accident, or that which happens by chance; more particularly an accident causing death.

CASUIST, one who studies and resolves cases of conscience. The Jesuit Escobar has made a collection of the opinions of all the casuists before him. M. le Féore, preceptor of Louis XIII., called the books of the casuists expositions of the "art of quibbling with God." Mayer has published a Bibliotheca of Casuists, divided into three heads —Lutheran, Calvinist, and Romish.—(See Jeremy Taylor's *Ductor Dubitantium.*)

CASUISTRY, the science or doctrine of cases of conscience; the science of resolving cases of doubtful propriety, or of determining the lawfulness or unlawfulness of what a person may do, by rules and principles derived from the Scriptures, the canon law, the councils and fathers, the laws of society, or from equity and natural reason. It is termed by Kant the *dialectics of conscience.*

CAT. See *index* to MAMMALIA.

CATA, a prefix of many English words derived from the Greek, signifying opposition, contrariety, under, down, downward; and sometimes used merely to express completeness or intensiveness, as in *cataclysm.*

CAT'S-EYE, or SUN-STONE, a kind of gem found chiefly in Siberia. In Latin it is called *oculus cati*, and sometimes *onycopălus*, from its white zones or rings like onyx, and its variable colours like opal. It is a sub-species of quartz, containing parallel fibres of amianthus.

CAT-GUT, a name absurdly enough given to the intestines of sheep, dried and twisted; used for the strings of violins, harps, &c., and sometimes coloured.

CAT-SALT, a name given by salt-workers to a very beautifully granulated kind of common salt.

CATACHRESIS (κατα against, and χρῆσις use), a trope which borrows a term of one idea to express another: as when Milton, in describing Raphael's descent from heaven to paradise, says he "*sails* between worlds and worlds." So in Scripture we read of the "*blood* of the grape."

CATACOMB (in low Latin *catacumbæ*, probably from κατά, and κύμβος, a cavity), a grotto or subterranean place for the burial of the dead.

The word *catacomb* is said to have been originally applied to the chapel of St Sebastian at Rome, in which the ancient Roman calendars say that the body of St Peter was deposited. The most extensive catacombs in the world are those in the Via Appia, which extend for six miles under ground. The entrance to them is in the church of St Sebastian, just without the Porta Capena. They probably were quarries originally, and seem to have been used as sepulchral chambers by the ancient Romans, being, in the opinion of many, the *puticuli*, or grave-pits for slaves, mentioned by Festus Pompeius and others. It is certain that they were used as sepulchres by the primitive Christians, who there found also an asylum in times of persecution. They contain numerous paintings of sacred subjects of the same era, interspersed with the symbol of the cross. These pictures are of considerable importance to the history of the art; as from them it would not be difficult to trace a series, almost unbroken, from the era of ancient art to the date of its reputed revival in Italy. Each catacomb is about three feet broad, and eight or ten high. Along the side walls of the galleries (which communicate with each other, and exhibit no masonry or vaulting), are the niches where the dead were deposited lengthwise parallel to the gallery, in three or four tiers, one above the other; and these were closed with tiles or slabs of marble, admirably cemented. Sometimes, though very rarely, the name of the deceased is found on the tile; frequently a palm is seen, painted or engraven, or the cipher Xp, which is commonly read *pro Christo.*

The best work on the catacombs of Rome is the rare and curious one by Antonio Bosio, entitled *Roma Sotteranea*, first published in 1 vol. folio in 1632, and afterwards in 2 vols. folio, with Latin descriptions; but the first is the most valuable. (See also Artaud, *Voyage dans les Catacombes de Rome.*) There are also ancient catacombs in the Capo di Monte at Naples, and in several other parts of the world.

The catacombs of Egypt have been described by Belzoni and many later travellers. The chambers extend a great distance under ground, and in some instances the walls are adorned with figures and hieroglyphics: in others the mummies are found in tombs ranged round the apartment and hollowed out in the rock.

The so-called catacombs of Paris, situate on the southern side of the Seine, are merely the quarries that furnished the stone of which the city was built. In these subterranean excavations were deposited the bones taken from the several cemeteries previous to the establishment of the system of extramural interment. These are piled in heaps so as to form various quaint devices. The excavations are of such extent that individuals have sometimes perished in their labyrinthine windings; but as they are in many parts knee-deep with water, they are seldom visited, nor indeed are they now open to public inspection.

CATADROMUS, in *Antiquity*, a rope stretched in a sloping direction in the theatres, down which the *funambuli* walked to show their skill. Elephants were also taught to descend the *catadromus.*

CATAFALQUE (Italian *catafalco*, a scaffold), a temporary structure of carpentry, decorated with painting and sculpture, and representing a tomb or cenotaph. The catafalque erected at Florence for the final interment of Michael Angelo was of unexampled magnificence.

CATAGOGIA, or feast of the return, a time of public rejoicing and festivity at Eryx in Sicily, to commemorate the return of Aphrodite (Venus), who was supposed at the feast of the *Anagogia* to go over to Africa accompanied by all the pigeons of the neighbourhood. At the return of the pigeons nine days after, the whole district, it is said, smelled of butter, which was regarded as a sign that the goddess had returned. (Ælian, *Hist. An.* iv.; *V. H.* i.; Athen. ix.)

CATAGRAPHA, a term used by Pliny to denote any oblique view of the countenance or figure, either in profile or otherwise; and which may be technically rendered *foreshortenings.* Catagrapha are said to have been the invention of Cimon of Cleonæ, who probably flourished in the time of Solon, though Pliny assigns him to a much earlier period. (Plin. *H. N.* xxxv. 34; Ælian. *V. H.* viii. 8.)

CATALEPSY (from the Greek word κατάληψις, a seizing), is a very rare form of disease, characterized by a sudden extinction of sensation and voluntary motion, with a peculiar rigidity of the voluntary muscles, in consequence of which the limbs retain during the paroxysm precisely the position they held at the moment of seizure, yet readily admit of and retain any other position they are made to assume. During this state the action of the heart and breathing continue, but are much slower and more feeble than during health. These fits come on at irregular intervals, and continue, when unchecked, for many years. Catalepsy is of such rare occurrence that few physicians have

seen a true case of the disease, and it has consequently been much confounded with different forms of hysteria and chorea; yet the distinction is quite marked.

The pathology of the disease is obscure; but from the cases which have been published, it appears probable that it depends either on functional disorder of the abdominal viscera reacting on the brain, or on these associated with disease of the brain itself. That the first supposition is most probably the correct one is evidenced from the fact, that the cure of the disease has been generally effected by attention to diet and regimen, the regulation of the bowels, to the restoration of suppressed secretions, and other means which improve the health and give tone to the system.

CATALOGUE, a list or enumeration of the names of men or things, disposed according to a certain order.

Catalogues of books are arranged either according to the order of the times when the books were printed, their form and size, in the alphabetical order of the authors' names, or according to the order of the subjects. Of this last kind is the *Catalogue Raisonné* (classed catalogue), in which the books are arranged under the heads of their several subjects, with a brief analysis of the contents of each. See BIBLIOGRAPHY, and LIBRARY.

CATALOGUE *of the Stars*, a list of the fixed stars, disposed in their several constellations, with the longitudes, latitudes, &c., of each, or according to their right ascensions. The first who undertook such a catalogue was Hipparchus, about the year B.C. 120. See ASTRONOMY, p. 791.

CATALONIA, in Spanish *Cataluña*, a department forming a triangle in the N.E. corner of the peninsula, is bounded N. by the Pyrenees W. by Aragon, S. by Valencia, and E. by the Mediterranean. It extends from N. Lat. 40. 30. to 42. 50., and from E. Long. 0. 12. to 3. 20. The line of sea-coast extends for about 200 miles, but is utterly destitute of good harbours, although a large portion of the population is engaged in the fisheries. The interior of the province is intersected by numerous sierras which branch off from the Pyrenees on the north, and the great central ridge which terminates in the Sierra de Llena on the S.W. Its climate and productions vary with the elevation of the surface, but there are few fertile plains, and little attention is paid to agriculture. As a manufacturing province Catalonia is the most important in Spain; but much of its commercial wealth is due to the contraband trade with France, which is easily carried on through the narrow and almost inaccessible defiles of the Pyrenees. The Catalonians generally are a powerful and hardy race, averse to the ordinary drudgery of the husbandman and mechanic, and foremost in all the revolts which have marked the political history of Spain. Catalonia is divided into the provinces of Barcelona, Tarragona, Lérida, and Gerona, the most important points in regard to which will be found under the heads of their respective capitals. The mineral wealth of the department is considerable, and consists in seams of coal, copper, lead, salt, cobalt, &c. The principal productions of the soil are corn, oil, hemp, fruits, and silk. The manufactures embrace cottons, woollens, silks, lace, leather, brandy, and wines. Area rather more than 12,000 square miles. Pop. 1,283,734.

CATAMARAN, a kind of rude raft, generally composed of three pieces of wood lashed together; used on the coasts of Coromandel and in South America, chiefly for conveying letters, messages, &c., to the shipping in the roads. It is particularly advantageous in crossing the heavy surf that always breaks on those shores.

CATANDUANES, a large island of the Philippine group, lying to the S.E. of the island of Luzon, about 36 miles in length by above 20 in breadth. It is subject to the Spaniards. The inhabitants are a barbarous race, and live by hunting and fishing.

CATANIA, the ancient *Catana*, a celebrated city and seaport of Sicily, capital of an intendancy of the same name, on the east coast of the island, at the foot of the southern projections of Mount Ætna. N. Lat. 37. 28. 20., E. Long. 15. 5. 15. Present population about 55,000. The ancient Catana was founded B.C. 730, by a colony from the neighbouring city of Naxos, which was itself founded by the Chalcidians of Eubœa. It maintained its independence till B.C. 476, when it was taken by Hiero I., who removed its inhabitants to Leontini, and repeopled the city with a new colony of 5000 Syracusans and an equal number of Peloponnesians, at the same time changing its name to Ætna. Soon after the death of Hiero the former inhabitants obtained possession of the town, when it again took the name of Catana. In B.C. 403 it was taken by Dionysius of Syracuse, who, after plundering the city and selling the inhabitants for slaves, established there a body of Campanian mercenaries. In the first Punic war it was one of the first among the cities of Sicily that submitted to the Romans, and appears to have afterwards continued on friendly terms with them. In Cicero's time it was a flourishing and wealthy city; but it suffered so severely from the ravages of Sextus Pompeius, that afterwards Augustus sent a colony of veterans thither. It has frequently suffered from earthquakes and eruptions of Mount Ætna. It was almost totally destroyed by an earthquake in 1693, but was rebuilt in a more magnificent style, and is now considered the handsomest town in Sicily. The remains of the ancient city are numerous, and include a large theatre, an amphitheatre, a small theatre, ruins of baths, some massive sepulchral monuments, and fragments of an aqueduct, all of Roman construction, the Greek city having probably been destroyed by some of the earthquakes to which it has in all ages been subject. The streets are wide, regular, and paved with lava; of which also the public buildings are mostly built, with facings of limestone and ornamented with marble. The appearance of the city from the sea is magnificent, and the harbour is sheltered by a natural mole of lava. Among the principal public buildings are the magnificent cathedral rebuilt since the earthquake of 1693, the senate house, *monte di pieta*, theatre, and the vast Benedictine abbey. It has numerous churches, convents, hospitals and other charitable institutions, and a museum. The university, founded in 1445, is well attended, and has a good library and museums. Silk is largely manufactured, and with lava and amber articles constitutes its chief products. The harbour is small, being accessible only to small craft; by means of which, however, a considerable trade is carried on—principally in corn, macaroni, potatoes, olives, figs, silk, and wine.

CATANZARO, a city of Naples, capital of the province of Calabria Ultra II., stands on the slope of a lofty and rocky hill near the Gulf of Squillace, 30 miles S.S.E. of Cosenza. It is the seat of a bishopric, and has a cathedral, several churches and convents, a castle, royal academy of sciences, diocesan school, college, theatre, a foundling and two other hospitals, and other charitable institutions. It has manufactures of silk, velvet, and woollen goods, and a considerable trade in corn, wine, &c. Pop. 12,000. In 1783, many of its principal buildings were destroyed by an earthquake.

CATAPHRACT (Lat. *cataphractus*, mailed), a horseman in complete armour. The cataphracti of ancient times were heavy-armed cavalry, whose horses were defended with armour composed of plates of brass or other metal, or with scale armour. The weight of such armour frequently rendered them so unwieldy that when once on the ground both rider and horse became an easy prey to the enemy. Cataphracti, from very early times, were common under the name of *clibanarii* among the Persians, and were also employed in many other eastern nations; and their use was afterwards adopted by the Macedonians. Cataphracti were first employed in the Roman army by Constantine. Liv.

xxxv. xxxvii.; Amm. Marc. xvi.) Ships called *cataphractæ naves* were decked vessels similarly protected, in which the rowers sat below the deck, so as to be completely sheltered from the weapons of the enemy.

CATAPULTA, a military engine used by the ancient Greeks and Romans for discharging arrows, lances, and stones. In accounts of ancient sieges and other military operations, this word frequently occurs in conjunction with *ballista;* and under that head it will be seen that the two were frequently confounded by writers subsequent to the time of Julius Cæsar. The chief use of the catapult appears to have been to shoot the enemy when they appeared on the walls during a siege; the ballista being employed to discharge stones against the battlements, while the force of the *aries* or battering-ram was directed against the solid walls. Catapults were distinguished, as were also the ballistæ, into greater and less, but were of a long form, whereas the ballistæ were square. Their construction, however, must be a matter of conjecture, though it is probable that the principle of their projectile force differed little from that of the ballista. Dr Adam remarks in his *Antiquities,* that the most powerful of the catapultæ, ballistæ, and scorpiones, may be regarded "as gigantic cross-bows, consisting not of a single beam or spring but of two distinct beams, each of which was inserted into an upright coil of ropes tightly twisted in such a manner that the extremities of the arms could not be drawn towards each other without increasing the tension of the ropes so as to produce a most violent recoil." Some of the spears and darts thrown by the catapults are said to have been 18 feet long, and to have been projected with such velocity as to take fire in their course. This, of course, is absurd; but it is not improbable that spears with firebrands attached to them were sometimes projected from these engines.

CATARACT, a great fall of water over a precipice, as that of Niagara, the Rhine, Danube, and Nile. The fall of the Nile now known as Chellat, was called by the ancients *Catadupa. Cataracta* also denoted a portcullis, from the noise it makes in falling.

Cataract, a disease of the eye, in which the crystalline lens, or its capsule, becomes opaque, whereby vision is impaired or destroyed. The surgical operation of depressing a cataract is termed *couching.*

CATARRH (Latin *catarrhus*), a defluxion or increased secretion of mucus from the membrane which lines the nose, fauces, and bronchiæ, accompanied with feverishness, sneezing, cough, thirst, lassitude, and loss of appetite; and frequently an entire deprivation of the sense of taste. It is also called *coryza,* and in familiar language *a cold.* When epidemic, it is termed *influenza.* Catarrh is sometimes a chronic disease affecting the mucous membrane of the nose and fauces.

CATASTROPHE, the change or revolution which produces the final event of a dramatic piece; or the unfolding and winding up of the plot. The ancient drama was divided into the protăsis, epităsis, catastăsis, and catastrophe.

CATCH, or Round, in *Music,* a vocal composition in three or more parts, all written in the same clef, the performers of which sing each part in succession, as indicated by the figures at the beginning and end of each line, viz., the first voice sings the first, second, and third parts in succession, and then the first again, and so on. The second voice begins the first part when the first voice begins the second part. The third voice begins the first part when the second voice begins the second part, and the first voice the third part.

Catch-Word, among printers, the word placed at the bottom of each page, which is to be inserted as the first word on the following page. This system is no longer in use.

CATEAU, Le, or Cateau-Cambresis, a town of France, in the department of Nord, on the Selle, 15 miles E.S.E. of Cambray. It is well built, and was formerly fortified. Its chief manufactures are shawls, merinos, calicoes, lace, leather, soap, starch, and tobacco. In 1559, a treaty between France and Spain was concluded here. Pop. 7600.

CATECHESIS, instruction in the first rudiments of an art or science. In the ancient church catechesis was instruction given *viva voce,* either to children or adult heathens, preparatory to baptism. See Catechumen.

CATECHISM, a form of instruction by means of questions and answers, particularly in the principles of religion. The word is formed from κατηχέω, a compound of κατα and ἦχος, q.d. *circumsono,* alluding to the noise made in this sort of exercise. Anciently the candidates for baptism were only instructed in the secrets of their religion by tradition, *viva voce,* without writing; as had also been the case among the Egyptian priests, and the British and Gaulish druids, who thus communicated the mysteries of their theology.

Catechism is now generally used to denote an elementary book in which the principles of religion are summarily delivered by means of questions and answers.

CATECHIST, one who catechises or instructs novices in the principles of religion. Catechist also denotes a person appointed by the church to instruct those intended for baptism in the fundamental articles of the Christian faith.

CATECHU, Cutch, Terra-Japonica, or Gambeer, is an astringent extract prepared from the wood of the *Acacia Catechu,* from the kernels of the *Areca Catechu* or betel-nut palm, from the leaves of the *Uncaria Gambir,* and probably also from other plants. The wood, kernels, or leaves, as the case may be, are boiled in water till their substance is extracted; the decoction is then strained, and the boiling continued till it becomes sufficiently concentrated to form a tough extract on cooling. It is then moulded or made up into the various forms met with in commerce, and dried in the shade. Catechu is imported into Britain from Bombay, Calcutta, Singapore, Colombo, and Pegu, and the number of its varieties is great. The most valuable variety now brought to the market is known in commerce by the name of cutch (from its native name *cutt*), and is chiefly imported from Pegu. It is darker and more astringent than the ordinary catechues, and before the Burmese war used to sell from L.7 to L.8 a ton higher than they. In consequence of the deficient supply, its present price (1854) has reached L.50 a ton, the ton of the ordinary catechues being only L.30. All the other varieties of catechu at present in the market are known by the names of Terra-Japonica and Gambeer, the former having a dark-brown or reddish-brown fracture, the gambeers a yellow or gray fracture. Of the brown catechues, those known by the names of Ball and Lump Catechu, so named from the forms in which they are made up, are prepared from the inspissated juice of the Acacia catechu, and are the varieties most common in the British market. The Colombo catechu, often erroneously termed Columbia catechu, is in flat circular cakes, and is probably the produce of the Areca or betel-nut. The varieties known by the name of gambeers are usually met with in the form of cubical cakes, about an inch in diameter, and are chiefly obtained from the decoction of the leaves of the *Uncaria Gambir.*

All the catechues are powerful astringents, and consist essentially of tannin, and a peculiar acid called the catechuic acid. The uses of catechu in the arts are numerous, and it is now substituted in many cases for oak bark in tanning leather, steeping herring-nets, &c. The commercial *cutch,* as containing the largest proportion of tannin, is preferred for these purposes. Within the last twenty years catechu is very largely used by the dyer, for cloths, silks, and calicoes. According to the different mordants and reagents used, it gives all shades of bronze, browns, brown-grays, reddish-olive grays, brownish-yellow, &c., and has almost quite superseded madder for giving a golder coffee-brown colour.

In medicine catechu is used as an astringent for arresting mucous and bloody discharges; and is hence employed in diarrhœa, dysentery, and in some cases of chronic catarrh. It is also highly useful in ulceration of the gums and throat, and especially in that relaxation and congestion of the throat and fauces to which public speakers and singers are liable. From the government returns, it appears that for the three years ending 5th January the following were the importations of terra-japonica and cutch.

	Terra-Japonica.	Cutch.
1852	4783 tons.	2436 tons.
1853	3244 ...	2236 ...
1854	3904 ..	485 ...

CATECHUMEN, a candidate for baptism, or one who is preparing himself for receiving that rite.

In the primitive church, the catechumens were the lowest order of Christians. They were the children of believing parents, or pagans not fully initiated in the principles of the Christian religion; and were admitted to this state by the imposition of hands and the sign of the cross.

They were of four degrees, viz., those instructed privately without the church, and denied for some time the privilege of entering it; the *audientes*, or those who were admitted to hear sermons and the Scriptures read in the church, but not allowed to partake of the prayers; the *genu-flectentes*, so called because they received imposition of hands kneeling; the *competentes et electi*, the immediate candidates for baptism, or such as were appointed to be baptized at the next approaching festival. These last, after examination, were exercised catechetically during twenty days, and were obliged to fast and confess: some days before baptism they went veiled, and it was customary to touch their ears, saying, *Ephatha*, be opened, as also to anoint their eyes with clay; these ceremonies being in imitation of our Saviour's practice, and intended to shadow out their condition both before and after their admission into the Christian church.

CATEGORICAL, in a general sense, is applied to those things ranged under a CATEGORY.

CATEGORICAL, absolute, positive, express, not relative, or hypothetical; as a *categorical* proposition, syllogism, or answer.

CATEGORY, in *Logic*, a series or order of all the predicates or attributes contained under any genus. The school philosophers distributed all the objects of our thoughts and ideas into *genera*, in Greek called *categories*, and in Latin *predicaments*.

CATENARIAN CURVE. See ARCH, FLUXIONS.

CATERPILLAR, the name of all winged insects when in their reptile or worm state. See ENTOMOLOGY.

CATHARINA SANTA. See SANTA CATHARINA.

CATHARINE. *Knights of St CATHARINE of Mount Sinai*, an ancient military order, instituted for the protection of pilgrims going to pay their devotion to the body of St Catharine, a virgin of Alexandria distinguished for her learning, who is said to have suffered martyrdom under Maximin. The body of the martyr was discovered on Mount Sinai; and an order of knighthood was instituted in 1063, the members of which bound themselves by oath to guard the body of the saint, keep the roads secure, observe the rule of St Basil, and obey their grand-master. Their habit was white, and on it were represented the instruments of martyrdom by which the saint had suffered, namely, a half wheel armed with spikes, and traversed with a sword stained with blood.

ST CATHARINE *at Sienna*, *Fraternity of*, a religious and charitable society, instituted in that city in honour of St Catharine, a saint famous for her revelations, and for her supposed marriage with Jesus Christ, whose wedding-ring is preserved as a valuable relic.

CATHARTICS, medicines which promote alvine discharges; purgatives.

CAT-HEAD, a strong timber projecting from either bow of a ship, to which the anchor is raised and secured.

CATHEDRA (Latin *cathĕdra*, from κατα and ἕδρα, a seat); a chair; more particularly used to denote a professor's chair or a preacher's pulpit; and also used for a bishop's see, or throne in a church.

CATHEDRAL, the principal church in a diocese; so called from possessing the episcopal chair or throne. The term cathedra (from which cathedral is derived) was originally applied to the seats in which the bishops and presbyters sate in their assemblies, which originally were held in the rooms where the worship of the early Christians was conducted. In after times the choir of the cathedral was made to terminate in a semi-circular or polygonal apsis; and in the centre of this recess was placed the chair or throne of the bishop, as president, while seats of an inferior class for presbyters were ranged on either side. The episcopal authority did not reside in the bishop alone, but in the presbyterium as a body. Till the time of Constantine the Christians were not permitted to erect temples; and hence by *churches* they meant only to denote their assemblies, and by *cathedrals* their consistories.—(See Bingham's *Origines Ecclesiasticæ, or Antiquities of the Christian Church.*)

CATHERINE PARR, *Queen of England*. See PARR.

CATHERINE I., *Empress of Russia*, was the natural daughter of a country girl, and was born at Ringen, a small village upon the Lake Virtcherve, near Dorpt in Livonia, in 1687. Her original name was Martha, which she changed for Catherine. Count Rosen, who owned the village of Ringen, supported both the mother and the child, and was for that reason supposed to have been the father. When only three years old, by the death of her mother and Count Rosen she was left in so destitute a situation that the parish-clerk of the village received her into his house. Soon afterwards Gluck, Lutheran minister of Marienburg, took her under his protection, and employed her in attending his children. In 1701, when she had attained the fourteenth year of her age, the romance of her life began with her espousal to a dragoon of the Swedish garrison of Marienburg. According to one account, the bride and bridegroom remained together eight days after marriage; and another asserts that on the morning of the nuptials her husband was sent with a detachment to Riga, and the marriage was never consummated. This much is certain, that the dragoon was absent from Marienburg when it surrendered to the Russians, and Catherine, who was reserved for a higher destiny, never saw him more.

Upon the taking of Marienburg, General Bauer saw Catherine among the prisoners, and took her to his house, where she superintended his domestic affairs, and was supposed to be his mistress. From his house she passed into the family of Prince Menzikof, who was no less struck with the attractions of the fair captive. With him she lived until 1704; when, in the seventeenth year of her age, she became the mistress of Peter the Great, whose affections she succeeded so completely in gaining that he married her on the 29th of May 1711. The ceremony was secretly performed at Yaverhof, in Poland, in the presence of General Bruce; and on the 20th of February 1712 was solemnized with great pomp at Petersburg.

Peter expired on the 28th of January 1725. Immediately after his death, the senate and nobility assembled to proclaim his successor, and the address of Menzikof and his party, who had gained over the imperial guards and provided witnesses of Peter's expressed intentions in regard to Catherine, overcame the hesitation of some of the nobles and softened the hostility of others so as to procure the appointment of his former housekeeper on the spot. The matter having been thus successfully managed in the assembly, she next presented herself at the window to the guards and the people, who shouted "Long live

Catherine!" whilst Menzikof scattered among them handfuls of money. Thus, says a contemporary, the empress was raised to the throne by the guards, in the same manner as the Roman emperors were by the prætorian cohorts, without either the appointment of the people or of the legions.

The reign of Catherine may be considered as the reign of Menzikof; for that empress having neither inclination nor abilities to direct the helm of government, placed the most implicit confidence in a man who had been the original author of her good fortune, and the sole instrument of her elevation to the throne. During her short reign her life was exceedingly irregular; she was extremely averse to business; would frequently, when the weather was fine, pass whole nights in the open air; and was particularly intemperate in the use of tokay. These irregularities, joined to a cancer and a dropsy, hastened her end; and she expired on the 17th of May 1727, a little more than two years after her accession to the throne, and in about the fortieth year of her age.

Catherine II. Empress of Russia, whose original name was Sophia Augusta Frederica, was the daughter of Christian Augustus of Anhalt Zerbst, a small district in Upper Saxony, and was born in the castle of Zerbst on the 23d of May 1729. She was educated under the eye of her parents, along with her brother Prince Frederic Augustus, and at an early period displayed a masculine spirit. Her person was at once majestic and handsome, her complexion clear and bright, and the expression of her countenance dignified, yet tempered by a smile of beneficence. But it was early observed that under this exterior she concealed a certain austerity of disposition, and an ambition, which was even then considered as excessive, and which proved afterwards insatiable.

The Empress Elizabeth, who had pitched upon her nephew the duke of Holstein Gottorp Oldenburg as her successor, was also desirous to choose a consort for him, and the princess of Anhalt Zerbst was selected upon this occasion, when only fourteen years of age. She was chiefly indebted for this unexpected honour to the tender regard which her imperial majesty always entertained for the memory of the princess's uncle, who had been her lover; and in an evil hour she united the fate of the prince, better known afterwards by the name of Peter III. to that of the princess of Anhalt Zerbst. In consequence of a special invitation, the future empress repaired to St Petersburg, accompanied by her mother, and being admitted into the bosom of the Greek church, the ceremonial of marriage, after some delay, took place; upon which these august personages were formally acknowledged, by her imperial majesty and the senate, as Grand Duke and Duchess of Russia.

The empress hoped that the name and pretensions of Prince Iwan would be obliterated by the issue of the grand duke; and the whole empire impatiently wished for and now expected an heir to the throne of Peter the Great. But a marriage of eight years was not productive of any issue; and strange suspicions began to be entertained. This alarmed the court; for a formidable rival, who possessed a superior claim to the throne, still existed; and although he was in bondage, yet, in a country like Russia, the interval is sometimes small between a dungeon and a throne. But the birth of a son and a daughter, soon afterwards, put an end to all apprehensions of this kind, and tended not a little to give stability to the empire.

The grand duke, who at times discovered noble and even magnanimous sentiments, had about this period formed a most unfortunate connection with Elizabeth Voronsoff, a lady of high rank, but celebrated neither for her beauty nor for her talents. He seldom saw his consort in private, and all the hours which were not occupied either by military exhibitions or the pleasures of the table were entirely devoted to his mistress.

The grand duchess, on the other hand, is said to have spent much of her time in company with a young Pole, whose history, like that of Catherine's, has since been interwoven with the annals of Europe. This was Count Poniatowski, afterwards known as Stanislaus Augustus, king of Poland. He was the third son of a grandee of the same name, the favourite of Charles XII. of Sweden, by the Princess Ezatoryska, who boasted the possession of the noblest blood in Poland, as she traced her descent from the Jagellons, the ancient sovereigns of Lithuania. His person was of exquisite symmetry, his air was noble, his manners were agreeable, and his mind, a circumstance extremely rare, was not less graceful than his person. At this period he was in no higher station than that of a gentleman in the suite of the minister plenipotentiary from England, who had formed an intimacy with his family during a former mission at Warsaw. But being now taught to look higher, he returned to his native country, and appeared soon afterwards at Petersburg as ambassador from the king of Poland. In this new capacity he did not forget to pay his respects at the little court of Oranienbaum; and the young plenipotentiary, with a view of ingratiating himself with the grand duke, smoked, drank, and praised the king of Prussia. At length Paul Petrowitsch received the Polish minister with coolness, and he was actually forbidden to visit at the palace. This, however, it is said, did not deter him from concealing the order of the white eagle, and disguising himself as a mechanic, under which assumed character he repaired one summer evening to the gardens in the neighbourhood of the Gulf of Cronstadt; but he was discovered by his highness, who ordered him to be brought before him, and, after affecting to reprimand the captain of his guard for his disrespect to the representative of a crowned head, told him he was at liberty to depart.

From this moment the grand duchess is said to have changed both her system and her conduct. She had formerly aspired only to direct the counsels of the future emperor; she now resolved, if possible, to obtain the crown for her son, and the regency for herself. Such a task would have discouraged a common mind; for it was impossible to achieve it without prevailing on the empress to consent to dethrone her own nephew. But Bestuchef, the grand chancellor, who hated the heir apparent, joined cordially in the scheme; and Elizabeth, who had herself obtained the crown by means of a revolution, was taught to tremble for her life, in consequence of the designs of her successor, who was represented as having resolved to shorten her days by poison. An unexpected revolution in the ministry, however, put an end to these intrigues. Bestuchef was driven into exile, and Poniatowski was recalled.

A long and melancholy interval now ensued, during which the ambition of the grand duchess was rather suspended than annihilated. In the midst of the gloom which overspread her, however, she had recourse to, and soothed her anguish by means of, books; and it was in her closet that she laid the foundation of her future greatness, and rendered herself in some measure deserving of a throne. During her leisure moments she found means to gain partisans; and she acquired the favour of the soldiery, who did duty around her person, by means of her liberality and condescension. Peter, on the other hand, to the personal exertions of a common soldier added the orgies of a bacchanalian. Surrounded by his male and female favourites, he consumed whole days and nights in intoxication, and forgot that he was a prince. There were some few moments, however, when he appeared great, and even mag-

nanimous; but unhappily these were of short duration; and it was his misfortune to have a weak woman for his mistress, and an able and ambitious one for his wife.

Such was the situation of the court when Elizabeth died, on the 5th of January 1762. The grand duke now ascended the throne by the name of Peter III. The following answer to a letter from the king of Prussia, who had requested him to be on his guard against the plot which was then hatching, conveys no unfavourable opinion of his heart: "Touching the interest you express for my safety, I request you will rest contented. I am called the father of my soldiers; they prefer a male to a female government. I walk alone constantly in St Petersburg: if any mischief is meditated, it would have been effected long since; but I am a general benefactor. I repose myself on the protection of heaven; trusting to that, I have nothing to fear."

This false security proved his ruin. Whilst his mind was occupied with plans of reform, and he aspired to rival, nay even to excel, his illustrious predecessor, whose name he had assumed, a person who had sworn fidelity to him at the altar, and who owed him allegiance by the double ties of wife and subject, was actually employed in planning a conspiracy, and organizing a revolt against him. It has been said that he intended to have shut up his consort and son in a convent. But it is known that, so far from this being the intention of Peter, he was preparing for a journey to Holstein, and had actually empowered his consort to act as regent during his absence.

The mistakes of the emperor did not escape the penetration of his enemies. He purposed to carry his guards into Holstein, with a view to recover the possessions wrested from his ancestors. But the regiments which had hitherto done duty at the palace, and were inured to the indulgences of the capital, revolted at the idea of a foreign war; they had been accustomed to be governed by women, and they were taught to fix their eyes on the consort of the czar.

It is not the least wonderful part of her conduct, that previously to the great catastrophe now meditating, Catherine had contrived to appear abandoned by all the world. She knew how interesting a female, and more especially an empress, appeared whilst in distress; and she took care to heighten the sensibility of the public, by bursting at times into a flood of tears. This artful woman had found means to attach many persons to her destiny; it must be owned, however, that her adherents were neither so powerful nor so numerous as to afford her any well-founded hopes of success. She had gained several subalterns, and some privates, of the guards; but her principal partizans consisted of the Princess D'Aschekof, niece to the new chancellor; Prince Rozamouski, who had risen from obscurity, having been originally a peasant; Odart, an intrigueing Italian; and Panin, governor to the grand duke. The arrest of Passick, one of the conspirators, seemed to lead to a discovery which would have proved fatal to the malcontents; but this very circumstance induced them to declare instantly, and in the end crowned an apparently desperate attempt with complete success.

The empress, who was asleep at the castle of Peterhof, received intimation of their design by a common soldier, who soon afterwards returned with a carriage and eight horses. On the faith of this man, and accompanied only by a few peasants, a German female domestic, and a French valet-de-chambre, she arrived at eight o'clock in the morning in the capital, and stopped opposite the barracks of the regiment of Ismailof. There she addressed the soldiers in an eloquent speech, intermingled with sighs and tears, and actually found means to persuade them that she and her son had but that moment escaped from the hands of assassins, sent by the emperor to murder them. This story, by agitating the passions of the troops, had a wonderful effect on them; and they all swore, with the exception of only one regiment, to die in defence of her and the young archduke. Upon this the empress ordered a crucifix to be brought, and commanded the priests to administer a new oath of allegiance. She afterwards repaired to one of the principal churches, where she was met by the Bishop of Novogorod and the clergy, and, having returned thanks to Almighty God, ascended a balcony, and presented her son to the people. In a few hours she was again seen, dressed in the uniform of the guards, riding at the head of a numerous and well-appointed army against her husband.

On the first intelligence of the plot, Munich had repaired to his benefactor, and advised him to march directly to the capital, at the head of his German troops. "I shall precede you," said the generous veteran, "and my dead body shall be a rampart to your sacred person." But, on the other hand, the emissaries of the empress, bathing his hands with their hypocritical tears, deprecated resistance, magnified the danger, and invited him to repose in the inviolable fidelity of his consort. In short, on the 14th of July 1762, he was taken prisoner by the orders of his own wife, to whom he had been married fourteen years; prevailed on by the threats and intreaties of Count Panin to renounce his crown; conveyed to the castle of Robscha; and, three days afterwards, put to death. The empress, on her assumption of the crown, now rendered vacant by murder, notified the event to all the courts of Europe, under her new name of Catherine Alexiewna II. But there was still a competitor for the empire; and suspicion never slumbers near a throne. This was Prince Iwan, son of the princess of Mecklenburg, and grand nephew of Peter the Great and the empress Anna Iwanowna, who had destined him as her successor; but in consequence of a former revolution, he had been seized while yet an infant, and doomed to lead a life of captivity. During eighteen years of precarious existence, he had been shut up in the castle of Schlusselburg, and never in all that time had he breathed the open air, or beheld the sky, but once. This prince was visited by Peter III., who, finding him in an arched room twenty feet square, determined to set him at liberty; but his generous intentions were unavailing; the youth, in consequence of his long and solitary confinement, had been deprived of his senses. In this situation the emperor determined to build a house for him, with a convenient terrace, where he might take the air daily within the fortress. Such, however, are the changes of fortune, that, in three weeks, Peter himself was precipitated from a throne, and suffered a violent death. This event was but the prelude to that of Iwan; for, as orders had been given, in case of an attempt to rescue him, that an end should be put to his life, and as a real or pretended plot had been hatched for this purpose, the motives and details of which have hitherto been involved in the most profound obscurity, the unhappy prince experienced the same fate as his generous protector.

Catherine being now firmly seated on the throne, wisely determined to divert the thoughts of the nation from the late horrid scenes, and fix them upon more agreeable objects. Having soothed Prussia, acquired a preponderance in the cabinet of Denmark, which had for some time been an absolute monarchy, and entered into a league with the popular party in Sweden, not yet bereft of its liberties; she cast her eyes on Courland, then governed by Prince Charles of Saxony, the second son of Augustus III. king of Poland, and, finding that country admirably situated for the increase of her present and the extension of her future power, she, in 1762, expelled the lawful sovereign, and in-

Catherine. vested Biron, a creatute of her own, with the ducal cap. Nor was she content with this; for the new duke, soon reduced to the most abject dependence, was prevented from resigning his precarious power, and the states assembled at Mittau were actually interdicted from nominating a successor. This, however, was only a prelude to scenes of greater importance; for she had scarcely dethroned one sovereign before she undertook to create another. Augustus II., or, as he is called by some, Augustus III. of Poland, having died at Dresden in 1763, her imperial majesty did not let slip so favourable an opportunity for interfering in the appointment to the vacant throne, and even placing upon it one of her own dependents. Count Poniatowski, on the elevation of Catherine, had sent a friend to Petersburg to sound the disposition of the empress about his return to that capital, where he naturally hoped to participate in her power, and bask in the sunshine of the imperial smiles. But the more prudent German, who was at this very moment meditating a splendid provision for him elsewhere, prohibited the journey from political motives. Accordingly, notwithstanding the opposition of the grand chancellor Bestuchef, and indeed of all her ministers, she determined to invest him with the ensigns of royalty. The head of the house of Brandenburg, being swayed by his hatred to Saxony and Austria; or, what is still more likely, the Prussian eagle having perhaps, even now, scented his future prey; Catherine was enabled to send into Poland 10,000 men, who, encamping on the banks of the Vistula, overawed the deliberations of the diet, assembled on the 9th of May 1764, and placed Stanislaus Augustus on the throne.

Having thus conferred the crown of Poland on an amiable and accomplished prince, who, on account of his youth, his poverty, and even his dependence on Russia, would have been excluded from that painful pre-eminence had the free suffrages of the nation been collected, and who, in consequence of the hatred of his countrymen, was still more subjected to the dominion of the empress, she began to prepare for a war against the Turks, which was accordingly declared in 1768. During this contest the Greek cross was triumphant both by sea and land.

In the mean time a dangerous insurrection broke out in the very heart of her dominions, instigated by a Cossack of the name of Pugatschef, who pretended to be Peter III. After displaying great valour and considerable talents, which had enabled him, at the head of raw and undisciplined levies, to contend against veteran troops and experienced generals, this unfortunate man was at length seized, inclosed in an iron cage, and beheaded at Moscow on the 21st of July 1775.

On the 21st of July in the preceding year, a peace had been concluded with the porte, which proved highly honourable to Russia; but it was productive of little benefit to the latter; for the liberty of navigating the Black Sea, and a free trade with all the ports of the Turkish empire, which would have afforded inestimable advantages to a civilized people, proved of but little consequence to a nation unacquainted alike with commerce and manufactures.

Accordingly, we find her imperial majesty still unsatisfied. Scarcely had four years elapsed, when, after an armed negociation, a new treaty of pacification was agreed to by the reluctant sultan, on the 21st of March 1789, by which the Crimea was declared independent; an event not calculated to allay ancient jealousies, but, on the contrary, to produce fresh dissensions, as it afforded an opening into the very heart of the Turkish empire, and a ready pretext for future interference. New claims and new concessions immediately followed. Russia insisted on establishing consuls in the three provinces of Moldavia, Wallachia, and Bessarabia; which she was accordingly permitted to do by the treaty of 1781. But mortifying as this compliance was, it produced only a short respite. The emperor Joseph was now brought upon the political stage, and the Roman and Russian eagles, after hovering over the carcass of the Turkish empire, and meditating to devour the whole, were at last content with part of the prey. The empress, as it may be readily believed, was not inattentive to her own interests; and by the treaty of Constantinople, signed on the 9th of January 1784, the entire sovereignty of the Crimea, which then received its ancient name of Taurica, the isle of Taman, and part of Cuban, were ceded to Russia. Catherine.

Thus, in the fifty-eighth year of her age, and the twenty-fifth of her reign, Catherine may be said to have attained the very summit of her wishes. Knowing the effect of splendour upon ignorance, she ushered in the year 1787 with a brilliant journey to Cherson. Accompanied thither at once by a court and an army, with foreign ambassadors, an emperor and a king, in her train, she intended to have assumed the high-sounding titles of Empress of the East, and Liberator of Greece. At Kiow, where she remained during three months, she was received under triumphal arches; and, having heard the petitions of the deputies from distant nations, and extended the walls of that city, she inscribed in Greek characters, on the quarter next to Constantinople, "Through this gate lies the road to Byzantium."

Scarcely, however, had the empress, after visiting Moscow, returned to her capital, when the Porte thought proper to declare war. Her majesty, long prepared for an event which was far from being displeasing, called forth the stipulated succours of her ally the emperor; and the combined army under the Prince de Cobourg made itself master of Choczin after a siege of three months. Oczakow, after a still more obstinate resistance, was assaulted and taken by the Russians alone. Having concluded a final treaty of peace with the Turk on the 9th of January 1792, by which the river Dniester became the boundary of the two empires, and was to be navigated by both, the empress had more time to apply her mind to European politics. Part of Poland had been dismembered and partitioned during the year 1792; not only in contravention of the unalienable rights of nations, but in direct opposition to the most solemn treaties on the part of Russia, Prussia, and Austria. The revolution which took place in that ill-fated country on the 3d of May 1791, and which afforded the prospect of a happy and stable government to the remains of the republic, was the signal of its annihilation. The imperial and royal spoilers seized this opportunity to fall once more in concert on their prey, which was in no condition to resist this detestable confederacy; and they shared it at their pleasure. Another great object had for some time engaged the attention of Catherine. This was the French revolution. With a treasury nearly exhausted by the war with the Ottoman porte, which had not then terminated, and at a distance from the scene of action, the empress could not well engage in the contest; but she readily entered into the coalition, and soon afterwards subsidized the king of Sweden. She also launched forth a menacing manifesto against France, and prepared for a new war. Afterwards, at the instigation of Zuboff, she formed the design of giving effectual assistance to the confederated kings; and, as a proof of her intentions, issued orders for a squadron of men-of-war to join the English fleet, and commanded a levy of 60,000 troops. But she at the same time prosecuted a war on the frontiers of Persia, where her army, under the command of a near relation of the grand master of the artillery, had experienced

a most humiliating defeat; and she was now preparing to send fresh succours to his assistance.

But while the mind of Catherine was occupied with projects for the overthrow of the French republic, and the subjugation of the distant Persians, she was smitten by the hand of death On the morning of the 9th of November she rose at her usual hour, and breakfasted, according to custom, on coffee. Some time afterwards she retired to her closet; and her long absence exciting the suspicion of her attendants, they entered the apartment and found her lying speechless. Dr Rogerson, her physician, being sent for, treated her disease as apoplexy, and considerable relief seemed to ensue after the application of the lancet. But the empress never entirely recovered her senses, and did not utter a single word during the remainder of her life, which was prolonged till ten o'clock in the evening of the 10th of November 1797.

Catherine was the only sovereign of Russia who ever exhibited a taste for letters. Nor was this all. She was an author herself, and did not disdain to compose little treatises for her grandchildren, whose education she superintended. She also possessed an exquisite relish for music, and brought Gabrielli and a number of singers of great note from Italy, allowing them liberal salaries, and treating them with great attention. Throughout the whole of her long reign Catherine also evinced a marked predilection for painting. In the midst of a war with the Turks she purchased pictures in Holland to the amount of 60,000 rubles, all of which were lost by the ship which carried them being wrecked on the coast of Finland. This, however, served rather to stimulate her to fresh exertions, and her agents accordingly procured whatever was to be found in Italy worthy of notice. The Houghton collection from England was also transferred, by an act of her munificence, to the shores of the Baltic; and, whilst it added to her glory, lowered this nation in the eyes of foreigners. Her conduct to learned men was truly worthy of a woman of genius. She was proud of the correspondence and friendship of Voltaire; she invited Diderot to her court, and lived with him while there in habits of the utmost familiarity; to D'Alembert she looked up as to a superior being, and endeavoured, although in vain, to induce him to fix his residence at St Petersburg. Her political character has been variously estimated; and no sovereign of modern times has attracted a greater share of censure and eulogium than Catherine. As a female she appears at times the slave of lust and the puppet of her courtiers; as a sovereign we behold her towering like an immense colossus, with one foot placed on Cherson, and another on Kamtschatka, waving her iron sceptre over the subject nations, and regulating the destiny of a large portion of mankind. The world, however, shudders at the untimely fate of Peter and of Iwan, and posterity will not easily pardon the partition of Poland and the massacres of Ismailof and of Praga.

Catherine, *St, Order of*, appropriated to ladies only, was instituted in 1714, by Catherine, wife of Peter the Great, in memory of his signal escape from the Turks in 1711. Its emblems are a red cross supported by a figure of St Catherine, and fastened to a scarlet string edged with silver, inscribed with the name of St Catherine and the motto *Pro fide et patria*.

CATHETER, in *Surgery*, a tube, usually of silver, which may be introduced by the urethra into the bladder, to draw off the urine when the natural discharge is suppressed.

CATHETUS, in *Geometry*, a line or radius falling perpendicularly on another line or surface; as the two sides of a right-angled triangle.

Cathetus *of Incidence*, in *Catoptrics*, a right line drawn from a point of the object, perpendicular to the reflecting line.

Cathetus *of Reflection*, or *of the Eye*, a right line drawn from the eye, perpendicular to the reflecting plane.

Cathetus *of Obliquation*, a right line drawn perpendicular to the speculum, in the point of incidence or reflection.

Cathetus, in *Architecture*, a vertical line supposed to pass through the centre of a cylindrical body.

CATHOLIC, universal or general; also liberal, not bigoted.

Catholic *Church*. The rise of heresies induced the primitive Christian church to assume the appellation of *catholic*, to distinguish itself from all sects, who, though they had party names, sometimes sheltered themselves under the name of Christians.

This epithet is now appropriated by the Romish Church; but strictly, there is no Catholic church, there being no universal Christian communion.

Catholic *King*, a title which has long been hereditary to the king of Spain.

CATILINA, Lucius Sergius, a Roman of a noble family, who, after ruining his fortune by debauchery and excesses of every kind, formed the design of destroying the senate, assassinating the consuls, seizing the public treasury, setting fire to Rome, and usurping sovereign power. In order to prosecute this design, Catiline associated in his plot some young noblemen, whom he prevailed upon, it is said, to drink human blood as a pledge of their union. His conspiracy, however, was discovered by the vigilance of Cicero, who was consul at the time; upon which Catiline retired from Rome, and having raised an army, fought with the utmost valour against Petreius, lieutenant to Antony, Cicero's colleague in the consulship. In this battle Catiline was defeated and killed, B.C. 62. The history of Catiline's conspiracy has been written by Sallust. See Roman History.

CATMANDOO, or Khatmandu, a city of Northern Hindustan, capital of the Nepaul country, and the residence of the Goorkhali rajah. It is situated in a romantic valley of Nepaul proper, on the E. bank of the Bishenmutty river, 40 miles S. of the Himalaya Mountains, and about 150 N. of the British possessions. It extends about a mile along the river, and is at its greatest breadth about half a mile; but in general it does not exceed a quarter of a mile. The houses, which are of two, three, and four stories, are of brick, with pent roofs, and have a mean appearance. The streets are narrow and filthy, as in other eastern towns. The temples are almost as numerous as the houses. The greater part are of wood, but several are brick and stone. The Brahminica religion is professed in all these. It possesses an ancient temple dedicated to Boodh, which is highly celebrated among the Tartars, and a great resort of pilgrims. It is built of stone, and consists of three lofty pyramids with two square apartments. It is of great antiquity, having been erected when Nepaul was in possession of the Thibetians. The possession of this temple has been always claimed by the sovereign pontiff, the Dalui Lama, on the ground of its having been in the possession of his predecessors from time immemorial; but in consequence of disputes the Lama's vicar was obliged to retire, and it is now held by a legate of the ruler of Bootan, who is a Boodhist. The city has markets supplied with every convenience. and is estimated to contain 50,000 inhabitants. Long. 85 18. E., Lat. 27. 42. N.

CATO, Marcus Portius, the Censor, sometimes styled Cato Major, one of the greatest men among the ancients, was born at Tusculum in the year B.C. 234. He began to bear arms at seventeen, and on various occasions signalized himself by his valour and military abilities. He was a man of great sobriety, and reckoned no bodily exercise unworthy of him. He had but one horse for himself and his baggage, and he looked after and dressed it himself. On his return from his campaigns he betook himself to plough his farm;

not that he was without slaves to do it, but because such was his inclination. He also dressed like his slaves, sat at the same table with them, and partook of the same fare. He did not in the meanwhile neglect to cultivate his mind, especially in regard to the art of speaking; and he employed his talents, which were of a very high order, in generously pleading causes in the neighbouring cities without fee or reward. Encouraged by Valerius Flaccus, a young nobleman who had a country seat in the neighbourhood, Cato went to Rome, where, not less by his own merits than by the influence of his patron, he soon attracted public notice. He was first elected tribune of the soldiers for the province of Sicily; and he was next made quæstor in Africa under Scipio. Having in this last office reproved the general for his profuseness to his soldiers, the latter answered that he would make war at what expense he pleased; nor was he to give an account to the Roman people of pelf, but of his enterprises, and the execution of them. Cato, provoked at this answer, left Sicily and returned to Rome.

In B.C. 198 he was made prætor, and fulfilled the duties of that office with the strictest justice. He conquered Sardinia, governed with admirable moderation, and in 195 was created consul. He carried on war in Spain with such success, that on his return he was honoured with a triumph. As tribune in the war of Syria, he gave distinguished proofs of his valour against Antiochus the Great, and contributed materially to the decisive victory at Thermopylæ. He now for the second time stood candidate for the office of censor. But the nobles, who not only hated him as a *new* man, but dreaded his severity, set up against him seven powerful competitors. Valerius Flaccus, who had introduced him into public life, and had been his colleague in the consulship, was a ninth candidate; and these two united their interests. On this occasion Cato, far from courting the favour of the people by insinuating speeches, or giving hopes of gentleness or complaisance in the execution of his office, loudly declared from the rostra, with a threatening look and voice, that the times required firm and vigorous magistrates to put a stop to that growing luxury which menaced the republic with ruin; censors who would cut up the evil by the roots, and restore the rigour of ancient discipline. It is to the honour of the Roman people that, notwithstanding these startling intimations, they preferred Cato to all his competitors who courted them by promises of a mild and easy administration. The comitia also appointed his friend Valerius his colleague, without whom he had declared that he could not hope to compass the reformations he proposed. Cato's merit, indeed, was superior to that of any of the great men who stood against him. He was temperate, brave, and indefatigable; frugal of the public money, and wholly incorruptible. There is scarcely any talent requisite for public or private life which he had not received from nature, or acquired by industry. He was a great soldier, an able statesman, an eloquent orator, a learned historian, and skilful in rural affairs. Yet with all these accomplishments he had very great faults. His ambition, being poisoned with envy, disturbed both his own peace and that of the whole city as long as he lived. Though he refused to take bribes, he was utterly unscrupulous in amassing wealth by all means which the law did not punish as criminal.

To the nobles and their wives, no part of the censor's conduct seemed so obnoxious as the taxes he laid upon luxury in all its branches, including dress, household furniture, women's toilets, chariots, slaves, and equipage. The people, however, were in general pleased with his regulations; insomuch that they ordered a statue to be erected to his honour in the Temple of Health, with an inscription which mentioned nothing of his victories or triumphs, but imported only, that by his wise ordinances in his censorship he had reformed the manners of the republic. Plutarch relates that before this, upon some of Cato's friends expressing their surprise that when many persons without merit or reputation had statues, he had none, he answered, "I had much rather it should be asked why the people have not erected a statue to Cato than why they have." Cato was the chief instigator of the third Punic war. Being despatched to Africa to terminate a difference between the Carthaginians and the king of Numidia, on his return to Rome he reported that Carthage had grown excessively rich and populous, and warmly exhorted the senate to destroy a city and republic during whose existence Rome could never be safe. Having brought from Africa some very large figs, he showed them to the conscript fathers in one of the lappets of his robe. "The country," says he, "where these figs grew, is but three days' voyage from Rome." We are told that from this time he never spoke in the senate upon any subject without concluding with these words, "Carthage must be destroyed." He judged that for a people enervated by prosperity nothing was more to be feared than a rival state, always powerful, and now, from its misfortunes, grown wise and circumspect. He held it necessary to remove all dangers that could be apprehended from without, when the republic had within so many distempers threatening her destruction.

Cato died in the year B.C. 149, aged eighty-five. He was twice married; first to Licinia, a lady of noble birth, who bore one son; and in his old age he espoused Salonia, the youthful daughter of his scribe and client M. Salonius, by whom in his eightieth year he had a son, who was the ancestor of Cato of Utica.

Of Cato's several works the most important was that entitled *Origines*, a history of Rome, of which only fragments are extant. His treatise on husbandry, *De Re Rustica*, has been preserved. The best editions of it are those contained in the *Scriptores Rei Rusticæ* of Gesner (Lips. 1773–4); and Schneider (Lips. 1794–7).

CATO, *Marcus Portius*, or *Cato of Utica*, was great-grandson to Cato the Censor. It is said that from his infancy he discovered, by his speech, his countenance, and even by his childish sports and recreations, an inflexibility of mind; for he forced himself to execute whatever he had undertaken, though the task was ill suited to his strength. He was equally rude to those who flattered and to those who menaced him; he was rarely seen to laugh, or even to smile, and not easily provoked to anger; but if once incensed he was scarcely to be pacified. Sylla, who had conceived a friendship for the father of Cato, sent often for him and his brother, and talked familiarly with them in presence of the boy. Cato, who was then about fourteen years of age, seeing on one occasion the heads of several persons brought in, and observing the suppressed agitation of those who were present, asked his preceptor "why does nobody kill this man?" "Because," said the other, "he is more feared than he is hated." The boy replied, "why then did you not give me a sword when you brought me hither, that I might have stabbed him and freed my country from this slavery?"

On the death of his father, under Antipater of Tyre, he applied more rigorously to the study of the Stoic philosophy, the principles of which so well suited the inflexibility of his character; and made considerable proficiency in declamation, which he regarded as a necessary means of defending the cause of justice. To increase his bodily strength, he inured himself to suffer the extremes of heat and cold; and used to make journeys on foot and bare-headed in all seasons. When he was sick, patience and abstinence were his only remedies; he shut himself up, and would see nobody till he became well. The only exception to his usual abstinence was made in favour of the philosophers, at whose entertainments it is said he acquired information at the expense of a habit of drinking freely, and sitting at table

till morning. He affected singularity; and, in things indifferent, sought to act directly contrary to the taste and fashions of the age. Magnanimity and constancy are generally ascribed to him; and Seneca makes that haughtiness and contempt for others which in Cato accompanied those virtues, a subject of praise. He served as a volunteer under Gellius Poplicola, in the war of Spartacus; and when military rewards were offered him by the commander he refused them, because he thought he had no right to them. Some years afterwards he went a legionary tribune into Macedonia under the pro-prætor Rubrius; in which station he appeared, in dress, and during a march, more like a private soldier than an officer: but the dignity of his manners, the elevation of his sentiments, and the superiority of his views, set him far above those who bore the titles of generals and pro-consuls.

Cato laboured to bring about a reconciliation between Cæsar and Pompey; but seeing that all his efforts were in vain he took part with the latter. When Pompey was slain he fled to Utica; and being pursued by Cæsar, advised his friends to go and throw themselves on the clemency of the conqueror. His son, however, remained with him; and also Statilius, a young man, remarkable for his hatred of Cæsar. The evening before the execution of the purpose he had formed with regard to himself, after bathing he supped with his friends and the magistrates of the city. They sat late at table, and the conversation was lively. The discourse falling upon this maxim of the Stoics, that the wise man alone is free and that the vicious are slaves, Demetrius, who was a Peripatetic, undertook to confute it from the maxims of his schools. Cato, in answer, treated the matter very amply, and with so much earnestness and vehemence of voice that he betrayed himself, and confirmed the suspicion of his friends that he designed to kill himself. When he had done speaking, a melancholy silence ensued; which was broken by Cato, who turned the discourse to the present situation of affairs, expressing his concern for those who had been obliged to put to sea, as well as for those who had determined to make their escape by land and had a dry and sandy desert to pass. After supper, the company being dismissed, he walked for some time with a few friends, and gave his orders to the officers of the guard; and going into his chamber he embraced his son and his friends with more than usual tenderness, which further confirmed the suspicions of the resolution he had taken. He then laid himself down on his bed, and took up Plato's Dialogue on the Immortality of the Soul. Having read for some time, he looked up, and missing his sword, which his son had removed while he was at supper, he called a slave and asked who had taken it away; and receiving an evasive reply he resumed his reading. Some time afterwards he asked again for his sword, and without showing any impatience ordered it to be brought to him; but having read out the book, and finding nobody had brought him his sword, he called for all his servants, upbraided them sternly, and struck one of them on the mouth with so much violence as to hurt his own hand, crying out in a passionate manner, "What! do my own son and family conspire to betray me and deliver me up naked and unarmed to the enemy?" Immediately his son and friends rushed into the room, and began to lament, and to beseech him to change his resolution. Cato raising himself, and looking fiercely at them, "How long is it," said he, "since I have lost my senses, and my son is become my keeper? Brave and generous son, why do you not bind your father's hands, that when Cæsar comes he may find me unable to defend myself? Do you imagine that without a sword I cannot end my life? Cannot I destroy myself by holding my breath for some moments, or by striking my head against the wall?" His son answered with his tears, and retired. Apollonides and Demetrius remained with him; and to them he addressed himself in the following words: "Is it to watch over me that ye sit silent here? Do you pretend to force a man of my years to live? or can you bring any reason to prove that it is not base and unworthy of Cato to beg his safety of an enemy? or why do you not persuade me to unlearn what I have been taught, that rejecting all the opinions I have hitherto defended I may now, by Cæsar's means, grow wiser, and be yet more obliged to him than for life alone? Not that I have determined anything concerning myself; but I would have it in my power to perform what I shall think fit to resolve upon; and I shall not fail to ask your counsel when I have occasion to act up to the principles which your philosophy teaches. Go tell my son that he should not compel his father to what he cannot persuade him." They withdrew, and the sword was brought by a young slave. Cato drew it, and finding the point to be sharp, "Now," said he, "I am my own master." Laying down the sword, he took up his book again, which it is reported he read twice over. After this he slept soundly; but about midnight he called two of his freedmen, Cleanthes his physician, and Butas, whom he chiefly employed in the management of his affairs. The last he sent to the port to see whether all the Romans were gone; to the physician he gave his hand to be dressed, which was swelled by the blow he had given his slave. This circumstance was regarded as an intimation that he intended to live, and gave great joy to his family. Butas soon returned, and brought word that they were all gone except Crassus, who had staid upon some business, but was just ready to depart. He added that the wind was high and the sea rough. These words drew a sigh from Cato. He sent Butas again to the port to know whether there might not be some one who, in the hurry of embarkation, had forgotten some necessary provisions, and had been obliged to put back to Utica. It was now break of day, and Cato slept yet a little more, till Butas returned to tell him that all was perfectly quiet. He then ordered him to shut the door, and flung himself upon his bed, as if he meant to finish his night's rest; but immediately he took his sword and stabbed himself a little below his chest; yet not being able to use his hand well, for it was still swelled, the blow was not fatal. It threw him into a convulsion, in which he fell from his bed, and overturned a table near it. The noise gave the alarm; and his son and the rest of the family, on entering the room, found him weltering in his blood, and his bowels half out of his body. The surgeon found, upon examination, that his bowels were not cut, and was preparing to replace them and bind up the wound when Cato recovered his senses, thrust the surgeon from him, and tore out his own bowels. He immediately expired. Thus died Cato, in the forty-eighth year of his age.

CATOPTRICS is that part of optics which explains the properties of reflected light, and particularly that which is reflected from mirrors. See Optics.

CATOPTROMANCY (κάτοπτρον a mirror, and μαντεία divination), a species of divination among the ancients by means of a mirror. Pausanias says, that among the Achaians if a person were sick he let down a mirror by a thread into a fountain before the temple of Ceres, and looking in the glass, if he saw a distorted ghastly face he regarded it as an ill omen; but if the face appeared fresh and healthy it was a token of recovery.

CATRINE, a manufacturing village of Scotland, county of Ayr, and parish of Sorn, on the Ayr, two miles S. by E. of Mauchline. It is indebted for its importance to the cotton manufacture established here in 1786. Extensive bleaching-works have also been established here. Pop. of parish (1851) 4174.

CATROU, François (1659-1737), a learned Jesuit, was born at Paris, and after officiating as a preacher, engaged for twelve years in conducting the *Journal de Trévoux*. Besides his contributions to it, he wrote a history of the

Mogul empire, and a history of Rome in which he was assisted by Father Rouillé, who afterwards wrote a continuation of the latter work.

The titles of his works are, 1. *Histoire Générale du Mogol*, 1705, 4to, with *L'Histoire du Regne d'Aurengzeb*, 1715; 2. *Histoire du Fanatisme dans la Religion Protestante, contenant l'Histoire des Anabaptistes, du Davidisme, et des Trembleurs*, Paris, 1733, 3 vols. 12mo; 3. *Traduction de Virgile*, with notes critical and historical, 1729, 4 vols. 12mo; 4. *Histoire Romaine*, 1725-37, 21 vols. 4to.

CATSKILL, a town in the state of New York, capital of Greene county, on the W. side of the Hudson, 32 miles S. of Albany. It stands on both sides of the Catskill creek near its junction with the Hudson, and has some handsome buildings, and a considerable trade. Pop. (1851) 5454.

CATSKILL MOUNTAINS, in the vicinity of the above, bend in the form of a crescent round the Mohawk river; the loftiest peak rising to the height of 3804 feet above tide-water. On the east they are precipitous, but on the west side the descent is comparatively gentle. Many of the wild animals indigenous to the state are still to be found here.

CATTARO, the southernmost of the circles into which the Austrian kingdom of Dalmatia is divided. It is surrounded, except on the sea frontier, by the Turkish dominions, and comprehends the district distinguished as the Bocca di Cattaro. It extends over 585 square miles, or 374,400 English acres, and contains about 40,000 inhabitants. Although corn sufficient for the consumption of five months only is raised, it has a considerable export trade in oil, wine, figs, silk, wool, tallow, wax, honey, and fish. The import trade is conducted chiefly with the Montenegrins and the Turks of the adjoining frontier.

CATTARO, the capital of the above district, is situated on the Bocca di Cattaro, and is strongly fortified both by sea and land. It is the seat of a Catholic bishop, and contains, besides the cathedral, a Catholic collegiate church, a Greek church, and fifteen convents. Though the Romans had a colony at Cattaro, the existence of the present town cannot be traced beyond the sixth century. Cattaro has twice suffered severely from earthquakes, once in 1563, and again in 1667. For some time previous to the treaty of Tilsit the town had been occupied by the Russians. The harbour is good, and capable of accommodating vessels of the largest size. But its trade is now by no means so extensive as it once was. Pop. 4500. E. Long. 18. 47.; N. Lat. 42. 25.

CATTEGAT, an extensive channel or strait lying between Jutland and Sweden, and bounded on the south by the Danish islands of Zealand and Funen. See BALTIC SEA.

CATTI, or CHATTI, a powerful and warlike German nation, who, though defeated by Drusus, Germanicus, and other Roman generals, were never wholly subjugated. Their territory extended from the Weser on the east to the Rhine on the west, and was bounded on the south by the Agri Decumates. Their capital was Mattium, now Maden.

CATTOLICA, a town of Sicily, in the intendancy of and 15 miles N.W. of the town of Girgenti. Pop. 7200. In the vicinity there are extensive sulphur mines.

CATULLUS, CAIUS VALERIUS, a celebrated Roman poet, born at Verona in the year B.C. 87. Though he inherited at least a comfortable independence, his fortune was greatly impaired by his dissipated manner of living in the metropolis. With a view to improve what remained, he visited Bithynia in the train of the prætor Memmius, but with little success. On his return he resided alternately in Rome and at his villas on the promontory of Sirmio and at Tibur. His great merits as a poet procured for him the esteem of Cicero and many other celebrated men of his time. Julius Cæsar was a frequent guest at his father's house; and although the poet ventured, from some temporary cause of irritation, to lampoon that illustrious man, an apology at once effected their reconciliation. Catullus appears to have died in B.C. 47, in the thirtieth year of his age. His extant works comprise 116 poems, including lyrics, elegies, epigrams, and his finest poem on the nuptials of Peleus and Thetis. From his intimate acquaintance with Grecian literature, he is styled *doctus* by Tibullus, Ovid, and others. Original invention and felicity of expression are the peculiar characteristics of Catullus, who may be said to have adorned everything he touched; but the licentiousness of the man is too frequently reflected in his works. Editions—by Aldus, Ven. 1502; Vossius, Lond., 1684; Volpi, Patav., 1710; Doering, Altona, 1834, 2d ed.; Lachmann, Berol., 1829. The best metrical translation into English is that of the Hon. George Lamb, Lond., 1821, 2 vols. 12mo.

CATZ, JACOB, a distinguished Dutch civilian and poet, was born at Brouwershaven in Zealand, in 1577. After residing some time in Leyden and France, he settled at Middleburg, and acquired by his pleadings such reputation that the city of Dort chose him as its pensionary; and some time afterwards Middleburg followed its example. In 1634 he was nominated pensionary of Holland and West Friesland, and in 1648 he was elected keeper of the seal of the same state, and stadtholder of the fiefs; but he soon resigned these offices in order to enjoy the repose which his advanced age demanded. As the post of grand pensionary had been fatal to almost all those who had held it, from the beginning of the republic till that time, Catz delivered up his charge upon his knees, before the whole assembly of the states, weeping for joy, and thanking God for having preserved him from the dangers which seemed attached to the duties of that office. But though he was resolved to spend the rest of his days in retirement, the love of his country induced him to comply with the desires of the states, who importuned him to go on an embassy to England at the delicate conjuncture when the republic found itself compromised during the protectorate of Cromwell. On his return he retired to Sorgvliet, where he lived in tranquillity till the year 1660, when he died. He wrote a great number of poems in Dutch, of which the most esteemed are his *Emblems* and *Country Life*. They have often been reprinted; and from their simple gaiety and morality of tone are highly valued by his countrymen.

CAUBUL. See CABUL.

CAUCASUS, a vast chain of mountains extending across that isthmus of Western Asia which is bounded by the Black Sea on the west and by the Caspian on the east. Commencing near the mouth of the river Kouba, which falls into the Euxine, it proceeds in a south-easterly direction, gradually increasing its distance from that sea, and then turning towards the east traverses Mingrelia and Imeritia. Approaching the source of the river Kouma, a ridge diverging to the south enters Georgia near the origin of the Kur, which rises in the mountains of Kars, while the main chain, advancing to the western shores of the Caspian, proceeds through the provinces of Daghestan and Shirvan, once belonging to Persia, but now nominally under the government of Russia. Here penetrating Ghilan, it is connected in a continued chain by the mountains of Mazanderan and the Paropamisan with the Hindu Koh or Indian Caucasus, a part of the great Himalaya range. Finally, taking a south-eastern direction, it terminates at the peninsula of Apsheron, which runs out into the Caspian Sea. It is also connected by means of a secondary range near the Black Sea with the mountains of Ararat; while the spurs which are thrown out from the main ridge towards the north are gradually lost in the immense steppes of southern Russia. The length of the whole chain from the mouth of the river Kouba to the peninsula where it terminates, is estimated at from 650 to 700 miles. The breadth from Mosdok to Tiflis is computed at 180 miles; but, with its various parallel chains and ramifications, the average cannot exceed 140 miles.

The Caucasian chain consists of mountains rising to a great elevation, some covered with forests, others bare and arid; while the summits of many are covered with perpetual snow. Their geological structure is very various. A considerable portion of the elevated region consists of white limestone, behind which are higher ridges of black slate. The most lofty mountain peaks are composed of basalt, granite, schistus, porphyry, and the more ancient formations. The mountains to the east of Elburz reach a much greater altitude than those which are situated between it and the Black Sea, towards which they gradually decline, terminating in a series of hills of very moderate elevation. Many of those parts of the Caucasian chain which reach the greatest altitude are exceedingly craggy and precipitous, and cannot be traversed without great danger at any season of the year; the narrow path by which the traveller is compelled to proceed often leading immediately over precipices of immense height, guarded by rocky walls which hang threateningly overhead. In some directions, immense masses of mountain present the appearance of having been rent asunder by some dreadful convulsion of nature. Numerous cataracts rush with a thundering noise over the abrupt precipices into the abysses below, from which they descend to the more level portions of the country. In other parts, the mountains stretch out into level plains; and many of the intervening valleys overhung by these immense precipices are remarkable for their fertility and beauty.

The Beshtau (corrupted from Besh Dagh, *i. e.*, the five mountains), or mountains of Pyätigorsk, situated to the S.W. of Georgiefsk, form, as it were, the advanced post of the great Caucasian chain. They are connected with it by means of a ridge which proceeds in a south-easterly direction between the rivers Kouma and Kouba, gradually increasing in elevation until it joins the Elburz, the loftiest mountain of the whole chain. The highest of the two conically shaped summits of the Elburz is said to reach an altitude of nearly 18,000 feet. Among the mountain tribes, whose superstitious faith represents its hollows and caverns as the entrance to the abode of the Peris, or fairies of eastern mythology, it is known by the name of Dshin Padishah, or king of spirits. North-west from the Elburz, the Pelav-Tepesh, the Oshten, the Idokopas, and the Shapsuch, are the highest mountains on the eastern coast of the Black Sea. In a south-eastern direction near the great Georgian military road, is the lofty Kasbek, which is considered to form the central point of the Caucasian range. At the foot of the snow-covered Krestovaya, or mountain of the cross, is the post station of Kobi, not far from which is the hamlet of Baidar, inhabited by the Ossetes, whose only duty is to assist such travellers as may have gone astray during the alarming snow-storms by which these elevated regions are so often visited. Between the Kasbek and the peninsula of Apsheron, one of the most remarkable mountains is the Besh Parmak Dagh, or mountain of the five fingers, so named from its peculiar form, which rises to a considerable height close to the Caspian Sea. The communication between Russia and its Transcaucasian provinces is maintained by means of two narrow passes or defiles. The most important is that of Dariel, known to the ancients under the name of the Caucasian Gates, through which the northern barbarians formerly made their way into the fairer regions of Asia Minor, and the great Georgian military road used by the Russians for the conveyance of troops, war-stores, and merchandise now proceeds. In some parts of this dangerous pass situated far above the line of snow, the narrow path leads immediately over the most fearful precipices and through rugged defiles such as the traveller meets with nowhere amid the most mountainous regions of Europe. All communication along this road is frequently stopped for weeks together by a sudden fall of snow, or the descent of an avalanche. The Caspian pass, formerly known as the Albanian Gates, is situated between the Caspian Sea and the precipitous rocks crowned by the Russian fortress of Derbend. The road which proceeds through this pass, leading from the town of Kislyar to that of Bakou, is connected by a third, which joins Yekaterino-gradskaya and Kislyar with the great Georgian road. The communication between the forts on the coasts of the Black and Caspian Seas is maintained by means of steam ships and small war vessels named Barkasses, which are propelled either by sails or oars.

Although a great number of mountain streams have their origin in the Caucasus, most of them are only insignificant tributaries by which the principal rivers are fed. The Kur, anciently the Cyrus, which takes its rise in the mountains of Kars, and directs its course through the middle of Georgia to the Caspian Sea, is the largest of the Transcaucasian rivers. From the northern declivity of the Caucasian range, the Terek, rising at the foot of Mount Kasbek, and rushing through the pass of Dariel, proceeds to the same destination. The Kouba which has its origin in the marshes on the north-western declivity of the Elburz, after sending two branches to the Sea of Azof, falls into the Black Sea. Along the Kouba, the Malka, and the Terek, is that great line of forts and Cossack stations extending almost without interruption from the Caspian to the Black Sea. The climate of the Caucasian countries, although generally speaking salubrious, is very various. The mountain tops covered with snow may be seen from valleys, gardens, and orchards, in which the most beautiful flowers and the richest fruits are growing. Into some districts, such as Imeritia and the neighbourhood of Derbend, the stranger who is unaccustomed to the peculiar nature of the climate cannot enter without great risk. The natives of the districts bordering upon the Black and Caspian Seas frequently suffer from severe fevers caused by their exposure to the pestilential exhalations rising from their marshy banks, and the unhealthy sea winds and mists which often prevail. Georgia, Mingrelia, Abasia, and the north of Daghestan, are all said to possess an excellent climate. In many parts the inhabitants of the plains are compelled to take refuge in the mountains during the heat of summer, while the mountaineers during the severity of winter descend with their flocks to the valleys. The vegetation of these regions, which differs in no respect from that usually seen in the two temperate zones, is at once various and abundant. Immense forests of pine and fir, often reaching an elevation of nearly 8000 feet, crown the mountain heights. The declivities and valleys are distributed into orchards, vineyards, corn fields, and pastures in rich variety. Grapes, chestnuts, figs, peaches, as well as grain of every description, rice, cotton, hemp, &c., grow in great abundance all over the country. The fruit trees generally attain a height and thickness which astonish the traveller from the most fertile regions of Europe. Among the natural productions of the Caucasus may be mentioned nitrate of potass, mineral pitch, and the hot sulphur springs which are found in different parts of it. The Ghebers, or fire worshippers, still perform the ceremonies of their faith in presence of the "eternal fires," which burn on the peninsula of Apsheron. These fires are not produced, as described in the works of earlier travellers, by the naphtha with which the soil is impregnated, but, according to M. Eichwald of Wilna, "by hydrogen gas (probably carburetted hydrogen) which rises through cracks and openings of the calcareous rocks, and on the approach of a flame takes fire, and continues to burn. It never takes fire spontaneously, nor by the approach of red coal, if not burning with flame. The gas, as it escapes from the rock, is without smell—is not sensibly warm—and on being respired does not occasion any disagreeable feeling. It burns with a yellowish-white flame, and forms with atmospheric air an exploding gas."

Caucasus.

The Caucasian territory, which nominally forms one of the provinces of Russia, is bounded on the north by the rivers Kouba and Kouma, on the south by the Araxes, on the west by the Black Sea, and on the east by the Caspian Sea. It formerly consisted of the provinces of Georgia, Imeritia, Mingrelia, Circassia, Daghestan, Shirvan, and Caucasia. Its two principal divisions at present under the Russian government are the Caucasian province, of which Stavropol is the capital, and Transcaucasia, in which the principal city is Tiflis, the capital of Georgia. By an imperial ukase issued in the year 1846, Transcaucasia was further divided for the administration of its affairs into the four governments of Derbend, Shemaka, Kutaïs, and Tiflis. The principal tribes inhabiting the Caucasus are the Georgians, Imeritians, and Mingrelians of the race of Kartvel, the Misdsheghi or Kists, the Lesghians, the Turks or Tatars, the Armenians, the Abasians, the Tscherkessi or Circassians, called by themselves Adighé, the Kabardians, and the Ossetes, besides a great number of Jewish and Cossack settlers. Several of the tribes, particularly the Circassians, Georgians, and Imeritians, are accounted the handsomest people in the world, the men being generally tall and powerful, the women slender and graceful, and both having regular features and expressive eyes. The Lesghians who inhabit a great portion of Daghestan or the mountain land, are one of the most warlike, chivalrous, and independent of the Caucasian races. The Suanians, who possess one of the loftiest inhabited valleys of the range, are remarkable for their physical strength and agility. The Mingrelians are said to be the descendants of the ancient Colchians. The Abasians and Ossetes are described as the rudest of the mountain tribes. With dark complexions and irregular features, the former have generally a very repulsive expression of countenance, emblematic of their moral and social inferiority. All the inhabitants of these countries are exceedingly fond of adorning their persons; and the traveller is often struck by the appearance of a splendidly equipped cavalier issuing from a cottage of the most miserable description. The Circassian and Georgian females are much sought after by the eastern princes, to whom they are sold even by their fathers and brothers. Most travellers assert that, with the exception of those parts of the country in which the principal races dwell, it is utterly impossible to determine the territorial boundaries of the Caucasian tribes. The state of religion amongst them is equally unsettled and perplexing. Many profess Christianity in a form which retains few or none of its distinctive principles, others are bigoted Mohammedans, and the remainder idolaters. The nobles sometimes profess one form of religion, and the great body of the people another. Many of the old Christian temples, which remain to this day in several districts, contain at the same time the emblems of Christianity in the images of the Virgin and the saints, of Mohammedanism in inscriptions from the Koran, and of idolatry in the idols to whom they bow.

Trade and commerce.

The trade and commerce of the Caucasian provinces are mostly in the hands of the Armenians, who inhabit the various districts of the country, but particularly that of Derbend on the shores of the Caspian. The inhabitants of Daghestan, so celebrated for its warlike and independent tribes, are also very enterprising in their commercial undertakings. In addition to weapons of various kinds, in the manufacture of which they excel, they produce cloth, silk, and beautiful silver work. The Abasians dispose of considerable quantities of a peculiar kind of honey, which, from its intoxicating influence, the Mohammedans are said to use instead of wine. Saltpetre is produced in a very curious manner in Suanethi. A portion of land which has been protected against the influence of snow or rain is covered on the approach of frost with great quantities of it. The inhabitants of this district also dig from the lower regions of Mount Elburz considerable quantities of sulphur, from which they produce gunpowder for sale among the neighbouring tribes. In the valleys of the Kur, the Phasis, the Alasau, and the Yora, the vine is cultivated with much success. The wine of Kakhetie, which is said to resemble that of Burgundy, is particularly celebrated for its excellence. In some of the Russian provinces the mulberry tree and the cotton plant are cultivated with great profit. The sugar-cane has been successfully introduced into the khanate of Talisch. Madder, saffron, rice, millet, barley, Indian corn, wheat, and tobacco, are among the principal articles of export.

The nations of the Caucasus, whose history has been regarded with the deepest interest in modern times, are the Lesghians and Circassians. The Lesghians inhabit the greatest part of Daghestan, which is bounded on the east by a chain of mountains running parallel with the coast of the Caspian, and penetrated in every direction by lofty and rugged spurs from the main chain. The Circassians occupy the mountain territory extending between the river Kouba and the Black Sea. The attempted conquest of these provinces, to which the Russians can lay no claim except that of the stronger over the weaker, has already cost them an immense amount both of blood and treasure. Especially since the year 1829, when by the treaty of Adrianople the Turks delivered over to the Muscovites a region over which they never possessed any sovereignty, the Russian armies have been completely baffled in all their attempts to establish the authority of the czar. The Russians have had to encounter immense difficulties, to traverse dangerous passes, to burn down forests, and to sacrifice immense numbers of lives, in order to gain small portions of territory. The war was for a long time chiefly maintained by the Circassians under their native chiefs; and no sooner did their exertions relax in consequence of the exhaustion caused by a long-continued contest, than a new enemy to Russia arose on the shores of the Caspian. Schamyl, the most devoted follower of the heroic Kasi Mullah, placed himself, on the death of that chief, at the head of the Lesghians. At once the prophet and the warrior of his race, by his enthusiasm and bravery he soon gained the confidence of the tribes, and prevailed upon them to follow a united and determined plan of action under his authority. His influence was daily increased, not only by the victories which he gained, but by the successful manner in which he frequently delivered himself and his followers from the most imminent dangers. His own escape from the rocky fortress of Achulko, where he was completely invested by the forces of General Grabbe, appeared both to his own countrymen and the enemy almost miraculous. In the year 1840 he even ventured to storm many of the Russian forts in the vicinity of the Black Sea; and although unable to retain them in his possession, secured an immense quantity of gunpowder and other munitions of war. The great exertions which were made by the Russians in the following year to reduce the tribes yet unsubdued, and those which had risen against their authority, were completely defeated by his indefatigable activity and bravery. In the year 1842, when the mountain tribes were filled with the greatest alarm in consequence of the advance of General Grabbe, that formidable enemy was completely defeated by Schamyl in the woods of Itchkeri. The Circassians, after again renewing their attacks upon the Russians in the neighbourhood of the Black Sea, were ultimately driven back to their fastnesses; but Schamyl still continued to maintain his position on the Caspian, and inflicted severe losses upon the armies of the enemy. The Russians were evidently at a loss how to proceed against a chief who had baffled all their schemes, who had been a prisoner in their hands, whose rocky home had been frequently in their possession, who had incurred the most imminent dangers and been driven to the greatest emergencies, and who was still opposing them with unconquerable resolution, watching the progress of their troops, cutting off their supplies, and harassing them by constant attacks. Various Russian generals were sent in succession to the Caucasus, new plans of action, defensive and offensive, were tried, but all without effecting any permanent conquest. In the year 1850 the Czarovitch made a progress to Tiflis, and was attacked on his journey by the soldiers of Schamyl in the immediate vicinity of some of the Russian forts. The armies of the czar may occasionally, with the sacrifice of a great number of lives, effect a march over the mountains, but no permanent conquest is achieved. With all the exertions of many years, their real authority is still confined to Georgia, the plains, and the immediate neighbourhood of the forts, of which so many have been erected all over the country. Georgia has now been subject to the civil and military government of Russia for more than half a century, and the result has not been at all favourable to that country. In most other parts of the Caucasian territory, the period during which the Russians have been

connected with them has been one of almost ceaseless war, in which little progress can have been made in the civilization of the people. With that indomitable spirit of independence which most of the Caucasian tribes have displayed, it is scarce to be expected that they will ever cultivate the arts of peace under the domination of the Russians, or while the Russian troops remain in possession of any portion of their country. Many of the inhabitants are inclined to commercial pursuits; and if they were not disturbed by the alarms of hostile invaders, commerce would do more to advance the general cultivation of the people than its conquest by a nation which is itself only half civilized.

It is very difficult, in the absence of all satisfactory statistical returns, to ascertain the exact amount of the population of the Caucasus. Those who by a long residence in the country have been enabled to form the most correct estimate, are of opinion that it cannot be less than one million or one million and a half. This number includes only the male portion of the population, no statement of the amount of the female portion being given in the Russian returns. The various principal races may be calculated in the following proportions:—

Tribes of the race of Kartvel	300,000
Armenians	135,000
Turkish and Persian tribes	350,000
Lesghians	350,000
Abasians and Circassians	150,000
	1,285,000

Little doubt can be entertained but that the Kists, Ossetes, and other tribes, the number of whose inhabitants cannot be certainly determined, will raise the population of the Caucasus to the amount stated. (See *Die Völker des Kaukasus*, by F. Bodenstedt, Berlin; and *The Tribes of the Caucasus*, by Baron von Haxthausen, London, 1855.

CAUDEBEC, a seaport town of France, in the department of Seine Inférieure, on the right bank of the Seine, at the mouth of the Caudebec. Pop. 2500.

CAUDETE, a town in the province of Albacete, Spain. It contains about 1200 houses, a town-house, prison, school of primary instruction, Carmelite convent and several other religious institutions. The inhabitants are engaged almost exclusively in agriculture and the manufacture of coarse fabrics for home consumption. The town was once fortified, and possesses some Roman remains. Pop. 5502.

CAUFIRISTAN, a mountainous country of Asia, situated partly upon the Hindu Koh, and partly upon the Beloor Taugh. It lies between Lat. 35. and 36., and Long. 69. 20., 71. 20. Its boundaries are Caubul, Budukshaun, and Bulkh. The name Caufiristan, signifying "land of infidelity," has been given to the country by the neighbouring Mussulmans, in consequence of the rejection of Mohammedanism by the inhabitants. These are called Siyah Posh or "black clad," from wearing black goatskin dresses. According to Elphinstone in his "Account of Caubul," the people "have no general name for their nation. Each tribe has a peculiar name, for they are all divided into tribes, though not according to genealogies but geographical position, each valley being held by a separate tribe." The country is drained by four considerable rivers, the Kama, the Alingar, the Alishang, and the Tagoa, which are reported to rise in the Hindu Koh, and which, holding a course generally to the S.W., pass into Afghanistan, and fall into the river of Caubul. Each river flows down a great valley inclosed on each side, S.E. and N.W., by lofty mountains, having in various places summits covered with perpetual snow, and furrowed by numerous valleys of inferior size to that through which the river takes its course. So steep are the slopes of the mountains, that in the villages which are always built on the declivities, probably from regard to purposes of defence, the houses are reared several stories high, with their backs against the precipice behind, in such a manner that the roofs of one row form the street for the one immediately above it. In person the Siyah Posh are strongly marked specimens of what is called the Caucasian variety of the human race; and in their fine figures, fair complexions, and regular features, bear a strong resemblance to the Circassians. They acknowledge a supreme deity, whom they call Imra; but they also worship numerous idols, which they say represent great men of former days, who intercede with the deity in favour of their worshippers. They venerate stone posts resembling *lingas*, and make offerings by throwing flour, butter, and water on them; and also sacrifice various animals, burning part of the flesh as an offering, and feasting on the rest. The Caufirs are a very martial race, being engaged in incessant warfare with their Mohammedan oppressors, by whom they are surrounded. They bear shields for defence; and for offensive arms, swords, spears, knives, and bows and arrows. Of late years they have begun to provide themselves with matchlocks purchased from the Afghans. Though readily admitted to quarter by the Mohammedans, in consequence of their marketable value as captives, they seldom spare the life of an enemy at their mercy. On the return of a party from an expedition, those who have slain Mohammedans are presented by the maidens with dried fruits; while those who failed in attaining this distinction are pelted with ashes. The female relatives of those who have slain Mohammedans are allowed the exclusive use of certain honorary distinctions in dress. The Siyah Posh have never been conquered. Tamerlane, who subdued so many kingdoms and empires and overcame all other resistance, from the Hellespont to Central India and from Syria to Moscow, retired baffled from his attempt to subjugate Caufiristan. About seventy years ago the adjoining Mohammedan powers confederated for the purpose of waging a religious war, and forcing this people to embrace Islamism. The Khan of Budukshaun, the chiefs of Kooner, of Bajour, and of several of the Eusufzai tribes, by simultaneous marches met in the heart of Caufiristan; but, unable to keep their ground, were forced to evacuate the country after suffering considerable loss.

The Caufirs are hospitable in the extreme. A stranger arriving at one of their villages is not only welcomed, but is expected to visit each of the principal men, where he is regaled with every dainty which the house can afford. Their wealth consists of cattle and slaves. The government is chiefly conducted by consultations among the rich men. Their dress consists principally of goats' skins with the hair turned outwards, two of which form a vest, and other two a kind of petticoat. They are less addicted to hunting than the Afghans. The favourite amusement is dancing, of which they never tire. They cannot accommodate themselves to the Asiatic practice of seating themselves cross-legged on the ground, but sit in the European manner on benches and stools. They also use tables, and drink wine copiously, though not to intoxication, out of silver cups. These European habits have given rise to the hypothesis of their being a Greek colony, left during the expedition of Alexander. They are themselves fond of claiming affinity with the Feringis or Europeans; and on the recent invasion of Afghanistan by the British, sent a mission to express their gratification at the arrival of so many brethren. The two chief towns, or rather villages, of the Caufirs, are Caumdaish and Tsokooee. The former contains five hundred houses.

CAUKING, or CAULKING, the driving of oakum or old rope untwisted into the seams between the planks in a ship's deck or sides, to prevent the entrance of water or leakage. The seams are then covered with melted pitch or rosin, to keep the oakum from rotting.

CAULABAGH, a town of Hindustan, in the British province of the Punjaub, situate on the right or west bank of the Indus, where it finds a passage through the salt range which stretches from Afghanistan into the Punjaub. It is a singularly built place, the houses being situated on terraces cut out of the declivity of the hill. In the vicinity of the town are large rocks, which yield an inexhaustible

store of the pure rock salt; and there is, besides, a considerable manufacture of alum. In both of these articles an extensive trade is carried on with the neighbouring provinces, which proves highly beneficial to the inhabitants. The river Indus, which here flows in one channel, is navigable from the sea; and the facilities of communication which have been established by means of government steam vessels between Kurrachee and Mooltan are about to be extended to this town. The proper name of the town is Khara Bagh, or Garden of Salt. E. Long. 71. 30., N. Lat. 32. 57.

CAULIFLOWER, a variety of cabbage. See HORTICULTURE.

CAURSINES, or *Caursini*, Italian usurers who first came into England about the year 1235, terming themselves the pope's merchants, but were driven out of the kingdom about the year 1250 on account of their merciless exactions.

CAUSE, that from which anything proceeds, or by virtue of which anything is done; or an antecedent relatively to an invariable consequent. It stands opposed to effect. See METAPHYSICS.

CAUSEWAY, or CAUSEY, a massive construction of stones, stakes, and fascines, or an elevation of fat viscous earth, well beaten, serving either as a road in wet marshy places, or as a mole to retain the waters of a pond, or prevent a river from overflowing the lower grounds. See ROAD. The word is derived from the French *chaussée*, anciently written *chaulsée;* and that, again, from the Latin *calceata*, or *calcata*, which, according to Somner and Spelman, comes *a calcando*.

CAUSEWAY most generally signifies a common raised way, maintained and repaired with stones and rubbish.

CAUSSADE, a town of France, department of Tarn and Garonne, pleasantly situated in a fertile district near the Caude, twelve miles N.E. of Montauban. It has manufactures of woollen and linen goods, and some trade in corn, saffron, and truffles. Pop. about 4000.

CAUSSIN, NICHOLAS, surnamed the Just, a French Jesuit, born at Troyes in Champagne, in 1583. He taught rhetoric in several of the colleges of the order, and as a preacher gained great reputation. This procured him the preferment to the office of confessor to Louis XIII.; but he discharged his duties too faithfully for Cardinal Richelieu, who procured his dismissal. He was exiled for some time, but afterwards returned, and died in the Jesuits' convent at Paris in 1651. The most popular of his works, which are numerous, is that entitled *La Cour Sainte*, 5 vols. 12mo.

CAUSTICS (καύστικος from καίω, καύσω, to burn), certain substances which when applied to the skin corrode and destroy its texture. Of these there are the common stronger caustic, the common milder caustic, the antimonial caustic, and the lunar caustic or fused nitrate of silver. See CAUTERY.

CAUSTIC *Curve*, in the higher geometry, a curve formed by the concourse or coincidence of the rays of light reflected from some other curve. See OPTICS.

CAUTERY, in *Surgery*, a burning or searing, as of morbid flesh, by the application of caustic medicines, or by a hot-iron. The first is termed *potential cautery*, the latter *actual cautery*.

CAUTIONER, in *Scots Law*, one who becomes bound for another to the performance of any deed or obligation.

CAVA, a town of Naples, province of Principato Citra, 26 miles S.E. of Naples. Including the adjoining and dependent villages, it has about 13,000 inhabitants. It is the seat of a bishopric, and has a cathedral, diocesan seminary, convent for noble ladies, and manufactures of silk, cotton, and woollen stuffs. In the vicinity is the famous Benedictine abbey called *La Trinità Della Cava*, with its fine library and valuable archives.

CAVAILLON, the ancient *Cabellio*, a town of France, on the Durance, department of Vaucluse, arrondissement and 13 miles S.E. of the town of Avignon. The town is ill built and dirty, but carries on a considerable trade, and the vicinity is very productive. Remains of a Roman arch are seen here. The only building worthy of notice is the town-hall. Pop. 4000.

CAVALCANTI, GUIDO, an Italian philosopher of the seventeenth century, whose father is consigned by Dante in the *Inferno* to the region of the condemned, on account of his Epicurean philosophy. He has written several poems, consisting of sonnets and canzones, chiefly in honour of Mandetta, a lady whom he met at Toulouse.

CAVALIER, a horseman, especially an armed horseman; a knight. During the civil war which brought Charles I. to the scaffold, the adherents of the king were first called Cavaliers, in contradistinction to the Roundheads or friends of the parliament.

CAVALIER, in *Fortification*, a sort of interior bastion elevated several feet above the principal bastion of a fortress.

CAVALIERI, BONAVENTURE (1598-1647), an eminent mathematician, a native of Milan, and friar of the order of the Jesuati of St Jerome, was the professor of mathematics at Bologna, where he published several mathematical books. The most famous of these are entitled *Directorium generale Uranometricum; Geometria indivisibilibus Continuorum*, &c.; *Trigonometria plana et spherica*, and *Exercitationes Geometricæ*.

CAVALLINI, PIETRO, an artist of the earliest epoch of the Roman school, who was taught painting and mosaic by Giotto, while he was employed at Rome; and it is believed that he assisted his master in the mosaic of the *Navicella*, or ship of St Peter, in the porch of the church of that saint. Lanzi describes him as an adept in both arts; and mentions with approbation his grand fresco of a Crucifixion at Assisi, still in tolerable preservation. Cavallini has another claim to notice, since, according to George Vertue, it is highly probable that he executed the mosaics and other ornaments of the tomb of Edward the Confessor in Westminster Abbey, by order of Henry III. The work, however, must have been executed by him in Rome, where he appears to have constantly resided. He died in 1344 at the age of 85.

CAVALLO, TIBERIUS, an electrician and natural philosopher, son of a physician established at Naples, was born in that city, March 30, 1749.

His father died when he was only eleven years old, but he received a liberal education through the kindness of his friends, and completed his studies at the university of Naples. He was originally destined for commerce, and came to England in 1771, in order to obtain more complete information respecting the various objects of mercantile pursuit. But he soon abandoned his intention of adopting that mode of life, and determined to devote his time almost exclusively to the cultivation of science, and to the literary employments connected with it. The splendid improvements which had been lately made in electricity easily directed his earliest attention to that amusing department of natural philosophy; but his studies were by no means confined to that subject, and the extent of his diversified researches may be understood from an enumeration of his principal publications.

1. *Extraordinary Electricity of the Atmosphere in October* 1775. *Phil. Trans.* 1776, p. 407. This observation was made at Islington, where the author then resided; and he seems to have been in some danger of becoming, like another Richmann, a martyr to his zeal in pursuit of his favourite science; for he says that he felt a number of severe shocks while he was holding the wire of his kite.

2. *An account of some new Electrical Experiments. Phil. Trans.* 1777, p. 48. He here describes two atmospherical electrometers, and an exhausted tube containing some quicksilver, for illustrating the nature of electrical excitation. A paper of Mr Henly, in the same volume, contains

also some communications from Mr Cavallo, and in particular a remark on the opposite electricities which he detected in the bow and strings of his violin.

3. *New Electrical Experiments.* *Phil. Trans.* 1777, p. 388. Relating to changes of the colours of pigments, with a description of a pocket electrometer.

4. *A complete Treatise on Electricity*, 8vo. London, 1777. German by Gehler, 8vo. Leipz. 1785. French by Silvestre, 8vo, Paris, 1785. Ed. 4, 3 vols. 8vo, London, 1795.

This essay contains a clear and familiar account of the principal facts respecting electricity, which had been discovered at the time of its publication, as well as of the best apparatus and of the most interesting experiments. The first part relates to the general laws of the science; the second to the hypothetical theories by which different authors have attempted to explain them, but without any mention of the calculations of Alpinus and Cavendish; the third part gives an account of the practical arrangement of electrical apparatus, and the fourth of some original experiments and instruments; the fifth part in the later editions is a republication of the author's *Essay on Medical Electricity.* To the fourth edition a third volume is added, containing an account of the recent discoveries respecting animal electricity; of the author's multiplier for detecting the presence of small quantities of electricity, by the repeated operation of two condensers connected together; and of some original and very important experiments relating principally to the effect of the contact of different metals with each other, and exhibiting an imperfect outline of those properties, which have since furnished Volta and Davy with their ingenious explanations of the phenomena of the electrochemical battery.

Mr Cavallo has inadvertently attributed to Nollet the honour of having first entertained the opinion of the electrical nature of thunder and lightning; and the German translator has thought it necessary to vindicate the scientific character of his own country, by laying claim to this conjecture on behalf of Winkler; but Mr Silvestre has remarked, with a laudable impartiality, that both Germany and France must on this occasion give way to England, since the first suggestion of the identity is found in a paper of Stephen Gray, published in the *Philosophical Transactions* about 1735.

5. *An account of some new Experiments in Electricity.* *Phil. Trans.* 1780, p. 15. Consisting of remarks on Professor Lichenberg's discovery of the peculiarity of the figures exhibited by strewing powders on the cake of the electrophorus; with an account of two improved electrometers.

6. *Thermometrical Experiments and Observations.* *Phil. Trans.* 1780, p. 585. This was a Bakerian lecture, delivered by appointment of the president and council of the Royal Society, an appointment which entitles the lecturer to a small fee, left by the will of Mr Henry Baker, but which is commonly considered as rather complimentary than lucrative. These experiments relate to the effect produced by colouring the bulb of a thermometer exposed to the sun's rays, and to the intensity of heat at different distances from its source. The most refrangible colours appeared to absorb the most heat; and it was observed that even the day-light, without sunshine, occasioned a perceptible difference in the indications of the different thermometers.

7. *An Essay on Medical Electricity*, 8vo, London, 1780. It is seldom that persons not medical have been sufficiently incredulous in their opinions respecting the operations of remedies; and the whole of the expectation held out in this work has certainly not been fulfilled by later experience; but, as a candid and distinct relation of cases, it may still have its value.

8. *Account of a Luminous Appearance.* *Phil. Trans.* 1781, p. 329. One of the permanent arches since found to be connected with the aurora borealis. It was so bright that the stars could not be seen through it, and lasted about an hour.

9. *Thermometrical Experiments.* *Phil. Trans.* 1781, p. 509. A Bakerian lecture, relating to the evaporation of ether, to the expansion of mercury, and to a thermometrical barometer; that is, a very delicate thermometer for ascertaining the temperature of boiling water at different heights above the level of the sea, according to the idea then suggested by Sir George Shuckburgh, and very lately resumed by other natural philosophers. Mr Cavallo observes that the instrument has the advantage of being very portable; but that unless the quantity of water be considerable, its boiling temperature will be somewhat unsteady.

10. *A Treatise on the Air, and other Permanently Elastic Fluids*, 4to, Lond. 1781. This elaborate work commences with the principles of chemistry and of hydrostatics, and proceeds to relate all the known properties of the different kinds of elastic fluids, many of which had been very lately discovered. These are followed by an account of some original experiments, for example, on the gas produced by the deflagration of gunpowder, which is found to be chiefly nitrogen and carbonic acid, without any nitric oxide; on the explosion of hydrogen mixed with atmospheric air, and on the evolution of gas from plants, respecting which the author finds some reason to differ from the opinions of Dr Ingenhurz. Considering that Mr Cavendish had not then discovered the composition of the nitric acid, it must be allowed that the experiments on gunpowder may justly be deemed an important step in the progress of chemical science.

11. *Description of an Improved Air-Pump.* *Phil. Trans.* 1783, p. 435. The improvement was made by Haas and Hurter, and consisted in a mode of opening the valve of oiled silk mechanically, when the elasticity of the air became too weak to raise it. The rarefaction obtained went to about the thousandth of an atmosphere. In this state the air transmitted electricity, with a light equably diffused; and the balls of the electrometer exhibited no divergence. Some later improvements are said to have carried the rarefaction to $\frac{1}{3000}$.

12. *Description of a Meteor.* *Phil. Trans.* 1784, p. 108. This observation was made at Windsor, and is highly valuable, from the circumstance of a noise like thunder having been heard, about ten minutes after the explosion of the meteor was seen; hence the author concludes that its direct distance was 130 miles, and its height 56½.

13. *The History and Practice of Aerostation*, 8vo, Lond. A work of temporary rather than of permanent interest; but which it was the more natural for Mr Cavallo to undertake, as he was one of the first who had made experiments on the means of employing hydrogen for raising bodies into the air by its levity.

14. *Mineralogical Tables*, f. Explanation, 8vo, Lond. 1785; containing a comparison of the different systems of mineralogical arrangement then most generally adopted, but at present almost wholly superseded by later methods.

15, 16. *Magnetical Experiments and Observations.* *Phil. Trans.* 1786, p. 62; 1787, p. 6. Two Bakerian lectures. The former relates chiefly to the magnetism of brass, and of some other metals, generally rendered discoverable by hammering them. In the latter the same subject is continued; and it is shown that the same powers may be detected in the metals in question without hammering them, if they are placed on a very clean and wide surface of quicksilver. The limit at which red hot iron begins to be attracted by a magnet is found to be the heat at which it

ceases to be visible in the day-light. A considerable change is observed in the magnetic powers of iron during its solution in acids; and the author endeavours to apply these experiments to the explanation of the variation of terrestrial magnetism, as derived from the effects of heat, and from internal changes in the constitution of the earth. Mr Bennet has endeavoured to explain the phenomena observed by Mr Cavallo, from the accidental operation of foreign causes; but he has not been perfectly successful in the attempt.

17. *A Treatise on Magnetism in Theory and Practice*, 8vo, Lond. 1787, ed. 3, 1800. The arrangement resembles that of the Treatise on Electricity. Under the head of Theory the name of Alpinus is mentioned with due respect. The original experiments are chiefly reprinted from the *Philosophical Transactions*. There is also a description of an improved mode of suspension for a magnetic needle; and there are several letters from Dr Lorimer on the terrestrial variation.

18. *Of the Methods of manifesting the presence of small quantities of Electricity*. *Phil. Trans.* 1788, p. 1. In this Bakerian lecture, Mr Cavallo proposes an improvement on Volta's condenser, and makes some remarks on Mr Bennet's doubler, which he thinks objectionable on account of the impossibility to deprive the plate of a small quantity of electricity adhering to it. His own instrument has the advantage of avoiding the friction to which the condensers and doublers in their original form were liable.

19. *Of the Temperament of Musical Intervals*. *Phil. Trans.* 1788, p. 238. The author's particular object is to calculate the exact scale for the division of a monochord, according to the system of a perfectly equal temperament; but he very candidly remarks, that, " for playing solos," the usual temperament is the best, " giving the greatest effect to those concords which occur most frequently;" and he says, that when a harpsichord was tuned according to the scale laid down on this monochord, the harmony was perfectly equal throughout, and the effect " the same as if one played in the key of E natural on a harpsichord tuned in the usual manner."

20. *Description of a new electrical Instrument, capable of collecting together a diffused quantity of Electricity*. *Phil. Trans.* 1788, p. 255. This collector consists of a fixed plate of tin, situated between two movable ones; it is said to be more certain in its operation than the condenser, the results of which are liable to considerable irregularities from various accidents, and to be more free from the inconvenience of permanent electricity than the doubler.

21. *Description of a Micrometer*. *Phil. Trans.* 1791, p. 283. *Description and use of the Mother of Pearl Micrometer*, 8vo, Lond. 1793. A thin slip of mother of pearl with a fine scale engraved on it, placed in the focus of the eye-piece of a telescope. Its principal use is for ascertaining the distance of an object of known dimensions by its apparent magnitude thus measured; for instance, to enable one to judge of the distance of a body of troops in military operations. The mother of pearl is found to be more convenient than glass for receiving the divisions, and to be sufficiently transparent for transmitting the images of the respective objects.

22. *On the Multiplier of Electricity*. Nicholson's *Journal*, i. p. 394, 1797. In this letter Mr Cavallo attempts to show the advantage of his instrument over doublers of all kinds. Mr Nicholson, in a very respectful answer, expresses his doubts whether the objections to the doubler do not arise from its extreme sensibility only, as demonstrating the existence of an electricity too weak to affect the other instruments compared with it. Mr Cavallo had however remarked, that the inconvenience partly arose from the greater intensity of the charge committed to the plate of the doubler during the operation, which required a longer time for the restoration of the natural equilibrium.

23. *An Essay on the Medicinal Properties of Factitious Airs, with an Appendix on the Nature of the Blood*. 8vo, London, 1798. The modern improvements in pneumatic chemistry have been still less productive of advantage to practical medicine than the discovery of the powers of electricity, and this work can scarcely be considered as having conferred any material benefit on the public. The observations on the blood are chiefly the result of a minute and careful microscopical examination of its particles, but the author was not particularly happy in the light which he employed for viewing them.

24. *Elements of Natural or Experimental Philosophy*, 4 vols. 8vo, Lond. 1803. This work, the last and most valuable of the author's publications, will long serve as a useful manual of the most important parts of the mechanical and physical sciences. The first volume is devoted to mathematical and practical mechanics, beginning with matter and motion, and proceeding to simple machines. The second relates, first, to fluids, to the principles of hydrostatics, cohesion, hydraulics, pneumatics, sound, and music; and, secondly, to the most important parts of chemistry. In the third volume we find the doctrine of heat, optics, electricity, and magnetism; and the fourth, besides astronomy and the use of the globes, contains a compendium of the history of aerostation; an account of meteors, including the recent discoveries respecting aeroliths; and a collection of useful tables.

25. Mr Cavallo was also an occasional contributor to several periodical publications, and his critical articles were not in every instance anonymous. He was made a member of the Royal Academy of Naples in 1779, and a fellow of the Royal Society of London in the month of December of the same year.

It is impossible to hesitate in attributing to Mr Cavallo the possession of very considerable powers of mind; but these powers seem to have been of a different nature from those which have distinguished some other individuals, remarkable for the faculty of acute reasoning and brilliant invention, and apparently born to succeed in the highest flights of genius. Mr Cavallo's talents appear to have had more of the imitative character, and to have been rather calculated for the attainment of excellence in the fine arts than in science; but his memory was uncommonly retentive, and his industry seems to have been indefatigable. He used to relate, that when he was first compelled to study Euclid, he felt himself utterly incapable of comprehending the train of argumentation, and he was obliged to get the whole work by heart, both propositions and demonstrations, in order to impress the conclusions strongly on his mind. This expedient answered his purpose very well, as long as the impression lasted; but after some years he had forgotten his task, and he was obliged to go through the whole again in the same manner, still finding it easier to commit the eight entire books, with all the unmeaning letters of reference, to the care of his ever-faithful memory, than to acquire the spirit of the mode of reasoning, and to anticipate the steps of the demonstration; although, after having performed this second labour, he felt himself sufficiently master of the subject. It may be observed that he possessed considerable skill in music; and music was called by the ancients an imitative art, a description which may indeed be somewhat objectionable with regard to the province of the original composer, who creates something altogether unlike what had ever before existed, but which may not improperly be applied to the occupation of a performer; indeed Mr Cavallo, even when his hearing was impaired, still retain-

ed a very correct taste in the execution of vocal music. He possessed also his country's aptitude for the painter's art; and he was particularly happy in cutting out striking likenesses of his acquaintances in paper. The principal object of his life was to collect and arrange the labours of others; and he was so much in the habit of collecting, that he had for many years made it his amusement to collect specimens of the handwriting of eminent persons, which he had extended to an immense number of individuals of different ages and countries. But he was by no means incapable of copying from the great book of nature; and he made, in the course of his various researches, a number of original experiments, well calculated to illustrate particular questions relating to the sciences which he cultivated. In the latter part of his life he had discontinued his attendance at the meetings of the Royal Society, as well as his contributions to the *Transactions;* but he was in the habit of frequenting some other literary conversations, at which he constantly met some of his oldest and kindest friends. A short time before his last illness, he was engaged in some experiments on M. Deluc's perpetual pile of paper, and on the electricity of different specimens of crystals; but he does not appear to have obtained any new results from these investigations. He died at his residence in Wells Street, on the 26th of December 1809, and was buried in St Pancras churchyard, near the tomb of General Paoli, with whom he had long been on terms of the greatest intimacy. (*Literary Memoirs of Living Authors;* Dance's *Collection of Portraits; Gentleman's Magazine,* 1809; *Supplement to the Monthly Magazine,* 1810, p. 86; Aikin's *General Biography,* vol. x.; Chalmers' *Biographical Dictionary,* vol. vii.) (T. Y.)

CAVALLUCI, Antonio, a modern Italian painter of considerable eminence, was born at Sirmoneta in 1752. His works are to be found in the principal cities of northern and central Italy, especially at Pisa and Rome. The best of all his pictures—that representing Venus and Ascanius—is preserved in the Cesarini palace of the latter city. He died in 1795.

CAVALRY (French *cavalerie,* from Latin *caballus* a horse), a body of soldiers who serve on horseback. See Army.

CAVAN, an inland county in the province of Ulster, in Ireland, situated between 53. 43.–54. 7. N. Lat., and 6. 45.–7. 47. W. Long.; bounded N. by Fermanagh and Monaghan, E. by Monaghan and Meath, S. by Meath, Westmeath, and Longford, and W. by Longford and Leitrim. Area 746 square miles, or 477,360 acres, of which 375,473 are arable, 71,918 uncultivated, 7325 in plantations, 502 in towns, and 22,142 under water.

The most ancient geographers describe this and the adjacent counties of Leitrim and Fermanagh as occupied by the tribe of the Erdini. At the period of the English settlement, and for some centuries afterwards, it was known by the name of the Brenny, or O'Reilly's country; and its inhabitants, protected by the nature of the country, long maintained their independence. In 1584 Cavan was formed into a county of Ulster by Sir John Perrott, lord-deputy of Ireland, and subdivided into seven baronies, two of which were assigned to Sir John O'Reilly free of all contributions, and three to other members of the family; while the two remaining baronies, possessed by the septs of Mackernon and Macgauran, and situated in the mountains bordering on O'Rorke's country, were left subject to their ancient tenures and the exactions of their Irish lord, the crown reserving 200 beeves upon the whole county for the lord-deputy's provision. There was also an ancient subdivision, peculiar to this county, into polls, each of which contained about 25 acres. Early in the reign of James I., a commission of inquiry was issued concerning all lands in several counties of Ulster, escheated to the crown by attainder, outlawry, or actual death in rebellion, by which the greater portion of this county was deemed to be vested in the crown, and its exact state thereupon investigated. Under the consequent project for the new plantation of Ulster, the county was distributed among the undertakers, British planters, servitors, natives, and ecclesiastics, &c. &c. The principal English and Scotch families settled in Cavan were the Auchmuties, Bailies, Butlers, Hamiltons, Lamberts, Parsons, and Ridgeways. The county is now divided into eight baronies—Castlerahan, Clanmahon, Clonkee, Loughtee Lower and Upper, Tullygarvey, Tullyhaw, and Tullyhunco. It is almost entirely within the diocese of Kilmore, and contains thirty-six parishes and parts of parishes. In military arrangements it is in the Belfast district; and there are barracks for cavalry at Belturbet, and for infantry at Cavan, where also the staff of the county militia is stationed. The headquarters of the constabulary force, consisting of 419 men and officers, are at Cavan; those of the eight districts, comprising thirty-nine stations, at Cavan, Arva, Ballyjamesduff, Bailieborough, Cootehill, Belturbet, Swanlinbar, and Killeshandra. The revenue police stations are at Belturbet and Bailieborough. The assizes are held at Cavan, where the county prison and the county infirmary are situated. There is a loan fund at Ballyjamesduff, and a savings-bank established in 1830 at Cavan. There are four union workhouses within the county—Bailieborough, Bawnboy, Cavan, and Cootehill; but portions of the county are comprised in the unions of Enniskillen, Granard, and Oldcastle. The amount of property valued under the Act 6th and 7th Will. IV., cap. 84 (Griffith's valuation), is L.247,817, and the net annual value of property rated to the poor is L.248,415. The chief towns are Cavan, pop. (in 1851) 3254, Cootehill 2105, and Belturbet 2054. Prior to the Union it contributed six members to the Irish parliament, two for the county at large, and two for each of the boroughs of Cavan and Belturbet; but since that period it has been represented in the imperial parliament by two county members only. The constituency under 13th and 14th Vict., cap. 69, in 1851, numbered 3850.

The remains of antiquity in this county are few in number and unimportant in interest. They consist of cairns, raths, and the ruins of small castles.

The surface of the country is uneven, consisting of hill and dale, without any great extent of level ground, but only in its northern extremity attaining a mountainous elevation. The barony of Tullaghagh, bordering on Fermanagh, a wild dreary mountain district, known as the kingdom of Glan or Glangavlin, contains the highest land in the county, called Slieve Russel. In the same barony is Quilca mountain, the place of inauguration for the Macguires, chieftains of Fermanagh, held in great veneration by the peasantry, in connection with legends and ancient superstitions. The remainder of the county is occasionally not deficient in wood, and adorned by numerous lakes, generally of small dimensions, but of much interest for their picturesque beauty, more especially Lough Oughter, which lies between the towns of Cavan and Killeshandra. Though not of very imposing size, the irregularity of its form, the large and beautiful islands imbedded in its waters, and the many deep recesses studded with overhanging woods that wind among its high banks, produce a rich variety of prospect. The water of the lakes is generally very clear, and they abound with fish. The chief river in the county is the Erne, which originates in the Lake of Scrabby, one of the minor sheets of water communicating with Lough Gawnagh, on the borders of Longford. The river takes a northerly direction by Killeshandra and Belturbet, being enlarged during its course by the Annalee and other smaller streams, and finally enters Lough Erne near the northern limit of the county. The other waters, consisting of numerous lakes and their connecting streams, are mostly tributary to the Erne. The great river Shannon is by some

supposed to have its source in a copious spring called the Shannon Pot, at the foot of the Cuilagh mountain, in the barony of Tullaghagh. The Blackwater, a tributary to the Boyne, also rises in this county, near Bailieborough. The main roads are kept in good order, but the cross roads are frequently ill planned and in bad condition. The line of railway in progress (1854) from Mullingar to Cavan and Enniskillen will pass through the county.

The climate of this county is cold but salubrious; the dampness, arising from its numerous lakes and the nature of the soil, being much dispelled by the boisterous weather which frequently prevails, more especially in the higher districts.

The south-eastern portion of Cavan rests upon clay-slate, and the remainder of the county upon the carboniferous limestone formation. A rich iron ore was formerly raised from Quilca mountain. The ore was smelted at Swanlinbar, but the works were ultimately relinquished in consequence of the failure of timber for fuel. Indications of lead, silver, and sulphur have been observed; and fullers' earth, pipe-clay, potters' clay, and brick-clay are frequently met with in Tullaghagh barony, in which there are also indications of coal. Several mineral springs exist in this county, the chief of which is near the once-frequented village of Swanlinbar. Its constituents are carbonic, muriatic, and sulphuric acids, combined with soda and a little lime. It acts as a diuretic, and is considered serviceable in diseases of the skin, kidneys, and bladder, and also in gout. In the neighbourhood of Belturbet, near the small lake of Annagh, is a carbonated chalybeate, resembling the crescent well of Harrowgate, beneficially used in cases of relaxation and debility, and especially in dyspepsia. There are several other springs of less importance: and the small Lough Leighs, or Lough-an-Leighaghs, which signifies the healing lake, on the summit of a mountain between Bailieborough and Kingscourt, is celebrated for its antiscorbutic properties. Its waters are used for drinking and bathing; but the most beneficial effects are said to be produced by the local application of the tenacious mud raised from the bottom of the lake. The level of the lake never varies. It has no visible supply nor vent for its discharge; neither is it ever frozen during the severest winters. The water at the surface is clear; but within a foot downwards it becomes clogged with mud, which thickens as the depth increases. The mud is drawn up for medicinal purposes by means of a pole with a hay rope twisted round it, to which the mud adheres, exhibiting a greasy shining surface like tar.

The chief manufacture is the weaving and bleaching of linen, which is carried on by the peasantry, in combination with agricultural occupations; but the combination is not to the advantage of either branch. There are also extensive distilleries. Illicit distillation was formerly carried on to a great extent, the lakes affording great facilities for its practice. The grain was steeped in them, and the portable and cheap apparatus employed was set up close to their shores, so that in case of alarm the whole could be flung into the water at a moment's notice, and remain concealed until raised again for future service.

The soil is generally a stiff wet clay, cold and spongy, but capable of much improvement by drainage, for which its undulating surface affords facilities of which little advantage has been taken. Agriculture is in a backward state, the farms being generally small, the tenures short and unsatisfactory, and the modes of culture generally defective. In the mountainous parts, where the land is chiefly under grazing, the farms are more extensive. The number of holdings in 1851 was 21,495, of which 2012 were of less than 5 acres, 9100 between 5 and 15 acres, 6546 between 15 and 30 acres, 3081 above 30 acres, and the remaining 756 not exceeding one acre. The extent of land under crops in 1847 was 158,366 acres, and in 1853, 176,591, viz.—wheat, 650; oats, 89,929; barley, bere, rye, pease and beans, 2883; potatoes, 27,734; turnips, 4528; mangel-wurzel, vetches, and other green crops, 3840; flax, 12,106; meadow and clover, 34,921. The culture of potatoes and flax has increased during the last few years, but other crops show little variation; that of wheat, however, as in the rest of Ireland, being on the decline. The live stock contained within the county in 1852 amounted to 10,043 horses, 9338 mules and asses, 92,690 cattle, 16,167 sheep, 24,715 pigs, 14,024 goats, 328,241 poultry, of the total value of L.757,943. The estimated value of the live stock in 1841 was L.492,506. The soil in those districts not well adapted for tillage is peculiarly favourable for trees. The woods were formerly very considerable, and the timber found in the bogs is of large dimensions; but plantations are now chiefly found in demesnes, where they are extensive; and the bareness of the landscape, too long a glaring drawback on the natural beauties of the county, is gradually becoming less observable.

There being but three towns in the county containing more than 2000 inhabitants, the population is chiefly rural, and increased at the rate of 17 per cent. between 1821–31, and 7 per cent. between 1831–41; since which period the numbers have rapidly declined, so that the decrease between 1841–51 has amounted to 28 per cent. The following are the numbers according to the census returns:—

Year	No. of Souls.	Increase.	Decrease.
1821	195,076	..	...
1831	227,933	32,857	...
1841	243,158	15,225	...
1851	174,071	...	69,087

The population of the county of Cavan is less mixed in race than in most parts of Ulster, being generally of Celtic extraction. The dwellings of the peasantry are miserable in appearance, and form a striking contrast to the seats of the resident gentry, which are numerous and elegant. Lord Farnham has a noble mansion at Cavan; and at Kilmore is the bishop's palace, a modern building.

In 1851 there were 174 national schools in operation, attended by 15,097 children, 8085 males and 7012 females. At the same period the state of education among the population exceeding the age of five years was as follows:—

	Rural districts.	Civic districts.	Total.	Proportion per cent. in 1851.	Proportion per cent. in 1841.
Could read and write	16,079	1234	17,313	22	14
Could read only	20,502	829	21,331	27	26
Could neither read nor write	38,791	1453	40,244	51	60

About two-thirds of the entire population are Roman Catholics; the remaining third belong to the Established church, with the exception of a small number of Dissenters.

Cavan, the capital of the county of the same name, and previous to the Union a parliamentary borough, has little to command special notice. It is situated near the centre of the county, on one of the tributary streams of the Annalee river, in a large valley surrounded on every side by elevated ground, with picturesque environs, adorned by the mansions and demesnes of Lord Farnham and the Bishop of Kilmore. The town, which in 1851 contained 3254 inhabitants, is of unpretending and rather humble appearance. The court-house, erected at an expense of L.11,000, is elegant in its proportions and convenient in its internal arrangements. The parish church, built on an elevated site, is also a graceful structure. The most conspicuous building is the grammar-school, founded by Charles I. It was rebuilt in 1819, at an expense of L.9000, on an eminence overlooking one of the main entrances into the town. It is a large and handsome edifice, capable of accommodating one hundred resident pupils, but has never yet contained more than one-fourth of that number. The master enjoys a salary of L.300 per annum, besides fees from

pupils, &c., and the use of ten acres of land adjoining the house. The other public buildings are the Roman Catholic chapel and Dissenters' meeting-houses; the county gaol and infirmary; a barrack; and the union workhouse. Cavan has still some linen trade, and a considerable retail business is transacted in the town, which was incorporated by a royal charter of the 8th of James I., now extinct. It is the seat of a presbytery of the General Assembly of the Presbyterian church in Ireland; but the great majority of the inhabitants are Roman Catholics. A monastery of Dominican friars, founded by O'Reilly chieftain of the Brenny, formerly existed here, and became the burial place of the celebrated Irish general, Owen O'Neal, who died as is supposed by poison, in 1649, at Cloughoughter. This monastery, and all the other antiquities of the town, have been swept away during the violent and continuous feuds to which the country has been subjected. Even so late as the year 1690 the chief portion of the town was burned by the Enniskilleners under General Wolsey. Cavan is distant 70 miles N.W. by N. from Dublin. (H. S—R.)

CAVANILLES, Antonio Jose, a Spanish ecclesiastic, who devoted himself with great assiduity to the study of botany, and has published several important works, was born in 1745, at Valencia. He received his first education among the Jesuits in that university, and he ever afterwards retained the urbanity of character and manners characteristic of that celebrated order of men. He early devoted himself to the studies of divinity and philosophy, and was distinguished for diligence and ability, not only in these pursuits, but in the mathematics, history, and belles-lettres. He afterwards removed to Murcia, where he acquired so much credit that he was chosen by the Duke de l'Infantado to superintend the education of his sons. He accompanied them to Paris in 1777, where he resided twelve years, adding to his various information, and particularly cultivating the science of botany, with all the aids which that celebrated capital was so well calculated to afford. Here he was more particularly associated with the famous Jussieu, and the pupils of his school. From the Linnæan botanists of Paris he was a good deal estranged; yet he acquired a great inclination towards the Swedish school, and imbibed many of its good principles.

The first publication of the Abbé Cavanilles was in French, entitled *Observations sur l'article "Espagne" de la Nouvelle Encyclopédie*. This pamphlet contained a defence of his country against what appeared to him an unfair attack upon it; but we know not the particular subjects of the discussion.

He soon afterwards devoted himself to a study which promised him a less thorny path. In 1785 he published at Paris his first *Dissertation upon Monadelphous Plants*, a Latin 4to, containing the species of the genus *Sida*, with some plants nearly related thereto. The plates, uncoloured, were executed from his own drawings; as were those of the rest of his numerous publications. The specimens delineated in this first essay were too small and imperfect. In that respect his following dissertations, making ten in all, have a considerable superiority. His subsequent figures were also better engraved. The descriptions are full and correct; the new species numerous; and the specific characters tolerably classical, though not quite uncontaminated by the feebleness and ambiguity of the French school. This work, in its beginning, not being received by the Linnæan botanists of Paris, and especially by L'Héritier, with any respectful attention, the author, in an evil hour, was induced to complain, in the *Journal de Paris*, of neglect and injustice. L'Héritier had not noticed the book in his *Stirpes Novæ;* had published the same plants by different names, without citing Cavanilles; and had even antedated some of his own *Fasciculi*, in order to conceal, as it appeared, this literary incorrectness. His reply could not, in the opinion of unprejudiced witnesses, clear him of illiberal conduct; though it is very certain he neither did nor could borrow anything from Cavanilles. It would have been better to have declared the truth, that his own plates were already engraved with different names, or that he had at least chosen such as seemed to him preferable. The ninth and tenth *fasciculi* of Cavanilles, on the *Monadelphous* Plants, were indeed published at Madrid, to which place the author returned in 1790. The number of plates in the whole work are 296, many of which, especially in the earlier part, contain several species. It cannot be denied that the merit of this work kept increasing as it advanced. The abilities of the writer gained strength by exercise, and his knowledge was enriched by experience. He is charged with admitting as *monadelphous* too many plants, the union of whose stamens is very light or uncertain; a more real fault is, the usual one of too great and artificial a subdivision of genera.

Soon afterwards the Abbé Cavanilles began a larger and more comprehensive publication in folio, entitled *Icones et Descriptiones Plantarum quæ aut sponte in Hispania crescunt, aut in Hortis hospitantur*. The first volume appeared in 1791, containing 100 plates, with ample descriptions. It was followed by five more, of equal size and merit, the last of which came out in 1801. The whole work is enriched with critical remarks, and with much economical, as well as what may be called picturesque and sentimental matter respecting many native Spanish plants. The exotic part of these volumes is derived from the highly valuable and novel discoveries of the Spaniards in Mexico, Peru, and Chili, and the acquisitions of some voyagers to New Holland and the Philippine Islands. Hence numerous very fine plants, originally discovered by our own celebrated circumnavigators, but unfortunately not yet published by them, have first been made known in the pages of Cavanilles.

In the course of the botanical tours of our author, he collected materials for a general *History of the Kingdom of Valencia*, which appeared in 1795, in Spanish, making two volumes. This work, which we have never seen, is said to be rich, not only in what relates to the three kingdoms of nature, but likewise in statistical and antiquarian information.

Having in June 1801 been intrusted with the directorship of the royal garden at Madrid, he published in 1802 another work in his native tongue, containing the characters and descriptions of the plants demonstrated in his public botanical lectures. To these is prefixed an exposition of the elementary principles of the science, together with explanations of botanical terms. Cavanilles was also a frequent and important contributor to the periodical work entitled *Anales de Ciencias Naturales*, published at Madrid. Some observations of his, translated from this journal, may be found in Dr Sim's and Mr König's *Annals of Botany*, vol. i. 409. The first of these indeed, relative to certain seemingly lenticular bodies, supposed to have an important share in the impregnation of ferns and mosses, he has himself contradicted, as arising from an optical deception. His candid avowal of this, in a letter to Dr Schwartz, is published in volume second of the said *Annals*, p. 587. We think him also mistaken in the true stigma of the *Iris*, his opinion being sufficiently refuted by those of Kolreuter and Sprengel, given in a note, in the very place just quoted; nor is his idea of the stamens of certain *Asclepiadeæ* correct. If he errs, however, he errs with great authorities.

The subject of our present memoir undoubtedly excelled more in practical observation than in physiological speculation. He is said to have prepared, and partly printed, the first volume of a *Hortus Matritensis*, being a sort of sequel to his *Icones;* for it was intended to contain not merely the figures and descriptions of curious or new plants from ethgarden, but also of rare dried specimens from the museum

at Madrid. This work was cut short by his death, in May 1804, in the fifty-ninth year of his age. (J. E. S.)

CAVE (Latin *cavea*), a cavern, either below the surface of the ground, or in the face of a rock or hill. The primitive inhabitants of the earth probably dwelt in caves before the art of building was practised; and caves long continued to be the proper habitations of shepherds. In some countries, at this day, caves in the face of rocks, and even below the ground, during winter in high latitudes are used as habitations. The ancient city of Petra may be said to be a city of artificial caves. These are cut in the face of the sandstone rock; and from their great number and extent, some of these were, in all probability, human habitations. In Genesis xix., we read that when Lot went up out of Zoar, "he dwelt in a cave, he and his two daughters." The primitive method of burial also was to deposit the bodies in caves; and this custom appears to have been the origin of catacombs. Among the Romans, *antra* or caverns were consecrated to nymphs, who were there worshipped, as other divinities in temples. The grotto of the nymph Egeria is still shown at Rome. The Persians also worshipped their deity Mithras in a natural cavern, consecrated for the purpose by Zoroaster. See GROTTO.

CAVE, *Edward*, a celebrated printer, born in 1691. He was placed by his father, who was a shoemaker at Rugby, at the free school of that place, which was then in high reputation, but he was soon after withdrawn and appointed clerk to a collector of the excise.

The drudgery and insolence to which he was subjected quickly disgusted him, and after having been engaged for some time by a timber-merchant in London, he was finally bound apprentice in the printing-office of Mr Collins. In two years he attained so much skill in his art, that he was sent to conduct a printing-house at Norwich, and publish a weekly paper. In this undertaking he met with some opposition, which produced a public controversy, and procured young Cave the reputation of a writer. On the death of his master he married, and eked out the emoluments of a small place in the post-office by occasional contributions to the periodical literature. He held for a short time the office of clerk of the franks, but his rigour in checking abuses soon produced his dismissal. He now embarked the capital which he had acquired in the publication of the *Gentleman's Magazine*, a periodical which procured a fortune for the projector, and survived almost all its competitors.

Cave now began to aspire to popularity as a patron of poets, to whom he proposed subjects and offered prizes. His parsimony, however, led him to underestimate the amount of remuneration required, and the scheme accordingly proved a failure. It must never be forgotten, however, that Cave was the first to give literary employment to Samuel Johnson when he arrived in London an unknown youth from the country.

Mr Cave continued to improve his magazine, and had the satisfaction of seeing its success proportionate to his diligence, till 1751, when his wife died of an asthma. At first he did not seem much affected by her death; but in a few days he became feverish, and lost his appetite. After having lingered for about two years, he was seized with a diarrhœa by drinking acid liquors; and afterwards falling into a kind of lethargic insensibility, he died on the 10th of January 1754, having concluded the twenty-third annual collection of his magazine.

CAVE, *Dr William* (1637–1713), a learned English divine, educated in St John's College, Cambridge, and successively minister of Hasely in Oxfordshire, of All-Hallows the Great of Islington in London, and of Isleworth in Middlesex. He became chaplain to Charles II., and in 1684 was installed as a canon of Windsor. The two works on which his reputation principally rests are, the *Apostolici*, or History of the Apostles and Fathers in the three first centuries of the Church, and *Scriptorum Ecclesiasticorum Historia Literaria*; in regard to both of which he was drawn into controversy with Le Clerc, who was then writing his *Bibliothèque Universelle*, and who accused him of partiality. Besides these, he wrote *Primitive Christianity, or Religion of the Ancient Christians, &c.; Tabulæ Ecclesiasticæ, Antiquitates Apostolicæ, A Dissertation concerning the Government of the Ancient Church, &c.; Ecclesiastici, or History of the Fathers of the fourth century;* and a work entitled *Chartophylax Ecclesiasticus*, which is an abridgment of the *Historia Literaria.*

CAVEDONE, JACOPO (1577–1660), an eminent Italian painter, was educated in the school of the Caracci, and under them painted in the churches of Bologna. His principal works are, the *Adoration of the Magi*, the *Four Doctors*, and *The Last Supper.*

CAVENDISH, HENRY, a great and justly celebrated chemist, natural philosopher, and astronomer; son of Lord Charles Cavendish, and grandson of William, second duke of Devonshire; born the 10th of October 1731, at Nice, where his mother, Lady Anne Grey, daughter of Henry duke of Kent, had gone, though ineffectually, for the recovery of her health.

Of a man whose rank among the benefactors of science and of mankind is so elevated as that of Cavendish, we are anxious to learn all the details both of intellectual cultivation and of moral character which the labours of a biographer can discover and record. Little, however, is known respecting his early education. He was for some time at Newcombe's school, an establishment of considerable reputation at Hackney, and he afterwards went to Cambridge; but it is probable that he acquired his taste for experimental investigation in a great measure from his father, who was in the habit of amusing himself with meteorological observations and apparatus, and to whom we are indebted for a very accurate determination of the depression of mercury in barometrical tubes, which has been made the basis of some of the most refined investigations of modern times. "It has been observed," says M. Cuvier, "that more persons of rank enter seriously into science and literature in Great Britain than in other countries; and this circumstance may naturally be explained from the constitution of the British government, which renders it impossible for birth and fortune alone to attain to distinction in the state without high cultivation of mind; so that amidst the universal diffusion of solid learning which is thus rendered indispensable, some individuals are always found who are more disposed to occupy themselves in the pursuit of the eternal truths of nature, and in the contemplation of the finished productions of talent and genius, than in the transitory interests of the politics of the day." Mr Cavendish was neither influenced by the ordinary ambition of becoming a distinguished statesman, nor by a taste for expensive luxuries or sensual gratifications; so that, enjoying a moderate competence during his father's life, and being elevated by his birth above all danger of being despised for want of greater affluence, he felt himself exempted from the necessity of applying to any professional studies, of courting the approbation of the public either by the parade of literature or by the habits of conviviality, or of ingratiating himself with mixed society by the display of superficial accomplishments. It is difficult to refrain from imagining that his mind had received some slight impression from the habitual recurrence to the motto of his family; the words *cavendo tutus* must have occurred perpetually to his eyes; and all the operations of his intellectual powers exhibit a degree of *caution* almost unparalleled in the annals of science; for there is scarcely a single instance in which he had occasion to retrace his steps or to recal his opinions. In 1760 he became a fellow of the Royal Society, and continued

 for almost fifty years to contribute to the *Philosophical Transactions* some of the most interesting and important papers that have ever appeared in that collection, expressed in language which affords a model of concise simplicity and unaffected modesty, and exhibiting a precision of experimental demonstration, commensurate to the judicious selection of the methods of research, and to the accuracy of the argumentative induction; and which have been considered, by some of the most enlightened historians, as having been no less instrumental in promoting the further progress of chemical discovery, by banishing the vague manner of observing and reasoning that had too long prevailed, than by immediately extending the bounds of human knowledge with respect to the very important facts which are first made public in these communications.

1. *Three Papers, containing Experiments on Factitious Air. Phil. Trans.* 1766, p. 141. It had been observed by Boyle, that some kinds of air were unfit for respiration; and Hook and Mayow had looked still farther forwards into futurity with prophetic glances, which seem to have been soon lost and forgotten by the inattention or want of candour of their successors. Hales had made many experiments on gases, but without sufficiently distinguishing their different kinds, or even being fully aware that fixed air was essentially different from the common atmosphere. Sir James Lowther, in 1733, had sent to the Royal Society some bladders filled with coal damp, which remained inflammable for many weeks; little imagining the extent of the advantages which were one day to result to his posterity from the labours of that society, by the prevention of the fatal mischiefs which this substance so frequently occasioned. Dr Seip had soon afterwards suggested that the gas which stagnated in some caverns near Pyrmont was the cause of the briskness of the water; Dr Brownrigg of Whitehaven had confirmed this opinion by experiments in 1741; and Dr Black, in 1755, had explained the operation of this fluid in rendering the earths and alkalies mild. Such was the state of pneumatic chemistry when Mr Cavendish began these experimental researches. He first describes the apparatus now commonly used in processes of this kind, a part of which had been before employed by Hales and others, but which he had rendered far more perfect by the occasional employment of mercury. He next relates the experiments by which he found the specific gravity of inflammable air to be about $\frac{1}{11}$th of that of common air, whether it was produced from zinc or otherwise: first weighing a bladder filled with a known bulk of the gas, and then in a state of collapse; and also examining the loss of weight during the solution of zinc in an acid, having taken care to absorb all the superfluous moisture of the gas by means of dry potass. He also observed, that the gas obtained during the solution of copper in muriatic acid was rapidly absorbed by water, but he did not inquire further into its nature. The second paper relates to fixed air, which was found to undergo no alteration in its elasticity when kept a year over mercury; to be absorbed by an equal bulk of water, or of olive oil, and by less than half its bulk of spirit of wine; to exceed the atmospheric air in specific gravity by more than one half, and to render this fluid unfit for supporting combustion, even when added to it in the proportion of 1 to 9 only. Mr Cavendish ascertained the quantity of this gas contained in marble and in the alkalies; but his numbers fell somewhat short of those which have been determined by later experiments. He also observed the solubility of the supercarbonate of magnesia. In the third part, the air produced by fermentation and putrefaction is examined. Macbride had shown that a part of it was fixed air; and our author finds that sugar and water, thrown into fermentation by yeast, emit this gas, without altering the quantity or quality of the common air previously contained in the vessel, which retains its power of exploding with hydrogen, exactly like common air. He also shows that the gas thus emitted is identical with the fixed air obtained from marble; and that the inflammable air extricated during putrefaction resembles that which is procured from zinc, although it appears to be a little heavier.

2. *Experiments on Rathbone Place Water. Phil. Trans.* 1767, p. 92. In this paper Mr Cavendish shows the solubility of the supercarbonate of lime, which is found in several waters about London, and is decomposed by the process of boiling, the simple carbonate being deposited in the form of a crust. The addition of pure lime water also causes a precipitation of a greater quantity of lime than it contains. These conclusions are confirmed by synthetical experiments, in which the supercarbonate is formed, and remains in solution.

3. *An Attempt to explain some of the principal Phenomena of Electricity by means of an Elastic Fluid. Phil. Trans.* 1771, p. 584. Our author's theory of electricity agrees with that which had been published a few years before by Æpinus, but he has entered more minutely into the details of calculation; showing the manner in which the supposed fluid must be distributed in a variety of cases, and explaining the phenomena of electrified and charged substances, as they are actually observed. There is some degree of unnecessary complication, from the great generality of the determinations; the law of electric attraction and repulsion not having been at that time fully ascertained, although Mr Cavendish inclines to the true supposition, of forces varying inversely as the square of the distance. This deficiency he proposes to supply by future experiments, and leaves it to more skilful mathematicians to render some other parts of the theory still more complete. He probably found, that the necessity of the experiments which he intended to pursue was afterwards superseded by those of Lord Stanhope and M. Coulomb; but he had carried the mathematical investigation somewhat farther at a later period of his life, though he did not publish his papers; an omission, however, which is the less to be regretted, as M. Poisson, assisted by all the improvements of modern analysis, afterwards treated the same subject in a very masterly manner. The acknowledged imperfections in some parts of Mr Cavendish's demonstrative reasoning, have served to display the strength of a judgment and sagacity still more admirable than the plodding labours of an automatical calculator. One of the corollaries seems at first sight to lead to a mode of distinguishing positive from negative electricity, which is not justified by experiment; but the fallacy appears to be referable to the very comprehensive character of the author's hypothesis, which requires some little modification to accommodate it to the actual circumstances of the electric fluid, as it must be supposed to exist in nature.

4. *A Report of the Committee appointed by the Royal Society to consider of a Method for securing the Powder Magazine at Purfleet. Phil. Trans.* 1773, p. 42. *Additional Letter*, p. 66. Mr Cavendish, and most of his colleagues on the committee, recommended the adoption of pointed conductors; Mr Wilson protested, and preferred blunt conductors; but the committee persisted in their opinion. Later experiments, however, have shown that the point in dispute between them was of little moment.

5. *An Account of some Attempts to imitate the Effects of the Torpedo by Electricity. Phil. Trans.* 1776, p. 196. The peculiarity of these effects is shown to depend in some measure on the proportional conducting powers of the substances concerned, and on the quantity of electricity, as distinguished from its intensity. Iron is found to conduct 400 million times as well as pure water, and sea water 720

times as well; and the path chosen by the electric fluid depending on the nature of all the substances within its reach, an animal not immediately situated in the circuit will often be affected, on account of the facility with which animal substances in general conduct the fluid. The shock of a torpedo, producing a strong sensation, but incapable of being conveyed by a chain, was imitated by the effect of a weak charge of a very large battery; and an artificial torpedo of wood being made part of the circuit, the shock diffused itself very perceptibly through the water in which it was placed; but the experiment succeeded better when the instrument was made of wet leather, which conducts rather better than wood, the battery being more highly charged, in proportion to the increase of conducting power.

6. *An Account of the Meteorological Instruments used at the Royal Society's House. Phil. Trans.* 1776, p. 375. Of the thermometers it is observed, that they are adjusted by surrounding the tubes with wet cloths or with steam, and barely immersing the bulbs in the water; since a variation of two or three degrees will often occur, if these precautions are neglected. For the correction of the heights of barometers, we have Lord Charles Cavendish's table of the depression arising from capillary action. The variation compass was found to exhibit a deviation from the meridian 15′ greater in the house of the Royal Society than in an open garden in Marlborough Street; there was also a mean error of about 7′ in the indications of the dipping needle; but it was difficult to ascertain the dip, without being liable to an irregularity which often amounted to twice as much.

7. *Report of the Committee appointed to consider of the best Method of adjusting Thermometers. Phil. Trans.* 1777, p. 816. This paper is signed by Mr Cavendish and six other members, but it is principally a continuation of the preceding. It contains very accurate rules for the determination of the boiling point, and tables for the correction of unavoidable deviations from them; establishing 29·8 inches as the proper height of the barometer for making the experiment if only steam be employed, and 29·5 if the ball be dipped in the water; but, with all precautions, occasional variations of half a degree were found in the results.

8. *An Account of a New Eudiometer. Phil. Trans.* 1783, p. 106. Mr Cavendish was aware of the great difference in the results of eudiometrical experiments with nitrous gas, or nitric oxide, according to the different modes of mixing the elastic fluids; and he justly attributes them to the different degrees of oxygenization of the acid that is formed. But he found that when the method employed was the same, the results were perfectly uniform; and he ascertained in this manner that there was no sensible difference in the constituent parts of the atmosphere under circumstances the most dissimilar; the air of London, with all its fires burning in the winter, appearing equally pure with the freshest breezes of the country. He also observed the utility of the sulphurets of potass and of iron for procuring phlogisticated air; but he does not seem to have employed them as tests of the quantity of this gas contained in a given mixture.

9. *Observations on Mr Hutchins's Experiments for determining the degree of Cold at which Quicksilver freezes. Phil. Trans.* 1783, p. 303. In experiments of this kind many precautions are necessary, principally on account of the contraction of the metal at the time of its congelation, which was found to amount to about $\frac{1}{23}$d of its bulk; and the results which had been obtained were also found to require some corrections for the errors of the scales, which reduced the degree of cold observed to 39° below the zero of Fahrenheit, or 71° below the freezing point, answering to — 39·4° of the centesimal scale. In speaking of the evolution of heat during congelation, he calls it "generated" by the substances; and observes, in a note, that Dr Black's hypothesis of capacities depends "on the supposition that the heat of bodies is owing to their containing more or less of a substance called the matter of heat; and as" he thinks "Sir Isaac Newton's opinion, that heat consists in the internal motion of the particles of bodies, much the most probable," he chooses "to use the expression heat is generated," in order to avoid the appearance of adopting the more modern hypothesis; and this persuasion of the non-existence of elementary heat he repeats in his next paper. It is remarkable that one of the first of Sir Humphry Davy's objects, at the very beginning of his singularly brilliant career of refined investigation and fortunate discovery, was the confirmation of this almost forgotten opinion of Mr Cavendish; and for this purpose he devised the very ingenious experiment of melting two pieces of ice by their mutual friction in a room below the freezing temperature, which is certainly incompatible with the common doctrine of caloric, unless we admit that caloric could have existed in the neighbouring bodies in the form of cold, or of something else that could be converted into caloric by the operation; and this transmutation would still be nearly synonymous with generation in the sense here intended. However this may be, it is certain that, notwithstanding all the experiments of Count Rumford, Dr Haldalt, and others, Sir Humphry was less successful in persuading his contemporaries of the truth of Mr Cavendish's doctrine of heat, than in establishing the probability of his opinions respecting the muriatic acid.

10. *Experiments on Air. Phil. Trans.* 1784, p. 119. This paper contains an account of two of the greatest discoveries in chemistry that have ever yet been made public; the composition of water, and that of the nitric acid. The author first establishes the radical difference of hydrogen from nitrogen or azote; he then proceeds to relate his experiments on the combustion of hydrogen with oxygen, which had partly been suggested by a cursory observation of Mr Warltire, a lecturer on natural philosophy, and which prove that pure water is the result of the process, provided that no nitrogen be present. These experiments were first made in 1781, and were then mentioned to Dr Priestley; and when they were first communicated to Lavoisier, he found some difficulty in believing them to be accurate. The second series of experiments demonstrates, that when phlogisticated air, or nitrogen, is present in the process, some nitric acid is produced; and that this acid may be obtained from atmospheric air, by the repeated operation of the electrical spark.

It has been supposed by one of Mr Cavendish's biographers, that if Mr Kirwan, instead of opposing, had adopted his chemical opinions, "he would never have been obliged to yield to his French antagonists, and the antiphlogistic theory would never have gained ground." But in this supposition there seems to be a little of national prejudice. Mr Cavendish by no means dissented from the whole of the antiphlogistic theory; and in this paper he has quoted Lavoisier and Scheele in terms of approbation, as having suggested the opinion "that dephlogisticated and phlogisticated air are quite distinct substances, and not differing only in their degree of phlogistication, and that common air is a mixture of the two." He afterwards mentions several memoirs of Lavoisier in which phlogiston is entirely discarded; and says that "not only the foregoing experiments, but most other phenomena of nature, seem explicable as well, or nearly as well, upon this as upon the commonly believed principle of phlogiston;" and after stating a slight conjectural objection, derived from the chemical con-

stitution of vegetables, he proceeds finally to observe, that "Lavoisier endeavours to prove that dephlogisticated air is the acidifying principle." This is no more than saying that acids lose their acidity by uniting to phlogiston, which, with regard to the nitrous, vitriolic, phosphoric, and arsenical acids, is certainly true; and probably with regard to the acid of sugar; "but as to the marine acid, and acid of tartar, it does not appear that they are capable of losing their acidity by any union with phlogiston;" and the acids of sugar and tartar become even less acid by a further dephlogistication. It is obvious that this argument amounts only to an exception, and not to a total denial of the truth of the theory. M. Cuvier has even asserted that the antiphlogistic theory derived its first origin from one great discovery of Mr Cavendish, that of the nature of hydrogen gas, and owed its complete establishment to another, that of the composition of water; but it would be unjust to deny to Lavoisier the merit of considerable originality in his doctrines respecting the combinations of oxygen; and however he may have been partly anticipated by Hook and Mayow, it was certainly from him that the modern English chemists immediately derived the true knowledge of the constitution of the atmosphere, which they did not admit without some hesitation, but which they did ultimately admit when they found the evidence irresistible. On the other hand, it has been sufficiently established, since Mr Cavendish's death, by the enlightened researches of the most original of all chemists, that Lavoisier had carried his generalization too far; and it must ever be remembered, to the honour of Mr Cavendish, and to the credit of this country, that we had not all been seduced, by the dazzling semblance of universal laws, to admit facts as demonstrated which were only made plausible by a slight and imperfect analogy.

11. *Answer to Mr Kirwan's Remarks upon the Experiments on Air. Phil. Trans.* 1784, p. 170. Mr Kirwan, relying on the results of some inaccurate experiments, had objected to those conclusions which form the principal basis of the antiphlogistic theory. Mr Cavendish repeated such of these experiments as seemed to be the most ambiguous, and repelled the objections; showing, in particular, that when fixed air was derived from the combustion of iron, it was only to be referred to the plumbago shown by Bergmann to exist in it, which was well known to be capable, in common with other carbonaceous substances, of affording fixed air.

12. *Experiments on Air. Phil. Trans.* 1785, p. 372. The discovery of the composition of the nitric acid is here further established; and it is shown that the whole, or very nearly the whole, of the irrespirable part of the atmosphere is convertible into this acid when mixed with oxygen, and subjected to the operation of the electric spark; the fixed air sometimes obtained during the process being wholly dependent on the presence of some organic substances.

13. *An Account of Experiments made by Mr John Macnab, at Henley House, Hudson's Bay, relating to Freezing Mixtures. Phil. Trans.* 1786, p. 241. From these experiments Mr Cavendish infers the existence of two distinct species of congelation in mixed liquids, which he calls the aqueous and spirituous congelations, and of several alternations of easy and difficult congelation when the strength is varied, both in the case of the mineral acids and of spirit of wine. The greatest degree of cold obtained in these experiments was — $78\frac{1}{2}°$.

14. *An Account of Experiments made by Mr John Macnab, at Albany Fort, Hudson's Bay. Phil. Trans.* 1788, p. 166. The points of easy congelation are still further investigated, and illustrated by comparison with Mr Keir's experiments on the sulphuric acid. It was found that the nitric acid was only liable to the aqueous congelation, unless it was strong enough to dissolve one fourth of its weight of marble; and that it had a point of easy congelation, when it was capable of dissolving $\frac{415}{1000}$, the frozen part exhibiting, in other cases, a tendency to approach to this standard. Mr Keir had found that sulphuric acid of the specific gravity 1·78 froze at 46°; and that it had another minimum when it was very highly concentrated.

15. *On the Conversion of a Mixture of Dephlogisticated and Phlogisticated Air into Nitrous Acid, by the Electric Shock. Phil. Trans.* 1788, p. 261. Some difficulties having occurred to the Continental chemists in the repetition of this experiment, it was exhibited with perfect success, by Mr Gilpin, to a number of witnesses. This was an instance of condescension which could scarcely have been expected from the complete conviction which the author of the discovery must have felt of his own accuracy, and of the necessity of the establishment of his discovery, when time should have been afforded for its examination.

16. *On the Height of the Luminous Arch which was seen on Feb.* 23, 1784. *Phil. Trans.* 1790, p. 101. Mr Cavendish conjectures that the appearance of such arches depends on a diffused light, resembling the aurora borealis, spread into a flattened space contained between two planes nearly vertical, and only visible in the direction of its breadth, so that they are never seen at places far remote from the direction of the surface; and hence it is difficult to procure observations sufficiently accurate for determining their height upon so short a base; but in the present instance there is reason to believe that the height must have been between fifty-two and seventy-one miles.

17. *On the Civil Year of the Hindoos, and its Divisions, with an Account of three Almanacs belonging to Charles Wilkins, Esq. Phil. Trans.* 1792, p. 383. The subject of this paper is more intricate than generally interesting; but it may serve as a specimen of the diligence which the author employed in the investigation of every point more or less immediately connected with his favourite objects. The month of the Hindus is lunar in its duration, but solar in its commencement; and its periods are extremely complicated, and often different for different geographical situations. The day is divided and subdivided sexagesimally. The date of the year, in the epoch of the Kaly Yug, expresses the ordinal number of years elapsed, as it is usual with our astronomers to reckon their days; so that the year 100 would be the beginning of the second century, and not the 100th year, or the end of the first century, as in the European calendar; in the same manner as, in astronomical language, 1817 December 31d. 18h. means six o'clock in the morning of the 1st of January 1818.

18. *Experiments to determine the Density of the Earth. Phil. Trans.* 1798, p. 469. The apparatus with which this highly important investigation was conducted had been invented and constructed many years before by the reverend John Michell, who did not live to perform the experiments for which he intended it. Mr Cavendish, however, by the accuracy and perseverance with which he carried on a course of observations of so delicate a nature, as well as by the skill and judgment with which he obviated the many unforeseen difficulties that occurred in its progress, and determined the corrections of various kinds which it was necessary to apply to the results, has deserved no less gratitude from the cultivators of astronomy and geography than if the idea had originally been his own. The method employed was to suspend by a vertical wire a horizontal bar, having a leaden weight at each end; to determine the magnitude of the force of torsion by the time occupied in the lateral vibrations of the bar; and to measure the extent of the change produced in its

situation by the attraction of two large masses of lead placed on opposite sides of the case containing the apparatus, so that this attraction might be compared with the weight of the balls, or, in other words, with the attraction of the earth. In this manner the mean density of the earth was found to be five and a half times as great as that of water; and although this is considerably more than had been inferred from Dr Maskelyne's observations on the attraction of Shichallain, yet the experiments agree so well with each other, that we can scarcely suppose any material error to have affected them. Mr Michell's apparatus resembled that which M. Coulomb had employed in his experiments on magnetism, but he appears to have invented it some time before the publication of M. Coulomb's Memoirs.

19. *On an improved Method of Dividing Astronomical Instruments. Phil. Trans.* 1809, p. 221. The merits of this improvement have not been very highly appreciated by those who are in the habit of executing the divisions of circular arcs. It consists in a mode of employing a microscope, with its cross wires, as a substitute for one of the points of a beam compass, while another point draws a faint line on the face of the instrument in the usual manner. The Duke de Chaulnes had before used microscopal sights for dividing circles, but his method more nearly resembled that which has been brought forward in an improved form by Captain Kater; and Mr Cavendish, by using a single microscope only, seems to have sacrificed some advantages which the other methods appear to possess; but none of them has been very fairly tried; and our artists have hitherto continued to adhere to the modes which they had previously adopted, and which it would perhaps have been difficult for them to abandon, even if they had been convinced of the advantages to be gained by some partial improvements.

Such were the diversified labours of a philosopher who possessed a clearness of comprehension, and an acuteness of reasoning, which had been the lot of very few of his predecessors since the days of Newton. Maclaurin and Waring, perhaps also Stirling and Landen, were incomparably greater mathematicians; but none of them attempted to employ their powers of investigation in the pursuit of physical discovery. Euler and Lagrange on the Continent had carried the improvements of analytical reasoning to an unparalleled extent; and they both, as well as Daniel Bernoulli and D'Alembert, applied these powers with marked success to the solution of a great variety of problems in mechanics and in astronomy. But they made no experimental discoveries of importance; and the splendid career of chemical investigation which has since been pursued with a degree of success unprecedented in history, may be said to have been first laid open to mankind by the labours of Mr Cavendish; although the further discoveries of Priestley, Scheele, and Lavoisier, soon furnished, in rapid succession, a superstructure commensurate to the extent of the foundations so happily laid. "Whatever the sciences revealed to Mr Cavendish," says Cuvier, "appeared always to exhibit something of the sublime and the marvellous; he weighed the earth; he rendered the air navigable; he deprived water of the quality of an element;" and he denied to fire the character of a substance. "The clearness of the evidence on which he established his discoveries, new and unexpected as they were, is still more astonishing than the facts themselves which he detected; and the works in which he has made them public are so many masterpieces of sagacity and of methodical reasoning, each perfect as a whole and in its parts, and leaving nothing for any other hand to correct, but rising in splendour with each successive year that passes over them, and promising to carry down his name to a posterity far more remote than his rank and connections could ever have enabled him to attain without them."

In his manners Mr Cavendish had the appearance of a quickness and sensibility almost morbid, united to a slight hesitation in his speech, which seems to have depended more on the constitution of his mind than on any deficiency of his organic powers, and to an air of timidity and reserve, which sometimes afforded a contrast, almost ludicrous, with the sentiments of profound respect which were professed by those with whom he conversed. It is not impossible that he may have been indebted to his love of severe study, not only for the decided superiority of his faculties to those of the generality of mankind, but even for his exemption from absolute eccentricity of character. His person was tall, and rather thin; his dress was singularly uniform, although sometimes a little neglected. His pursuits were seldom interrupted by indisposition; but he suffered occasionally from calculous complaints. His retired habits of life, and his disregard of popular opinion, appear to have lessened the notoriety which might otherwise have attached to his multiplied successes in science; but his merits were more generally understood on the Continent than in this country, although it was not till he had passed the age of seventy that he was made one of the eight foreign associates of the institute of France.

Mr Cavendish was not less remarkable, in the latter part of his life, for the immense accumulation of his pecuniary property, than for his intellectual and scientific treasures. His father died in 1783, being at that time eighty years old, and the senior member of the Royal Society; but he is said to have succeeded at an earlier period to a considerable inheritance left him by one of his uncles. He resided principally at Clapham Common; but his library was latterly at his house in Bedford Square; and his books were at the command of all men of letters, either personally known to him, or recommended by his friends; indeed the whole arrangement was so impartially methodical, that he never took down a book for his own use, without entering it in the loan book; and after the death of a German gentleman, who had been his librarian, he appointed a day on which he attended in person to lend any work for the accommodation of the few who thought themselves justified in applying to him for such books as they wished to consult. He was constantly present at the meetings of the Royal Society, as well as at the conversations held at the house of the president; and he dined every Thursday with the club composed of its members. He had little intercourse with general society, or even with his own family, and saw only once a year the person whom he had made his principal heir. He is said to have assisted several young men whose talents recommended them to his notice, in obtaining establishments in life; but in his later years such instances were certainly very rare. His tastes and his pleasures do not seem to have been in unison with those which are best adapted to the generality of mankind; and amidst the abundance of all the means of acquiring every earthly enjoyment, he must have wanted that sympathy which alone is capable of redoubling our delights, by the consciousness that we share them in common with a multitude of our friends, and of enhancing the beauties of all the bright prospects that surround us, when they are still more highly embellished by reflection "from looks that we love." He could have had no limitation either of comfort or of luxury to stimulate him to exertion; even his riches must have deprived him of the gratification of believing, that each new triumph in science might promote the attainment of some great object in life that he earnestly desired; a gratification generally indeed illusory, but which does not cease to beguile us till we become cal-

 lous as well to the pleasures as to the sorrows of existence. But in midst of this "painful pre-eminence," he must still have been capable of extending his sensibility over a still wider field of time and space, and of looking forward to the approbation of the wise and the good of all countries and of all ages; and he must have enjoyed the highest and purest of all intellectual pleasures, arising from the consciousness of his own excellence, and from the certainty that, sooner or later, all mankind must acknowledge his claim to their profoundest respect and highest veneration.

"It was probably either the reserve of his manners," says Cuvier, "or the modest tone of his writings, that procured him the uncommon distinction of never having his repose disturbed either by jealousy or by criticism. Like his great countryman Newton, whom he resembled in so many other respects, he died full of years and honours, beloved even by his rivals, respected by the age which he had enlightened, celebrated throughout the scientific world, and exhibiting to mankind a perfect model of what a man of science ought to be, and a splendid example of that success which is so eagerly sought, but so seldom obtained." The last words that he uttered were characteristic of his unalterable love of method and subordination; he had ordered his servant to leave him, and not to return till a certain hour, intending to pass his latest moments in the tranquillity of perfect solitude; but the servant's impatience to watch his master diligently having induced him to infringe the order, he was severely reproved for his indiscretion, and took care not to repeat the offence until the scene was finally closed. Mr Cavendish died on the 24th of February 1810, and was buried in the family vault at Derby. He left a property in the funds of about L.700,000, which he divided into six equal parts, giving two to Lord George Cavendish, the son of his first cousin, one to each of his sons, and one to the Earl of Bessborough, whose mother was also his first cousin. Some other personal property devolved to Lord George as residuary legatee; and a landed estate of L.6000 a year descended to his only brother, Mr Frederic Cavendish of Market Street, Herts, a single man, and of habits of life so peculiarly retired, that any further increase of income would have been still more useless to him than it had been to the testator.

Much as Mr Cavendish effected for the promotion of physical science throughout his life, it has not been unusual, even for his warmest admirers, to express some regret that he did not attempt to do still more after his death by the appropriation of a small share of his immense and neglected wealth to the perpetual encouragement of those objects which he had himself pursued with so much ardour. But however we might be disposed to lament such an omission, we have surely no reason to complain of his determination to follow more nearly the ordinary course of distribution of his property, among those whose relationship would have given them a legal claim to the succession if he had not concerned himself in directing it. We may observe on many other occasions that the most successful cultivators of science are not always the most strenuous promoters of it in others; as we often see the most ignorant persons, having been rendered sensible by experience of their own deficiencies, somewhat disposed to overrate the value of education, and to bestow more on the improvement of their children than men of profounder learning, who may possibly have felt the insufficiency of their own accomplishments for insuring success in the world. But even if Mr Cavendish had been inclined to devote a large share of his property to the establishment of fellowships or professorships, for the incitement of men of talents to a more complete devotion of their lives to the pursuit of science, it is very doubtful whether he could have entertained a reasonable hope of benefiting his country by such an institution; for the highest motives that stimulate men to exertion are not those which are immediately connected with their pecuniary interests. The senators and the statesmen of Great Britain are only paid in glory; and where we seek to obtain the co-operation of the best educated and the most enlightened individuals in any pursuit or profession, we must hold out as incentives the possession of high celebrity and public respect, assured that they will be incomparably more effectual than any mercenary considerations, which are generally found to determine a crowd of commercial speculators to enter into competition for the proposed rewards, and to abandon all further concern with the objects intended to be pursued as soon as their avarice is gratified. To raise the rank of science in civil life is therefore most essentially to promote its progress; and when we compare the state not only of the scientific associations, but also of the learned professions, in this country and among our neighbours, we shall feel little reason to regret the total want of pecuniary patronage that is remarkable in Great Britain with respect to every independent department of letters, while it is so amply compensated by the greater degree of credit and respectability attached to the possession of successful talent. It must not however be denied, that even in this point of view there might be some improvement in the public spirit of the country. Mr Cavendish was indeed neither fond of giving nor of receiving praise; and he was little disposed to enliven the intervals of his serious studies by the promotion of social or convivial cheerfulness; but it would at all times be very easy for an individual, possessed of high rank and ample fortune, of correct taste and elegant manners, to confer so much dignity on science and literature, by showing personal testimonies of respect to acknowledged merit, as greatly to excite the laborious student to the unremitting exertions of patient application, and to rouse the man of brilliant talent to the noblest flights of genius. (T. Y.)

Cavendish, *Margaret*, Duchess of Newcastle, famous in her day for her voluminous productions, was born about the end of the reign of James I., and was the youngest daughter of Sir Charles Lucas of Colchester. She married the Duke of Newcastle at Paris in 1645; and remained abroad till after the Restoration. On her return she wrote a vast number of plays and poems, together with the life of her husband, to the amount of about twelve folio volumes. "What gives the best idea of her unbounded passion for scribbling," says Mr Walpole, "was her seldom revising the copies of her works, lest, as she said, it should disturb her following conceptions." She died in 1673.

Cavendish, *Thomas*, of Suffolk, the second Englishman who sailed round the globe, was descended from a noble family in Devonshire. Having dissipated his fortune, he resolved to repair it at the expense of the Spaniards. He sailed from Plymouth with three small ships in 1586, passed through the Straits of Magelhaens, took many rich prizes along the coasts of Chili and Peru, and near California possessed himself of the St Anna, an Acapulco ship with a cargo of immense value. Having completed the circumnavigation of the globe, he returned home round the Cape of Good Hope, and reached Plymouth again in September 1588. Besides the wealth which he had obtained, he had the honour of contributing not a little to the progress of geographical discovery. But his hastily acquired riches did not last long; for in 1591 he had reduced himself to the necessity of undertaking another voyage, which was far from being so successful as the former. He proceeded no farther than the Straits of Magelhaens, where the weather obliged him to return. At this he became dispirited, and died of grief in the homeward voyage.

Cavendish, *Sir William*, descended of an ancient and

honourable family, was born about the year 1505, and was the second son of Thomas Cavendish of Cavendish in Suffolk, clerk of the pipe in the reign of Henry VIII. Having had a liberal education, he was taken into the family of Cardinal Wolsey, whom he served in the capacity of gentleman-usher of the chamber. In 1527 he attended his master on his embassy to France, returned with him to England, and was one of the few who continued faithful to him in his disgrace. Cavendish was with him when he died, and delayed going to court till he had seen his remains decently interred. The king was so far from disapproving of his conduct, that he immediately took him into his household, made him treasurer of his chamber and a privy-councillor, and afterwards conferred on him the order of knighthood. He was also appointed one of the commissioners for receiving the surrender of religious houses. In 1540 he was nominated one of the auditors of the court of augmentations; and soon afterwards obtained a grant of several considerable lordships in Hertfordshire. In the reign of Edward VI. his estates were much increased by royal grants in seven different counties; and he appears to have continued in high favour at court during the reign of Queen Mary. He died in 1557. Sir William was the founder of Chatsworth, and ancestor of the Dukes of Devonshire. He wrote *The Life and Death of Cardinal Wolsey*, of which a mutilated copy appeared in 1641. It was first correctly printed in Dr Woodsworth's *Ecclesiastical Biography*, 6 vols. 8vo, 1810.

Cavendish, *William*, the first Duke of Devonshire, distinguished as a statesman and patriot, was born in 1640, and spent the early part of his life abroad. In 1677, having taken his seat in parliament for Derby, he vigorously opposed the venal measures of the court; and in the following year he was one of the committee appointed to draw up articles of impeachment against the lord-treasurer Danby. In 1679 he was re-elected for Derby, and made a privy-councillor by Charles II.; but he soon withdrew from the board with his friend Lord Russell, when he found that the Popish interest prevailed. He carried up the articles of impeachment to the House of Lords against Lord Chief-justice Scroggs, for his arbitrary and illegal proceedings in the court of king's bench; and when the king declared his resolution not to sign the bill for excluding the Duke of York, afterwards James II., he moved in the House of Commons that a bill might be brought in for the association of all his majesty's Protestant subjects. He also openly denounced the king's counsellors, and voted for an address to remove them. He appeared in defence of Lord Russell at his trial, at a time when it was scarcely more criminal to be an accomplice than a witness. The same fortitude, activity, and love of his country, animated him to oppose the arbitrary proceedings of James II.; and when he saw that there was no other mode of saving the nation, he was foremost in inviting the Prince of Orange from Holland, and was the first nobleman who appeared in arms to receive him at his landing. He was created Duke of Devonshire in 1694 by William and Mary, at whose court he held several important offices. His last public service was assisting in concluding the union with Scotland, for negotiating which he had been appointed a commissioner by Queen Anne. He died in 1707, and ordered the following inscription to be put on his monument:

Willielmus dux Devon,
Bonorum Principum Fidelis Subditus,
Inimicus et Invisus Tyrannis.

CAVERY, or Cauvery, a river of Hindustan, which rises among the Coorg Hills, near the coast of Malabar, in Lat 12. 25, Long. 75. 34, and passing through the Mysore near Seringapatam, Coimbetoor, and the Carnatic, below the Ghauts, falls into the Bay of Bengal by several mouths, after a winding course of nearly 500 miles. Opposite to Trichinopoly, in the Carnatic, the Cavery is divided just below the island of Seringham into two branches. The northern branch is named the Coleroon; the southern continues to bear the name of Cauvery. Extensive systems of canal irrigation, in connection with both branches of the river, have been constructed of late years by the British government; the effects of which have been to render the district of Tanjore one of the most fertile provinces of the presidency of Madras.

CAVIARE, a kind of food consisting of the salted roes of large fish, the best being that of the sturgeon. It is usually packed in kegs; and an inferior kind is formed into small dry cakes about an inch thick and three or four inches broad. Caviare is chiefly made in Russia, especially at Astrachan, where it is called *ikra*. It is greatly esteemed by that nation, and is also consumed in considerable quantities in Italy and France.

CAVITE, a fortified seaport-town, capital of a province of the same name in the island of Luzon, Philippines, on a tongue of land in the bay, and nine miles south of the city of Manilla. It is the head naval depôt of the Spanish possessions in the East, and has an arsenal, hospital, and several churches and convents. It was formerly of considerable importance. Pop. 5000.

CAWNPORE, a British district of Hindustan, named from its principal town, and situate within the jurisdiction of the lieutenant-governor of the north-western provinces of Bengal. It lies within the tract of country stretching from the Ganges to the Jumna, the latter river constituting its south-western boundary, and the former its north-eastern frontier. It extends from Lat. 25. 55. to 27., and from Long. 79. 34. to 80. 37.; is 75 miles in length from north to south, and 65 in breadth. The population has been returned at 993,031. The Ganges and the Jumna are both navigable throughout their entire course along this district; and the means of water-carriage and irrigation in this part of the north-western provinces will shortly be vastly increased by the prolongation of the Ganges canal, the line of which has been laid down on the highest tract of the district with a view to its termination at the city of Cawnpore, where the canal will rejoin the parent stream. The lands of Cawnpore are fertile and highly cultivated, few spots being left to nature except those cut up by ravines. The principal crops are wheat, barley, maize, pulse, oil-seeds, sugar-cane, and potatoes. The opium poppy (recently introduced) thrives well, as does also tobacco. Cotton is an important crop, and indigo is considered indigenous. The esculent vegetables of Europe are produced in great abundance; as are also grapes, peaches, mangoes, shaddocks, plantains, limes, and oranges. The district was ceded to the British government by the nawaub of Oude in 1801, in commutation of the annual subsidy payable by the nawaub for the maintenance of a British military force. The city of Cawnpore is situate on the right bank of the Ganges, stated to be here 500 yards wide at the season of low water. It covers an area of 690 acres, and contains about 11,000 houses, with a population of 59,000 inhabitants, exclusive of the military and the population of the cantonments. It is known as one of the principal military stations of the British in the Doab. The buildings which have been erected here for the accommodation of the troops are barracks for four hundred artillery, two regiments of European and three of native cavalry, and seven thousand native infantry, with a general hospital for the reception of the sick. The officers of every description provide their own lodgings, which consist of elegant bungalows built without any regularity, and which extend about six miles along the Ganges. Cawnpore is subject to great heats. The hot winds blow here with great violence during the months of April, May, and June; not a drop of rain then falls; and from the parched ground clouds of dust arise so thick as to obscure the sun, and to envelope the station in darkness. Cawnpore is nevertheless

esteemed a healthy station. Bishop Heber remarks that "there are many handsome mosques, and the view of the town from the course gives quite the idea of a city:" and adds, "On the whole, it is in many respects one of the most considerable towns which I have seen in Northern India; but, being of merely modern origin, it has no fine ancient buildings to show. The European architecture is confined to works of absolute necessity only, and marked by the greatest simplicity; and few places of its size can be named where there is so absolutely nothing to see." Distant S.W. from Lucknow, 53 miles; N.W. from Calcutta, 628 miles. Lat. 26. 29., Long. 80. 25.

CAXAMARCA, a city of Peru, capital of a province of the same name, department of Truxillo. It is pleasantly situate in a valley of the same name, on the eastern side of the Andes, about 9400 feet above the sea, and 80 miles N.N.E. of Truxillo. It has a considerable trade, and extensive manufactures of iron and silver wares. Pop. about 7000, chiefly Indians and Mestizoes. It has a number of fine churches and a gymnasium; and in the vicinity are the baths of the Incas. Among its public buildings is the ancient palace of the Incas, where Atahualpa, the last Inca of Peru, was basely murdered by the Spaniards.

CAXTON, William (1410–1492), the earliest English printer. See Printing.

CAYENNE, an island of South America. See Guiana,

Cayenne, a seaport-town and capital of French Guiana, on the N.W. extremity of the island of that name, in Lat. 4. 56. N., Long. 52. 15. W. It contains about 500 houses, mostly of wood, and is divided into the old and new towns, the latter clean and well built. It is the seat of a court of assize; and has a handsome church, Jesuit college, government house, and several large warehouses. The harbour is shallow, has two quays, and is protected by a fort and several batteries. Pop. about 6000.

Cayenne *Pepper* is prepared from several varieties of capsicum, a genus of solanaceous plants which produce a fleshy-coloured fruit. This fruit contains an extremely pungent principle, that exists in greatest activity in the seed. The capsicum from which the Cayenne is procured is a native of the East Indies and America. The principal Indian species is *C. frutescens*, and the American *C. annuum*. The capsicum enters largely into the seasoning of food and the preparation of pickles; and is also used in medicine, both internally and externally. The pods may be preserved in vinegar, or in a dry state in salt. The strongest variety of Cayenne pepper comes from the West Indies, and is prepared from the *Capsicum baccatum* (bird pepper).

CAYLUS, Anne-Claude, Philippe de Tubieres, de Grimoard, de Pestels, de Lévi, Comte de, Marquis d'Esternay, Baron de Bransac, was born at Paris in October 1692. He was the eldest of the two sons of John Count de Caylus lieutenant-general of the armies of the king of France, and of the Marchioness de Villette. The countess was the niece of Madame de Maintenon, and the author of a book entitled *Souvenirs de Madame de Caylus*, of which Voltaire published an elegant edition. Count de Caylus was only twelve years of age when his father died. He entered the corps of the *Mousquetaires;* and in his first campaign, in 1709, distinguished himself so much, that Louis XIV. rewarded him with an ensigncy in the *gens-d'armerie*. In 1711 he commanded a regiment of dragoons which was called by his own name, and signalized himself at the head of it in Catalonia. In 1713 he was present at the siege of Fribourg, where he was exposed to imminent danger in the bloody attack of the covered way. After the peace of Rastadt he travelled in Italy; and returned to Paris with so strong a passion for antiquities, that he resolved to devote himself entirely to that pursuit.

He had no sooner left the service of Louis than he set out for the Levant; and passed from Smyrna to Constantinople. He next visited Greece and the East, exposing himself to fatigue, contagion, and danger, in order to gratify his thirst for knowledge. He visited the ruins of Ephesus, and the other interesting cities of Ionia, under the escort of robbers belonging to a troop or band called Caracayali; returned to Byzantium by the Dardanelles; and lastly repaired to Adrianople, where the sultan, Mustapha II., then resided. In February 1717 he returned home at the urgent solicitation of his mother. From that time he only left France to make two excursions to London. The Academy of Painting and Sculpture admitted him as an honorary member in the year 1731; and the Count in return spared neither labour, credit, nor fortune, to instruct and assist the artists. He wrote the lives of the most celebrated painters and engravers who had done honour to the academy; and, in order to extend the limits of the art, he collected, in three different works, new subjects for painting which he had met with in the works of the ancients.

Regretting the decay which almost immediately followed the disentombment of ancient paintings, he caused a large collection of coloured drawings, taken by Pietro S. Bartoli from antique pictures, to be engraved at his own expense, and presented them to the cabinet of the king of France. Of the engravings only thirty copies were published. The inimitable purity and precision of the originals renders it a collection entirely unique.

Count Caylus was himself an admirable engraver, and produced numerous works, finished in a slight masterly style. They are almost all executed with the *point*, and scarcely show traces of the *graving-tool*. Upwards of 200 of his plates "from the drawings of the great masters" are preserved in the Imperial Library of France: and his "Heads after Rubens and Vandyck" were preserved in the cabinet of Crozat. He engraved also a set of "Antique Gems;" and his Collection of "Heads after Lionardo da Vinci" was published in 1730.

Count Caylus was at the same time engaged in an enterprise alike illustrative of the greatness of Rome and the history of France. This consisted in finishing the edition of engravings taken from Mignard's drawings of Roman antiquities in France, which Colbert had begun. At his death he left this design unfinished, and bequeathed it in his last illness to M. Mariette.

In 1742 Count Caylus was admitted as an honorary member of the Academy of Belles-Lettres; and from that time the study of literature became his ruling passion. To it he consecrated his time and his fortune; he even renounced his pleasures to give himself wholly up to the object of making some discovery in the field of antiquity. Amidst the fruits of his research nothing afforded him so much gratification as his discovery of encaustic painting. A description of Pliny, too concise to give a clear view of the matter to an ordinary reader, suggested the idea of this art to M. de Caylus. He availed himself of the friendship and skill of M. Magault, a physician in Paris, and an excellent chemist; and by repeated experiments discovered the secret of incorporating wax with various tints and colours, and of rendering it manageable with the pencil. Pliny has made mention of two kinds of encaustic painting practised by the ancients, one of which was executed with wax on various substances, and the other upon ivory with hot punches of iron. It was the former kind, however, that Count Caylus had the merit of reviving; and M. Muntz afterwards made many experiments in order to carry it to perfection.

In the hands of Count Caylus literature and the arts lent each other mutual aid. But it would be endless to give an account of all his works. He published above forty dissertations in the Memoirs of the Academy of Belles-Lettres; and founded a prize of five hundred livres, the object of which was to explain, by means of authors and monuments,

the usages of ancient nations. To render as generally accessible as he could the treasures which he had collected, he caused them to be engraved, and gave a learned description of them in a work which he embellished with eight hundred copperplates.

The strength of his constitution seemed to give him hopes of a long life; but a disease which settled in one of his legs entirely destroyed his health, and he expired on the 5th of September 1765. His character is thus drawn by a French biographer:—" A severe probity, a rooted aversion to flattery, great indifference about honours, a singular simplicity, perhaps sometimes a little dogmatism in his opinions, formed the basis of his character. In him young artists found both a guide and a friend; and with a discernment and a delicacy still more rare than generosity, he anticipated the wants of those whose progress would have been otherwise retarded by the narrowness of their means. Naturally beneficent, he sometimes amused himself when he met a pauper whose appearance indicated probity, by giving him a louis to get changed, and then concealing himself where he could enjoy the poor creature's embarrassment when the person from whom he received the gold was not to be found. Caylus, indeed, never knew any other luxury than that of liberality. His dress, in particular, was so plain that, having one day stopped before a shop on which a sign-painter was painting a figure of St Francis, the latter, taking him for one of his comrades, asked his opinion respecting the work, which Caylus instantly gave him, and which delighted the painter so much, that he put the pallet and pencil into the hand of his new acquaintance, and begged him to retouch the picture. Caylus mounted the ladder, and having succeeded to the entire satisfaction of the painter, the latter wished to take him to a neighbouring tavern, when the carriage of the Count arrived, and his footman opened the door for his master. The painter of saints and signs was stupefied with astonishment; but Caylus, taking him by the hand, said, *Au revoir, camarade, ce sera pour la première fois que nous nous rencontrerons.*"

The numerous literary works of Count Caylus may be divided into three classes; humorous pieces and romances; productions relative to the fine arts; and those which treat exclusively of antiquities. I. The first class consists of, 1. *Les Eccosseuses, ou les Œufs de Pâques*, Troyes, 1739 et 1745, 12mo; 2. *Histoire de Guillaume, Cocher*, 12mo; 3. *Féeries Nouvelles*, Paris, 1742, 2 vols. 12mo; 4. *Soirées du Bois de Boulogne*, Paris, 1742, 12mo; 5 *Etrennes de la St Jean*, in conjunction with Moncrieff, Crebillon the younger, Duclos, La Chaussé, Voisenon, and others; 6. *Contes Orientaux*, 1743, 12mo; 7. *Histoire de Mlle. Cronel, dite Frétillon (Mlle. Clairon)*, Paris, 1743, 12mo; 8. *Histoires Nouvelles et Mémoires ramassés*, Paris, 1743; 9 *Quelques Aventures des Bals de Bois*, 1745, 12mo; 10. *Cinq Contes des Fées*, 1745, 12mo; 11. *Recueil de ces Messieurs*, 1745, 12mo; 12. *Les Manteaux*, Paris, 1746, 12mo; 13. *Les Fêtes roulantes et les Regrets des petites rues*, 1747, 12mo; 14. *Mémoires de l'Académie des Colporteurs*, 1748, 8vo; 15. *Le Calsandre fidèle*, translated from the Italian of Marini, Paris, 1740, 3 vols. 12mo; 16. *Histoire du Vaillant Chevalier Tyran-le-Blanc*, translated from the Spanish, London, 1775, 3 vols. 12mo; with some other pieces which are attributed to him. II. His works relating to the fine arts are, 1. *Nouveaux Sujets de Peintre et de Sculpture*, Paris, 1755, 12mo; 2. *Tableaux tirés de l'Iliade, de l'Odyssée et de l'Enéide, avec des Observations générales sur le Costume*, Paris, 1757, 8vo; 3. *Histoire d'Hercule le Thébain*, Paris, 1758, 8vo; 4. *Les Vies de Mignard et de Lemoyne* in the *Recueil des premiers Peintres du Roi*, Paris, 1752, 8vo; 5. *Mémoire sur la Peinture à l'Encaustique*, 1755, 8vo; 6. *Description d'un tableau représentant la sacrifice d'Iphigénie*, 1757, 12mo; 7. *Vie d'Edme Bouchardon*, Paris, 1762, 12mo. III. His works relative to antiquities are, 1 *Recueil d'Antiquités Egyptiennes, Etrusques, Grecques, Romaines, et Gauloises*, Paris, 1752, and the years following, 7 vols. 4to; 2. *Numismata Aurea Imperatorum Romanorum*, without date, 4to, very rare; *Recueil de Medailles du Cabinet du Roi*, no date, 4to, also very rare; 4. *Dissertation sur le Papyrus*, Paris, 1758, 4to, in the *Mémoires de l'Académie des Inscriptions*; 5. *Recueil de Peintures antiques*, Paris, 1757, fol.

CAYSTER, or CAYSTRUS, in *Ancient Geography*, a river of Lydia and Ionia, which rises in the Montes Cilbiani, and falls into the sea a little to the north of Ephesus. At the foot of Mount Gallesus it is crossed by an ordinary bridge of three arches. It is sometimes called by the Turks Little Meendras, after the river Meander, which it resembles in its windings. At its mouth was the Asius Campus, noted for the flocks of wild fowl by which it was frequented. The Cayster was a favourite haunt of the wild swan.

CAZALLA DE LA SIERRA, a town of Spain, province of Seville, on the Sierra Morena, in the neighbourhood of extensive marble quarries, and mines of silver, iron, sulphur, and copper, from which, as well as from agriculture, it derives its trade. In the suburbs are remains of Roman and Moorish antiquities. Its manufactures are purely domestic. Pop. 6552.

CAZIQUE, or CACIQUE, a title given by the Spaniards to the native princes and chiefs of the several countries of America, when they first visited that country.

CAZORLA, a town on the Vega, Jaen, Spain. It contains about 964 houses, generally well built, 2 old castles, one of them Arabic, 2 schools, several hospitals, a spacious theatre, a very ancient church, and several convents. Agriculture is the prevailing occupation. Pop. 7383. Cazorla was an important military station under the Romans and Moors; and has suffered considerably during the vicissitudes of the civil wars in Spain.

CEBES, of Thebes, a Socratic philosopher, author of a work entitled Πίναξ, (*Tabula*), or *Dialogues on the Birth, Life, and Death of Mankind*. He was the disciple and intimate friend of Socrates. The above work is mentioned by Lucian, Diogenes Laertius, Tertullian, and Suidas; but of Cebes himself we have no account, save an accidental notice by Plato, and another by Xenophon. The former says in his *Phædo* that Cebes was a sagacious investigator of truth, and never assented without the most convincing reasons; the latter, in his *Memorabilia*, ranks him among the few intimates of Socrates who excelled the rest in the innocence of their lives. The *Tabula* of Cebes is usually printed with the *Manuale* of Epictetus. It has been translated into all the languages of Europe, and into Arabic.

CECIL, WILLIAM, Lord Burleigh, treasurer of England in the reign of Queen Elizabeth, was the son of Richard Cecil, Esq., master of the robes to King Henry VIII. He received the rudiments of his education in the grammar-school at Grantham; and from this seminary he was removed, first to Stamford, and afterwards about the year 1535 to St John's College, Cambridge. Here he began his studies with great enthusiasm. At the age of sixteen he read a sophistry lecture, and at nineteen a voluntary lecture in Greek. In 1541 he went to London, and became a member of the society of Gray's Inn, with an intention of studying the law; but he had not been long in this situation before an accident introduced him to King Henry, and gave a new bias to his pursuits. O'Neil, a famous Irish chief, having brought to court with him two Irish chaplains, adherents of the Romish faith, Mr Cecil, happening to meet these ecclesiastics when on a visit to his father, had a warm dispute with them in Latin, in which he displayed uncommon abilities. The king, being informed of the circumstance, summoned Cecil into his presence, and granted him the reversion of the *custos brevium* at the court of common pleas. About this time he married the sister of Sir John Cheke, by whom he was recommended to the Earl of Hertford, afterwards Duke of Somerset and protector.

Soon after King Edward's accession, Mr Cecil came into the possession of the office of *custos brevium*, worth about L.240 a year; and married, as his second wife, the daughter of Sir Anthony Cook, director of the king's studies. In 1547 he was appointed by the protector master of requests; and soon afterwards accompanying the expedition against the Scots was present at the battle of Musselburgh, where his life was miraculously preserved by a friend, who, on

Cecil.

pushing him out of the line of a cannon-shot, had his arm shattered to pieces. The story is told in his life by a domestic. In the year 1548 Mr Cecil was made secretary of state; but in the following year when the Duke of Northumberland's faction prevailed, he shared in the disgrace of the protector Somerset, and was sent prisoner to the Tower. After three months' confinement he was released, restored to his office in 1551, and soon afterwards knighted and sworn a member of the privy-council. In 1553 he was made chancellor of the order of the Garter, with an annual fee of a hundred merks.

On the death of Edward VI. Sir William Cecil refused to take any part in Northumberland's attempt in favour of the unfortunate Lady Jane Grey; and when Queen Mary succeeded to the throne, he was graciously received at court; but not choosing to change his religion, was dismissed from all his employments. During this reign he was twice elected knight of the shire for the county of Lincoln, and often spoke in the House of Commons with great freedom and firmness, in opposition to the ministry. So great was his tact and prudence, that, though a Protestant and a patriot, he was suffered to live unmolested during the whole of that reign.

Queen Elizabeth's accession, in the year 1558, immediately restored him to his former rank and influence. During the reign of her sister he had constantly corresponded with the princess Elizabeth; upon the very day of her accession, he presented her with a paper containing twelve articles necessary for her immediate despatch; and in a few days after he was sworn a privy-councillor and made secretary of state. His first advice to the queen was to call a parliament; and the first business he proposed after it had assembled was the establishment of a national church. A plan of reformation was accordingly drawn up under his immediate inspection, and the legal establishment of the Church of England was the consequence. Sir William Cecil's next important concern was to restore the value of the coin, which had been considerably debased in the preceding reigns. In 1561 he was appointed master of the wards, and, in 1571, created Baron of Burleigh as a reward for his services, particularly in having lately stifled a formidable rebellion in the north. The following year he was honoured with the garter, and raised to the office of lord high treasurer of England. From this period we find him the principal agent in every material transaction during the glorious reign of Queen Elizabeth. Notwithstanding the temporary influence of other favourites, Lord Burleigh was her prime minister, and the person in whom she chiefly confided in matters of real importance. Having filled the highest and most important offices of the government for forty years, and guided the helm of the state during the most glorious period of English history, he died on the 4th of August 1598, in the seventy-eighth year of his age. His body was removed to Stamford, and there deposited in the family vault, where a magnificent tomb was erected to his memory.

He wrote, 1. *La Complainte de l'Ame pêcheresse*, or the Complaint of a sinful Soul, in French verse; 2 Materials for Patten's *Diarium Exped. Scoticæ*, London, 1541, 12mo; 3. Slanders and Lies, maliciously, grossly, and impudently vomited out in certain traiterous books and pamphlets against two counsellors, Sir Francis Bacon and Sir William Cecil; 4. A Speech in Parliament, 1562, Strype's Mem., vol. iv., p. 107; 5. Precepts or Directions for the well ordering of a Man's Life, 1637, Harl. Cat., vol. ii., p. 755; 6. Meditations on the Death of his Lady, Ballard's Mem., p. 184; 7. Meditations on the state of England during the reign of Queen Elizabeth, manuscript; 8. The execution of justice in England for the maintenance of public and Christian peace, &c, Lond, 1581, 1583, Somer's Tracts, 4th Collect, vol. i., p. 5; 9. Advice to Queen Elizabeth in Matters of Religion and State, *ib.*, p. 101, 106; 10. A great number of Letters; 11. Several Pedigrees, some of which are preserved in the Archbishop of Canterbury's library at Lambeth.

CECIL, Robert (1550–1612), son of the preceding, was delicate in constitution, and deformed in person, but early distinguished himself in parliament, to which he was sent as member for Westminster In 1588, he went on board the fleet which was sent by Elizabeth against the Spanish Armada, and on his return was rapidly promoted to places of honour and trust at court. Having been knighted by the queen, he was sent as an attaché to the English embassy in France, and afterwards sworn a member of the privy-council. He held the office of second secretary of state till the death of Sir Francis Walsingham, when he was appointed principal secretary—an office which he held till his death. During the reign of Elizabeth, he was intrusted with the conduct of numerous delicate negotiations abroad, and on the death of his father in 1598, was appointed prime minister. Having previously kept up a secret correspondence with James I., he was not only confirmed in his office, but raised to additional dignities on the accession of that monarch. It is well remarked by Lord Hailes, that this consummate politician "was no less solicitous to maintain his own power than to settle the succession to his aged benefactress Queen Elizabeth." (*Pref. to Cecil's Correspond.*) He was created successively Baron of Essenden, Viscount Cranbourne, and Earl of Salisbury, and notwithstanding the efforts of the Spanish court through their ambassadors to bring him into disgrace on account of his attachment to the interests of the United Provinces, he continued to rise in popular estimation. On the death of Sir Thomas Sackville, he was appointed lord high treasurer, in which capacity he effected considerable reforms in the exchequer. He died at Marlborough in 1612, and was buried at Hatfield. He wrote *A Treatise concerning the State and Dignity of a Secretary of State, with the care and peril thereof; A Treatise against the Papists; and Notes on Sir John Dee's Discourse about the Reformation of the Calendar.*

Cecilia.

CECILIA, St, the patron saint of music, has been honoured as a martyr ever since the fifth century. Her story, as delivered by the Notaries of the Roman Catholic church, and thence transcribed into the Golden Legend and similar books, says that she was a Roman lady, born of noble parents about the year 295; that, notwithstanding she had been converted to Christianity, her parents married her to a young Pagan nobleman named Valerianus, who on the wedding night was given to understand by his spouse that she was nightly visited by an angel, and that he must forbear to approach her, otherwise the angel would destroy him. Valerianus, troubled at these words, desired that he might see his rival the angel; but he was told that was impossible, unless he would consent to be baptized and become a Christian. To this he consented; after which, returning to his wife, he found her in her closet at prayer, and by her side, in the shape of a beautiful young man, an angel clothed with brightness. After some conversation with the angel, Valerianus told him that he had a brother named Tiburtius, whom he greatly desired to see a partaker of the grace which he himself had received. The angel answered that his desire was granted, and that they should be both crowned with martyrdom in a short time. Upon this the angel vanished, and was not long in showing that he had kept his word; for Tiburtius was converted, and both he and his brother Valerianus were beheaded. Cecilia was offered her life upon condition that she would sacrifice to the deities of the Romans, but she refused; upon which she was thrown into a caldron of boiling water and scalded to death. Others say, that she was stifled in a dry bath, or an inclosure from which the air had been excluded, heated by a slow fire underneath; a kind of death which was sometimes inflicted by the Romans on women of rank who were criminals. Upon the spot where her house stood is a church, said to have been built by Pope Urban I., who administered baptism to her husband and his brother. This church is that of St Cecilia in Trastevere; and within it is a curious painting of the saint, and a stately monument surmounted by a cum-

bent statue with the face downwards. There is a tradition that St Cecilia excelled in music, and that the angel was drawn from the celestial regions by the charms of her melody; hence she came to be regarded as the patroness of music and musicians. The legend of St Cecilia has furnished the subject of several exquisite works of art. Raphael has painted the saint in the attitude of singing with a regal in her hand; and Domenichino and Mignard in that of singing and playing on the harp.

CECROPS, the founder and first king of Athens, supposed to have been contemporary with Moses. He was the first who established civil government, religious rites, and marriage among the Greeks. He reigned fifty years. See ATHENS, and ATTICA.

CEDAR. See PINUS, PLANTING, SYRIA, TIMBER.

CEDRENUS, GEORGIUS, a Greek monk, who lived in the eleventh century, and wrote Annals, or an abridged History, from the beginning of the world to the reign of Isaac Comnenus, emperor of Constantinople, who succeeded Michael IV. in 1057. This work is no more than a compilation from several historians. There is an edition of it printed at Paris, 2 vols. fol., 1647, with the Latin version of Xylander, and the notes of Father Goar, a Dominican. A more recent edition has been published by Immanuel Bekker, 2 vols. 8vo, Bonn, 1838–9.

CEFALU, a fortified seaport-town on the north coast of Sicily, intendancy and 40 miles E.S.E. of Palermo. It is tolerably well built, but its port is small, and its trade inconsiderable. On the summit of a lofty conical hill above the town are ruins of a Saracenic castle. Pop. about 9000.

CEHEGIN, a town of Murcia, Spain, 3 miles east from Caravaca. Its houses, 1616 in number, are generally handsome, being built chiefly of marble from the neighbouring quarries, and its civil, religious, and educational establishments are in a comparatively prosperous condition. It possesses a considerable trade in agricultural produce, especially wine, hemp, and oil; and also several manufactories of paper and coarse linen. Pop. 10,354.

CEILING, the top or roof of a room. See ARCHITECTURE. In ship-building it denotes the lining or inside planks of a ship.

CEIMELIA, (from κειμαι, to be laid up) in *Antiquity*, treasures or other things stored up as valuable in a *ceimelarchium*, *i. e.* a storehouse or repository. Thus, sacred vestments, plate, and the like, are the ceimelia of a church. Medals, antique stones, manuscripts, &c., are the ceimelia of men of letters.

CEIMELIOPHYLAX (from κειμήλιον, a treasurer, and φυλάσσω, to guard), or ceimeliarcha, an officer in the ancient churches or monasteries, answering to what was otherwise denominated *chartophylax* and *custos archivorum*.

CELANO, LAKE, see FUCINUS LACUS.

CELARENT, among logicians, a mode of syllogism, in which the major and the conclusion are universal negative propositions, and the minor a universal affirmative.

E. gr. cE None whose understanding is limited can be omniscient.
lA Every man's understanding is limited.
rEnt Therefore no man is omniscient.

CELASTRUS, the staff-tree, a genus belonging to the natural order Celastraceæ. See BOTANY, p. 189. In Senegal the negroes use the powder of the root of this plant as a specific against gonorrhœa.

CELATURE, the art of engraving and embossing. Under the term *cælatura*, the ancients included every kind of ornamental work in metal, with the exception of statues.

CELBRIDGE, a pleasantly situated and well built town of Ireland, county of Kildare, on the Liffey, 11 miles west of Dublin. It has a church, chapel, savings-bank, hospital, large woollen factory, a handsome stone bridge over the river; and in 1851, 1674 inhabitants.

CELEBES, an important group of islands in the Indian Archipelago, the principal of which extends from N. Lat. 1. 45. to S. Lat. 5. 45.; and from E. Long. 113. 10. to 116. 45. Its length is estimated at 576, its average breadth at 75 miles, and its area is by various authorities computed at 75,000 square miles. The Portuguese, by whom the island was invaded in the sixteenth century, appear to have been the first Europeans by whom any part of it was occupied. English and Danish settlements, which were not long maintained, were afterwards formed on various parts of the coast. The Dutch ultimately acquired permanent possession of all the most important districts, the native princes having given their assent to treaties by which they acknowledged the sovereignty of that power, and placed themselves under its protection. The island of Celebes and its surrounding groups now constitute one of the most valuable colonial possessions of Holland. Celebes is described as very irregular in its conformation, the most considerable portion of the island consisting of four great peninsulas, the form of which is determined by three arms of the sea, extending from east to west far into the land, and its coast is penetrated in all directions by numerous small gulfs and bays. The whole of it, but particularly the interior and northern parts, are very mountainous, the highest elevations being Lampo-Betang, 7000 feet, and Mount Klabat, 6000 feet high. There are also several other mountains and volcanoes, both active and extinct, ranging from 5000 to 3000 feet in height. The northern districts of Mongondo and Menado, in some parts of which there are immense quantities of sulphur, have been frequently exposed to severe shocks of earthquakes. In its physical constitution, the island consists for the most part of ignigenous rocks, particularly basalt in a state of decomposition, covered with a vegetable soil of various degrees of depth. Between the elevated regions of the interior and the coasts are extensive plains of great fertility, beautiful valleys covered with a rich intertropical vegetation, and picturesque lakes surrounded by richly wooded banks. In the northern parts of the island there are several mines of copper, tin, iron, and gold. Considerable quantities of the more precious metal, which is found in the form of dust and spangles, are unfortunately lost in consequence of the imperfect system of gold washing adopted by the natives. The highly tempered weapons of the natives are manufactured by themselves from steel and the metal to which they give the name of *pamor*. The vegetable productions of the island, which are both numerous and valuable, consist of nutmegs, pepper, cloves, ginger, sago, tapioca, cocoa, coffee, the sugar-cane, rice, maize, and tobacco. The ebony tree, the palm, the sandal, the banana, the silk cotton tree, the indigo plant, the samuk, the calambang, the waranguin, the bamboo, the lingoa, and tanjoung, also flourish in various parts of Celebes. No formidable beast of prey is known to exist in any part of the island, the only peculiar animals being some species of the monkey tribe, such as the *papio niger*, and the *papio nigrescens*, several kinds of bats, the *sus babirussa*, the antelope *depressicornis;* and a small but spirited race of horses, great numbers of which are sent to Batavia, Madras, and Calcutta. The rivers, of which the principal are the Gea, the Sadang, the Maros, and the Boli, are frequented by crocodiles, lizards, and serpents of various kinds. The transparent sea of those regions, which sometimes assumes an appearance of milky whiteness, supposed to be caused by the presence of an immense number of microscopical mollusca on the surface, contains a great number of those crustacea and mollusca which are so much admired and sought after by the lovers of curiosities. When the waters are calm, fields of zoophytes may be distinctly perceived at a considerable depth extending their branches on all sides in ever-changing varieties of form and colour

The peninsulas extending to the north, the south, and the east, are the only parts of the island which have been re-

garded by the Dutch as commercially important, or which have ever been explored by any Europeon. Each of these peninsulas includes a great number of petty states, of which Macassar (native capital Goa, upon a river of the same name), Boni, Wadjo, and Mandhar are among the principal, all governed by native kings, princes, sultans, and rajahs, who are either subject to the Dutch government or under its influence and protection. The town of Macassar, which is situated at the south-western extremity of the southern peninsula stretching out into the sea of Java, is the chief European settlement. The governor of the island, who is assisted in the administration of its affairs by five residents located in different districts, resides here. Macassar is admirably situated for commercial purposes, being in the direct line of the navigation connected with the straits of Malacca, the principal ports of Java, the Moluccas, the southward route to Australia, and the ports which China has opened to the ships of all nations. The northern peninsula, known as the residence of Menado, comprehends all that portion of the island situated between the bay of Palos and Cape Taliabo. The other two peninsulas (in one of which is the bay of Vosmaer, the superior advantages of which for European commercial settlements have been so strongly represented by one of the late Dutch residents, whose name has been bestowed upon it) have hitherto been regarded by the government as only of secondary importance. Of the numerous groups of smaller islands by which Celebes is surrounded, the principal are Salajer, Sangir, Talant, Boeton, Moena, Kambeina, and Wangi Wangi. The population of Celebes, which consists of the aboriginal Alfoeres, Malays, Chinese, and Dutch, is estimated to amount to 1,104,000; although by some the computation has been carried as high as 3,000,000, which is considered, however, by the most intelligent judges as far above the actual number. According to the approximative census of 1838, the population immediately subject to the government of the Netherlands amounted only to 410,000. The Malays, who in religion are Mohammedans, are said to have come originally from Sumatra, to have conquered the districts on the coast, and, with the exception of a few whom they compelled to adopt their manners, customs, and religion, to have driven all the native inhabitants into the interior. The Alfoeres, Minahasses of the north, while worshipping several secondary deities and holding the doctrine of metempsychosis, profess to believe in one supreme being whom they name Epong. The Malays and Alfoeres, living in the neighbourhood of the European settlements, are described as active, intrepid, and brave; but when their passions are roused, and their jealousy or suspicion excited, as haughty, vindictive, and cruel. In some of the more remote districts, particularly in the south-eastern peninsula, the natives are extremely uncultivated and savage. The barbarous custom of cutting off heads in order to adorn their persons, weapons, houses, and tombs, with portions of the skull and the hair of their victims, still continues to be practised. Piracy is carried on to a great extent all along the coast and in the neighbouring islands; and it is almost hopeless for the industrious agricultural and fishing communities who are settled in the more remote and unprotected districts to carry on their labours with any probability of ultimate benefit. Many of the Malays and Alfoeres are actively engaged in commerce, the articles which they convey from the island in their pirogues being coffee, rice, bees' wax, cocoanut oil, palm sugar, Macassar mats, tortoise-shell, and *goemoeti*, a very strong kind of cordage produced from the fibres of one of the species of the palm-tree growing in Celebes. The principal imports which they bring back in return are cotton and silk manufactures, arak, iron, steel, copper utensils, and the various productions of China. Celebes altogether presents one of the most promising fields for commercial enterprise and manufacturing industry. Being free from that pestilential miasma by which many other tropical regions are rendered so unhealthy for Europeans, possessing a salubrious climate and a fertile soil, it may reasonably be anticipated that when the island has been more thoroughly explored, civilization more widely spread, the barbarous and superstitious customs of its inhabitants extirpated, and its commercial advantages more fully appreciated, it will ultimately become, like Java, one of the most valuable dependencies of the crown of Holland.

CELERES, in Roman antiquity, a regiment of body-guards established by Romulus, composed of three hundred young men of the most illustrious families, and approved by the suffrages of the curiæ of the people, each of which furnished ten. The name was given them because of their promptness to obey the king, whom they attended both in peace and in war. In war they formed the vanguard in the engagement; in retreats the rearguard. Though the *celeres* were a body of horse, yet they usually dismounted and fought on foot. Their commander was called *Tribunus Celerum*. They were divided into three centuries, each commanded by a captain called centurio; and their tribune occupied the second place in the state. Plutarch says that Numa broke the *celeres*. If this be true, they were soon re-established; for we find them under most of the succeeding kings. Brutus, who expelled the Tarquins, was tribune of this *corps d'élite*. See EQUITES.

CELERITY, the swiftness of any body in motion. It is also defined as an affection of motion by which a movable body runs through a given space in a given time.

CELERY (σέλινον), a variety of *Apium graveolens*. See HORTICULTURE.

CELESTINE, the name of five popes. See POPE.

CELESTINS, a religious order, so called from their founder Peter de Mouron, afterwards Pope Celestine V. He was born of humble parents at Ifernia in the kingdom of Naples in 1215; and retired while very young to a solitary mountain, in order to dedicate himself to prayer and mortification. The fame of his piety soon attracted followers; and with these in 1254 he formed a kind of community, which ten years later was approved by Pope Urban IV. and erected into a distinct order, called the *Hermits of St Damien*. Peter de Mouron governed this order till 1286, when his love of solitude induced him to quit the charge. In July 1294 he was raised to the pontificate by the name of Celestine V. By a bull he approved of the constitution of the Celestins, and confirmed all their monasteries to the number of twenty. After governing the church but five months and a few days, he found that he was unequal to the burden, and renounced the pontificate in a consistory held at Naples.

After his death, which happened in 1296, the Celestins made great progress, not only in Italy, but likewise in France, whither in 1300 the then general, Peter of Tivoli, sent twelve religious persons at the desire of Philip the Fair, who gave them two monasteries; one in the forest of Orleans, the other in the forest of Compiègne. This order also passed into several provinces of Germany. They possessed about ninety-six convents in Italy, and had twenty-three in France at the time of their suppression in 1778.

The Celestins rise two hours after midnight to say matins; eat no flesh except when sick; and observe frequent fasts. Their habit consists of a white gown, a capuche, and a black scapulary. In the choir, and when they leave the monastery, they wear a black cowl with the capuche.

CELEUSMA, or CELEUMA (from κελεύω), in *Antiquity*, the command or call given by the chief oarsman to the rowers. This officer was called *celeustes*; and by the Romans *portisculus*, *pausarius*, or simply *hortator*. His duties are well described by Silius Italicus—

> Mediæ stat margine puppis,
> Qui voce alternos nautarum temperet ictus,
> Et remis dictet sonitum, pariterque relatis
> Ad sonitum plaudat resonantia cærula tonsis.

CELIBACY (*cœlibatus*, or *cælibatus*, single life; *cœlebs* or *cælebs*, an unmarried person); the unmarried state. Scaliger derives the word from κοίτη, bed, and λείπω, to leave; and some more fancifully, from *cœli beatitudo*, *i.e.*, the blessedness of heaven.

Clearchus, a pupil of Aristotle, states that at a certain festival at Sparta, the women were enjoined to flog old bachelors around an altar, that they might be constrained to take wives.

The ancient Romans enacted various laws to discourage celibacy. Dionysius Halicarnasseus mentions an ancient constitution by which all persons of mature age were obliged to marry. But the first law of that kind of which we have any certain information is that under Augustus, called *Lex Julia de Maritandis Ordinibus*. It was afterwards denominated *Papia Poppœa*, and more usually *Julia Papia*, on account of some new sanctions and amendments made to it under the consuls Papius and Poppæus. By this law various prerogatives were given to persons who had many children; while penalties were imposed on those who lived a single life, such as being incapable of receiving legacies, unless they married within the space of a hundred days from the testator's death.

CELIBATE, the same with celibacy; but it is chiefly used with reference to the single life of the Popish clergy, or the obligation they are under to abstain from marriage. In this sense we speak of the law of *celibate*. Monks and religious persons take a vow of celibate, and of chastity.

The Church of Rome imposes celibacy on all its clergy, from the pope to the lowest deacon and subdeacon. The advocates for this usage pretend that a vow of perpetual celibacy was required in the ancient church as a condition of ordination, even from the earliest apostolic ages. But the contrary is evident from numerous examples of bishops and archbishops who lived in a state of matrimony, without prejudice to their ordination or their function. It is generally agreed that most of the apostles were married; some say all of them, except St Paul and St John. In the ages immediately succeeding the apostles, we have accounts of many married bishops, presbyters, and deacons, without any reproof or mark of dishonour being set on them: for instance, Valens, presbyter of Philippi, mentioned by Polycarp; and Chæremon, bishop of Nilus. Novatus was a married presbyter of Carthage, as we learn from Cyprian, who himself was also a married man, as Pagi confesses; and so was Cæcilius, the presbyter who converted him, and Numidius, another presbyter of Carthage. The reply which the Romanists give to this is, that all married persons when they came to be ordained promised to live separate from their wives by consent, which answered the vow of celibacy in other persons. But this is not only said without proof, but against it; for Novatus, presbyter of Carthage, was certainly allowed to retain his wife after ordination, as appears from the charge which Cyprian brings against him, that he had struck and abused his wife, and thereby caused her to miscarry. There seems indeed to have been in some cases a tendency towards the introduction of such a law by one or two zealots; but the motion was no sooner made than it was quashed by the authority of wiser men. Thus Eusebius observes, that Pinytus, bishop of Gnossus in Crete, was for laying the law of celibacy upon his brethren; but Dionysius, bishop of Corinth, wrote to him that he should consider the weakness of men, and not impose that heavy burden on them. In the council of Nice, A.D. 325, the motion was renewed for a law to oblige the clergy to abstain from all conjugal intercourse with their wives whom they had married before their ordination; but Paphnutius, a famous Egyptian bishop, and one who himself was not married, vigorously declaimed against it,—upon which it was unanimously rejected. The story is thus told by Socrates and Sozomen; and all that Valesius, after Bellarmin, has to say against it is, that he suspects the truth of it. The council of Trullo, held in 692, made a difference in this respect between bishops and presbyters; allowing presbyters, deacons, and all the inferior orders, to live with their wives after ordination; and giving the Roman church a smart rebuke for the contrary prohibition, but at the same time laying an injunction upon bishops to live separate from their wives, and appointing the wives to betake themselves to a monastic life, or become deaconesses in the church. And thus was a total celibate established in the Greek church as to bishops, but not as to any others. In the Latin church a similar rule was established, but by slow degrees in many places; for in Africa even bishops cohabited with their wives at the time of the council of Trullo. The celibacy of the clergy, however, appears of ancient standing, and if not of command and necessity, yet of counsel and choice. But as it is clearly neither of divine nor apostolical institution, it is not easy at first view to conceive from what motive the court of Rome could have persisted so obstinately in imposing this institution on the clergy. But we are to observe that this was a leading step to the execution of the project formed of making the clergy independent of princes, and rendering them a separate body to be governed by their own laws. In effect, while priests had children it was difficult to prevent their dependence on princes, whose favours have such an influence on private men; but having no family they were more at liberty to adhere to the pope. That ambitious pontiff Gregory VII., perceiving the great advantages in these respects that must accrue to the church, enforced the laws of celibacy with unbending rigour.

CELIDOGRAPHIA, a description of the spots on the disc of the sun, or of planets.

CELL (*cella*, from *celare* to conceal), in ancient writers, a place or apartment, usually under ground, and vaulted, in which were stored up wine, honey, oil, and provisions generally; and according to which it was called *cella vinaria*, *mellaria*, *olearia*, &c. Cella also denoted a room in a brothel, as being anciently in underground vaults, and hence also denominated *fornix*. It was also applied to the dormitories of slaves and menials. Cicero, inveighing against the luxury of Antony, says, the beds in the very cellæ of his servants were spread with pompous purple coverlets. The word was further applied to the apartments of baths. Of these there were three principal ones, *frigidaria*, *tepidaria*, and *caldaria*. See BATHS. It likewise signified the *adytum*, or part of a temple in which the image of the god stood.

Cella was also used for a lesser or subordinate monastery dependent on a great one. Most of the great abbeys in England had *cells* in places distant from the mother abbey. The alien priories in England were cells to abbeys in Normandy, France, or Italy. The name of *cell* was sometimes applied to independent monasteries.

CELL signifies also a small apartment or chamber, such as those in which monks and hermits live in retirement. Some derive the word from the Hebrew כלא a prison. The hall in which the Roman conclave is held is divided by partitions into different cells, for the use of the cardinals.

CELLAR (*cellarium*), in ancient writers, the same with cella, namely, a conservatory of provisions or liquors.

CELLAR now denotes an apartment under a house or other building, used as a repository of liquors, provisions, or other stores.

CELLARER, or CELLERER (*Cellerarius* or *Cellarius*), an officer in monasteries, to whom belonged the care and procurement of provisions for the convent.

The *cellerarius* was one of the four *obedientiarii*, or great officers of monasteries. Under his orders were the *pistrinum* or bakehouse, and the *bracinum* or brewhouse. In the richer houses there were particular lands set apart for the maintenance of his office. The *cellerarius* was an impor-

tant person in the convent. He was bound to see his lord's corn got in and stored; and his appointment consisted in a certain proportion of grain, usually a thirteenth part of the whole, together with a furred gown. He had also the receipt of his lord's rents throughout the whole extent of his jurisdiction. (See Chronicle of Jocelyn of Brakelonde.)

CELLARIUS, CHRISTOPHER, was born in 1638, at Smalcald in Franconia, of which town his father was minister. He took a doctor's degree at Jena, and was professor of Hebrew and moral philosophy at Weissenfels. He was afterwards rector of the colleges at Weimar, Zeitz, and Merseburg; and ultimately became professor of rhetoric and history in the college of Halle, founded by the king of Prussia. In this latter place he composed the greater part of his works. His great application to study hastened the infirmities of old age, and brought on his death in 1707.

His principal works are, I. Philological; *Antibarbarus Latinus*, Cizæ, 1677; *Orthographia Latina*, Jenæ, 1704; *Curæ posteriores de Barbarismis, &c., Sermonis Latini*, Jenæ, 1700; *Grammatica Hebræa*, Jenæ, 1699; *Chaldaismus*, Cizæ, 1685; *Rabbinismus*, ibid., 1684; *Isagoge in Linguam Arabicam*, ibid., 1678; *Porta Syriæ*, and *Porta Syriæ patentior*, Cizæ, 1682. II. Historical; *Historia Antiqua*, Cizæ, 1685; *Historia Medii Ævi*, ibid., 1688; *Historia Nova*, Halæ, 1696. III. Geographical; *Notitia orbis antiqui*, Lips., 1701-1706; *Geographia antiqua*, Jenæ, 1691; *et nova*, ibid, 1709.

CELLINI, BENVENUTO, (1500-1570), was born at Florence, where his ancestors had long been known as architects and musicians. His father, who was a musician, designed him for the same profession with himself, and endeavoured to thwart the inclination of Benvenuto for sculpture and engraving. When he had reached the age of fifteen, his youthful predilection had become too strong to be resisted, and his father reluctantly gave his consent to his becoming apprenticed to a goldsmith. In this capacity he soon distinguished himself by his superior skill in chasing sword-handles, cutting dies, and engraving medals. He had already attracted considerable admiration in his native place, when, being implicated in a fatal fray with some of his companions, he was banished to Siena, from which he soon after removed to Rome. A beautiful gold medal of Clement VII., of which he was known to have furnished the die, secured him a favourable reception at the papal court, and gained him abundant employment in cutting seals for his ecclesiastical patrons. On his return to Florence, his violent temper again embroiled him in a quarrel, which again compelled him to retreat in disguise to Rome. In the war with France, which broke out immediately after, the bravery and address of Cellini proved of signal service to the pontiff; and his exploits paved the way for a reconciliation with the Florentine magistrates, and his return shortly after to his native place. Here he assiduously devoted himself to the execution of medals, the most famous of which are Hercules and the Nemean lion, and Atlas supporting the sphere. From Florence he went to the court of the Duke of Mantua, and thence again to Rome, from which he quickly fled to Naples to shelter himself from the consequences of a duel in which he was a party. Through the influence of several of the cardinals he obtained a pardon; and on the elevation of Paul III. to the pontifical throne he was reinstated in his former dignities, notwithstanding a fresh homicide which he had committed in the interregnum. Once more the plots of Pier Luigi, a natural son of Paul III., led to his retreat from Rome, and once more he was restored with greater honour than before. On returning from a visit to the court of Francis I., he was imprisoned on a charge of embezzlement during the war, but was liberated at the intercession of Cardinal Bembo, to whom he presented a splendid cup. For a while he wrought at the court of Francis I.; but the intrigues of the king's favourites, whom he would not stoop to conciliate, and could not venture to silence by the sword, as he had his enemies at Rome, led him to retire in disgust to Florence, where he employed his time in works of art. During the war with Siena, Cellini was appointed to strengthen the defences of his native city, and continued to gain the admiration of his fellow-citizens by the magnificent works which he contributed for its decoration. He was buried with great pomp in the church of the S. Annunziata. Besides the works in gold and silver which have been alluded to, Cellini executed several pieces of sculpture on a grander scale. The most distinguished of these is the bronze group of Perseus cutting off the head of Medusa, placed in front of the old ducal palace at Florence. Nothing, however, is more highly characteristic of Cellini than his autobiography, in which his adventures, pursuits and passions are depicted with the utmost *naiveté* and good humour. It has been translated into English by Thos. Roscoe. Several of Cellini's writings, however, still exist in manuscript.

CELSUS, AURELIUS CORNELIUS, a very celebrated physician of the first century, and author of a treatise *De Medicina*, in eight books. See ANATOMY and SURGERY.

CELTÆ, in Greek Κελται, CELTES, or CELTS, or KELTS, an ancient nation, by which most of the countries in Europe appear to have been occupied at a period anterior to the commencement of history.

When the Greek and Roman writers first began to turn their eyes westward, they found Europe, from the extremity of Ireland to the banks of the Danube, peopled by a race called Gauls, or Celts, or rather Kelts, who, before they became bound to the soil by tillage, had overspread part of Spain in the course of their armed migrations, and had even poured their predatory bands through the Alpine passes, into the great plain of northern Italy. They extended along the Danube, as far as the Euxine, and spread themselves till they were met on different sides by the Sarmatians, Thracians, and Illyrians. Their expeditions were in general prior to the period of history; and we have but slender means of probable conjecture as to the antiquity, extent, and direction of the great migratory movements of this remarkable race.[1]

At that era, indeed, when the dawn of history begins to dispel the dark cloud which had overshadowed the early ages of the world, we find the different races of people in Europe occupying nearly the same relative situations as at present; and, even in the oldest memorials, we can scarcely discern a trace of those wanderings or migrations of tribes which must nevertheless have originally filled this region of the earth with inhabitants.[2] From a remote antiquity, the whole of the country between the Euxine and the German Ocean appears to have been possessed by the Cimmerii or Cimbri, one of the grand divisions of the Celts; while Gaul was occupied by the other division, to which the name of Celtæ was more properly and commonly applied.[3] Herodotus mentions the Celts and Cynetæ as inhabiting the remotest parts of Europe, towards the setting of the sun, near the sources of the Ister or Danube; and it is unknown during how many ages they had occupied this region before the father of history obtained this, which is the earliest notice of them. Aristotle and other ancient writers give us nearly the same information with Herodotus, whom they probably followed. With regard to Britain, it must have been inhabited at a period anterior to the Trojan war, since, from the statement of Herodotus, it appears that tin exported from Britain by Phœnician traders was at that

[1] Mackintosh, *History of England*, vol. i. introd. p. 2.
[2] Pritchard *on the Eastern Origin of the Celtic Nations*, p. 14.
[3] Pinkerton, *Dissertation on the Scythians or Goths*, part. i. chap. 2.

time in general use; a circumstance which seems to imply that our island was then peopled by a race who had already explored its metallic treasures; whilst, from other considerations, it has with much probability been inferred that the earliest settlers or inhabitants of Britain were of Celtic origin. At a period not long subsequent to the age of Herodotus, the Teutonic nations inhabited the north of Europe. Pytheas of Marseilles, contemporary with Aristotle, mentions the Guttones, who inhabited the shores of an estuary which must have been the mouth of the Vistula, and carried on a traffic in amber with their neighbours the Teutones,[1] then well known under that appellation; and as the Guttones were probably Goths, we thus already discern in the north of Europe two of the most celebrated nations belonging to the Germanic family, in an age when the name of Rome had scarcely become known to the Greeks. The Finns and Sclavonians are supposed to have been the latest of the great nations who formed the population of Europe. Finningia and the Fenni are mentioned both by Tacitus and by Pliny. In the age of these writers the Finns were situated near the eastern shores of the Baltic, and had probably extended themselves as far as those districts where their descendants were afterwards known under the name of Beormas or Biarmiers. The Sclavonians are not early distinguished in Europe under that name; but the appellation of Wends, given to the Sclavonic race by the Germans, seems to identify them with the Venedi mentioned in the geographical descriptions of Pliny and Tacitus, as also with the Ουενεδαι or Winidæ of Ptolemy and Jornandes, these being terms appropriated to the Sclavonic nations. Besides, it is probable that the Russians were known to Herodotus, and that they are mentioned by him under an appellation differing but little from that which is now applied to them by their Finnish neighbours. The Rhoxolani, first described by Herodotus, are stated by Strabo to have inhabited the plains near the sources of the Tanais and Borysthenes; and the Finns still distinguish the Muscovites by the name of Rosso-lainen, or Russian people, a term which, if heard by a Greek, would naturally be written Rhoxolani.[2]

It thus appears that the European races, in the earliest periods of which we have any information respecting them, occupied nearly the same relative situations as the tribes chiefly descended from them still continue to possess. The few scattered facts or intimations which history furnishes, therefore, afford no evidence against the hypothesis that different parts of the world were originally filled with autochthones or indigenous inhabitants, nor indeed against any other hypothesis or theory whatsoever. Great reliance has been placed by many upon traits of resemblance in customs and superstitions; and from the coincidence of the doctrines of druidism and the mythology of the Sagas, some have ascribed a common origin to the nations of Europe and those of the East. But this principle is exceedingly unsafe; for by a similar mode of reasoning we might conclude that the Turks and Tartars came from Arabia, and derive the Buddhists of Northern Asia from India, or perhaps from Ceylon. Nor can historical traditions, however plausible and striking these may in some instances appear, fill up the void; because, besides involving every element of error, they are found, when examined and compared, to lead to contradictory and incompatible results. It is, therefore, only by an analysis of languages, which, after all, are in reality the most durable of human monuments, and by detecting in their composition common elements and forms of speech, that we can ever hope to obtain satisfactory evidence of the identity or connection in point of origin of those races by which they are spoken with ancient nations whose languages have been preserved either in whole or in part.

The diversity of opinion which has hitherto prevailed on this subject proves the uncertainty and insufficiency of the data from which inquirers have hitherto deduced their conclusions. Among the ancients the notion that each particular region of the earth was from the beginning supplied, by a distinct creation, with its peculiar stock of indigenous inhabitants, seems to have prevailed universally; and the frequent recurrence of such terms as *autochthones*, *indigenæ*, and *aborigines*, affords undoubted evidence of the fact. In modern times, however, the very opposite opinion has been that most generally entertained; and all the nations of the earth have, on the authority of the sacred Scriptures, been referred to one common parentage. But of late years, many learned men, chiefly on the Continent, have evinced a strong inclination to adopt an opinion similar to that of the ancients; and the notion of radically distinct and separate races of men seems to be gaining ground among the naturalists and physiologists of France, as well as among the historians and antiquaries of Germany. Among the former there are some who speak of the Adamic race as of one among many distinct tribes, and others who broadly controvert its claims to be considered as the primary stock of the human race. On the other hand, some of the most learned of the Germans have divided man into five distinct *varieties*. Humboldt, notwithstanding the many evidences of intercourse between the inhabitants of the eastern and western continents, appears to regard the primitive population of America as a distinct variety of the race. Malte-Brun has plainly taken it for granted, that, from the earliest times, each part of the earth had indigenous inhabitants, into whose origin it is vain to make inquiries; and even Niebuhr, perplexed by his researches into the early history and population of Italy, is glad to escape from the difficulty of his subject by adopting a similar opinion. On the other side of the question, or what may be called the Scriptural theory, names of equal celebrity may be cited, including that of Sir William Jones, which is in itself a host. But this subject is not one which can be decided either way by authority; and it is only by examining the evidence which seems to bear more immediately on the subject that we can ever hope to arrive at a satisfactory conclusion. This, viewed generally, is of two kinds, and comprises, first, considerations resulting from a survey of the natural history of the globe, and facts connected with physical geography and with the multiplication and dispersion of species of both plants and animals; and, secondly, analytical investigations into the structure, affinities, and diversities of languages, in reference to the general question as to the history of our species. With regard to the arguments deduced from the former source, however, although they may at first view appear to bear with the greatest weight upon this question, yet, from our inability duly to appreciate the effects of physical causes operating during a course of ages indefinitely great, it is impossible, with any degree of certainty, to infer original distinction from the actual differences observable among mankind. But in the case of languages, especially those which, though they have ceased to be spoken, are still preserved, there is no such element of uncertainty; and hence we are inclined to hold, that the only conclusions on which we can safely rely respecting the aboriginal history of our species, are those deducible from an analysis of languages conducted on strict philosophical principles.

[1] Plin. *Hist. Nat.* lib. xxxvii. cap. 2.

[2] Pritchard *on the Celtic Nations*, p. 16.

Such an analysis of various languages as that here spoken of will in every instance display one or other of four different relations subsisting between them. 1. In comparing some languages, little or no analogy can be discovered in their grammatical structure, but a resemblance more or less extensive may be traced in their vocabularies, or in the terms for particular objects, actions, and relations; and if this correspondence is the result of commercial intercourse, conquest, or the introduction of a new system of religion, literature, and manners, it will extend only to such words as belong to the new stock of ideas thus introduced, and will leave unaffected the great proportion of terms which are expressive of more simple ideas and of universal objects; but if the correspondence traced in the vocabularies of any two languages is so extensive as to involve words of a simple and apparently primitive class, it indicates a much more ancient and intimate connection. 2. Certain languages, which have but few words in common, nevertheless display, when carefully examined, a remarkable analogy in their principles and forms of grammatical construction; as in the polysynthetic idioms of the American tribes, and the monosyllabic languages of the Chinese and Indo-Chinese nations. 3. A third relation discoverable between languages, connected by both the circumstances already pointed out, consists in what may be properly called cognation; an epithet which is applied to all those dialects which are connected by analogy in grammatical forms, and by a considerable number of primitive words or roots common to all, or which at least possessed such a resemblance as manifestly indicates a common origin. 4. The fourth and last relation, which is almost purely negative, exists between languages in which none of the connecting characters above described can be discerned, and there is discoverable neither analogy of grammatical structure, nor any correspondence in words, sufficient to indicate a particular affinity; circumstances which are held as conclusive that such languages are not of the same family, and that they belong to nations remote from each other in descent as well as differing in physical characteristics.[1]

Upon these principles, which are now universally received as almost the only guides in investigating the origin and descent of nations, the languages of the Finnish tribes, the Laplanders, the Hungarians, the Ostiaks, and the Siberian Tschudes, have been compared and analysed by Gyarmathi, Adelung, Gatterer, Klaproth, and others; and the result, which appears to have been sufficiently established, is, that all these nations have sprung from one common original stock, the primitive seat of which was the country situated between the chain of Caucasus and the southern extremities of the Uralian Mountains. But our chief concern at present is with those tribes which have been latterly denominated Indo-European; a term which includes all that class of nations, many of them inhabitants of Europe, whose dialects are more or less nearly related to the ancient language of India. The idea of this classification, which is by far the most scientific that has yet been adopted, was suggested by comparing the Sanscrit with the Greek and Latin languages, and observing the interesting and remarkable results evolved by the comparison. These were, first, the detection of a very considerable number of primitive words, which were found to be common to all these languages; and, secondly, the discovery of a still more striking affinity which was proved to exist between their respective grammatical forms. In the case of the Greek and the Sanscrit this affinity amounts almost to complete identity; in that of the Latin and Sanscrit, it is also, as might be supposed, exceedingly striking; and these languages are all evidently branches of one common or parent stem. But the same process of analysis has led to other and not less curious or interesting results. It has been proved that the Teutonic as well as the Sclavonic, including the Lettish or Lithuanian, stand in nearly the same relation to the ancient language of India as the Greek and Latin; and several intermediate languages, as the Zend and other Persian dialects, the Armenian, and the Ossete, which is one of the various idioms spoken by the nations of the Caucasus, have been held, by those who have examined their structure and etymology, to belong to the same stock.[2] In this way, a close and intimate relation was proved, by unquestionable evidence, to subsist between a considerable number of languages and dialects used or spoken by nations who are spread over a great part of Europe and of Asia, and to them the term Indo-European has in consequence been applied. In fact, the more accurately these languages have been examined, the more extensive and deep-rooted have their affinities appeared; and it is only necessary to refer to Professor Jacob Grimm's masterly analysis of the Teutonic idioms, to enable the reader to verify the truth of this remark. The historical inference deducible from these investigations, therefore, is, that the European nations who speak dialects referrible, on analysis, to this class or family of languages, are of the same race with the Indians and Asiatics, to whom a like observation may be applied; and that all are the descendants of some original nation or people who spoke the primitive language, to which all the Indo-European forms of speech may be referred as a common source.

But a more immediate subject of inquiry is, whether the Celtic dialects belong to the class or family of languages thus allied and denominated; and the question is the more interesting as it bears directly on the origin of the nations of western Europe, including the British islands, as well as on the more extensive one relating to the physical history of mankind. Many have supposed the Celts to be of oriental origin, but, for the most part, on grounds which are either altogether fanciful, or at least insufficient to warrant such a conclusion. The compilers of the *Universal History*, for instance, gravely tell us that the Celts were descended from Gomer, the eldest son of Japhet, the son of Noach; that Gomer settled in the province of Phrygia in Asia Minor, while his sons Ashkenaz and Togarmah occupied Armenia, and Riphath took possession of Cappadocia; that when they found it necessary to spread themselves wider, they moved regularly in columns, without disturbing or interfering with their neighbours; that the descendants of Gomer or the *Celtæ* took the left hand, and gradually spread themselves westward to Poland, Hungary, Germany, France, and Spain; and that the descendants of Magog, the brother of Gomer, moved to the eastward, peopling Tartary, and spreading themselves as far as India and China. Speculative fancies like these, however, are too absurd and extravagant to be even amusing. The real question is, whether the same arguments which prove most of the other nations of Europe to be of eastern origin and descent, may not also be applied to that great stock, the branches of which, at a period anterior to the commencement of history, had overspread Gaul, Britain, and occupied a considerable portion of Spain.

But here it is proper to observe, that writers on the his-

[1] Pritchard *on the Celtic Nations*, pp. 9, 10. Kennedy's *Researches into the Origin and Affinity of the Languages of Asia and Europe*, p. 80. *Edinburgh Review*, No. cii. p. 560.

[2] Klaproth, *Asia Polyglotta.*

tory of languages and the antiquity of nations are divided in opinion with respect to this question. Adelung and Murray have considered the Celtic as a branch of the Indo-European stock; but the latter has left that part of his work which relates to the Celtic dialects in a most incomplete state; and Adelung has committed the error of supposing the Welsh or Cymric to be derived from the language of the Belgæ, and not from that of the Celtæ, who inhabited the central parts of Gaul and of Britain. From want of information respecting the Celtic dialects, many of the continental writers, among whom may be mentioned Frederick Schlegel and Malte-Brun, have been led to believe the Celtic to be a language of a class wholly unconnected with the other idioms of Europe; and in Britain the same opinion has, from the same cause, been expressed by several well-known authors. Mr Pinkerton, for instance, has declared, in his usual dogmatical manner, that the Celtæ were a people entirely distinct from the rest of mankind; and that their language, the real Celtic, is as remote from the Greek as the Hottentot from the Lapponic. And Colonel Kennedy, at the conclusion of the chapter in which he successfully refutes some of the opinions of Pelloutier and Bullet respecting the Celtæ and their language, concludes, that "the Celtic, when divested of all words which have been introduced into it by conquest and religion, is a perfectly original language;" and that "this originality incontrovertibly proves that neither Greek, Latin, or the Teutonic dialects, nor Arabic, Persian, or Sanskrit, were derived from the Celtic, since these languages have not any affinity whatever with that tongue."[1] Davis, however, in the preface to his Dictionary, had said, "Ausim affirmare linguam Britannicam (Celticam) tum vocibus, tum phrasibus et orationis contextu, tum litterarum pronunciatione, manifestam cum orientalibus habere congruentiam et affinitatem;" and the result of a more accurate and minute analysis has been to confirm this opinion in the most complete manner possible.

The connection of the Sclavonian, German, and Pelasgian races with the ancient Asiatic nations may be established by historical proof. But the languages of these races, and the Celtic, although differing from each other, and constituting the four principal classes of dialects which prevail in Europe, are nevertheless so far allied in their radical elements, that they may with certainty be considered as branches of the same original stock. Remarkable indeed is the resemblance observable in the general structure of speech, and in those parts of the vocabulary which must be supposed to be the most ancient, as, for instance, in words descriptive of common objects and feelings for which expressive terms existed in the primitive ages of society. In fact, the relation between the languages above mentioned and the Celtic is such as not merely to establish the affinity of the respective nations, but likewise to throw light upon the structure of the Indo-European languages in general; and particularly to illustrate some points which had previously been involved in obscurity. This is clearly demonstrated by Dr Pritchard's ample and satisfactory analysis, which embraces almost every thing that can possibly enter into an inquiry of this nature. He examines the permutation of letters in composition and construction, the sandhi and samasa in Sanscrit, and shows that the same principles are discoverable in the Celtic dialects, particularly in the Welsh and in the Gaelic. He exhibits proofs of common origin in the vocabulary of the Celtic and other Indo-European languages, first, in the names of persons and relations; secondly, in the names of the principal elements of nature, and of the visible objects of the universe; thirdly, in the names of animals; fourthly, in verbal roots found in the Celtic and other Indo-European languages; and, fifthly, in adjectives, pronouns, and particles. He then proceeds to investigate the proofs of a common origin derived from the grammatical structure of the Celtic as compared with that of other Indo-European languages, particularly the Sanscrit, the Greek, the Latin, the Teutonic dialects, the Sclavonian dialects, and the Persian language; and in all of these he shows that a striking resemblance is discoverable in the personal inflections of verbs, as well as in the personal pronouns, and in the inflections of verbs through the different moods and tenses; and he concludes with a further illustration of the principles which he had previously established by an analysis of the verb substantive and the attributive verbs in the Celtic dialects, and in other Indo-European forms of speech, the result of which is to evolve coincidences precisely analogous to those already exemplified with the utmost accuracy of detail. What, then, is the legitimate inference to be deduced from the obvious, striking, and, we may add, radical analogies here proved to exist between the Celtic dialects and the idioms which are generally allowed to be of cognate origin with the Sanscrit, the Greek, and the Latin languages? The marks of connection are manifestly too decided and extensive, and enter too deeply into the structure and principles of these languages, to be the result of accident or casual intercourse; and being thus interwoven with the intimate texture of the languages compared, seem incapable of explanation upon any principle except that which has been admitted with respect to the other great families of languages belonging to the ancient population of Europe; namely, that the whole Celtic race is of oriental origin, and a kindred tribe with the nations who settled on the banks of the Indus, and on the shores of the Mediterranean and the Baltic. It is probable, indeed, that several tribes emigrated from their original seat at different periods and in different stages of advancement in respect to civilization; and hence we find their idioms in different stages and degrees of refinement: but the proofs of a common origin, derived from an accurate examination and analysis of the intimate structure and component materials of these languages, are nevertheless such as, in our judgment, must command general assent; more especially considering that the general inference thus deduced receives strong confirmation from those purely physical investigations to which we have already alluded. If, indeed, there be any truth in those principles of classification which naturalists have adopted, the Mongol, the Chinese, the Hindu, and the Tartar, are not more certainly oriental than the native Celt, whose physical conformation exhibits only a slight modification of that which is peculiar to the great race whence he is descended; while his superstitions, manners, customs, and observances, as well as language, are all decidedly marked with traces and indications of an eastern origin.

With respect to the form of government which prevailed among the Celts, we are left in some measure to conjecture. It seems, however, to have partaken somewhat of the character of a theocracy, which, with great powers of adaptation to circumstances, generally maintained a complete ascendency. The druids, assisted by the bards, were the guardians and interpreters of their laws, as well as the ministers of their religion; they judged all causes, whether civil or criminal; and their sentence was reckoned so sacred, that whoever refused to abide by it was excluded from assisting at their rites, denied the use of fire, and intercommuned or interdicted from all con-

[1] Kennedy's *Researches*, p. 85. Pritchard's *Celtic Nations*, pp. 20, 22.

verse with his fellow-men. Indeed, the law of caste, in as far as the sacred order was concerned, appears to have been inveterate and indelible; and hence Sir James Mackintosh, without going into any inquiry respecting the origin and descent of this singular race, justly remarks that the druidical system is not without oriental features. The Celts, however, erected neither temples nor statues to the Deity, but, on the contrary, were fierce iconoclasts, destroying shrines and idols wherever they could find them. Instead of these they planted spacious groves, which, in their opinion, were more acceptable to the Deity, who is absolutely unconfined, than houses made with human hands; and amidst the depth and gloom of umbrageous forests, the druids celebrated their holy mysteries, and, as is generally believed, offered up human sacrifices. They were perfectly inexorable to mere idolaters; in which respect their religion bore a resemblance to that of the Parsees and the disciples of Zoroaster. It differed, however, in their making the oak instead of the fire the emblem of the Deity, and in their choosing that tree in preference to others to plant their groves withal, as well as in their attributing supernatural virtues to its wood, leaves, fruit, and particularly the mistletoe, all which were made use of in their sacrifices and other parts of their worship. But after they had adopted the idolatrous superstitions of the Romans and other nations, and particularly admitted the apotheosis of their heroes and princes, they came to worship the latter much in the same manner as the people whose practice they followed; venerating Jupiter under the name of *Taran*, which in the Celtic signifies thunder, and also Mercury, whom some authors call *Heus* or *Hesus*, probably from the Celtic *handh*, which signifies a dog, a circumstance which has led some to consider him as identical with the *Anubis Latrans* of the Egyptians. Mars was held in the greatest veneration by the warlike, and Mercury by the trading part of the nation. The care of religion, as has already been stated, was immediately intrusted to the druids and bards, who, as Cæsar informs us, were the performers of sacrifices and all religious rites, and the expounders of religion to the people. They also instructed youth in all kinds of learning with which they were acquainted, as philosophy, astronomy, astrology, and the like. Their doctrines, however, were only taught orally, being esteemed as too sacred to be committed to writing. But more common subjects, such as hymns to their gods, and the exploits of princes and generals in time of war, were couched in a species of verse, and recited, or rather sung, on all proper occasions; though even these were kept from vulgar eyes, and either committed to memory, or, if to writing, withheld from the laity. Cæsar mentions that these poetical records had in his time increased to such a bulk that it took a young bard nearly twenty years to learn them by heart; and Diodorus says, that the poets or bards used to accompany their songs with instrumental music, on organs, harps, and the like; and that these minstrels were held in such veneration, that if in the time of an engagement between two armies one of the bards appeared, both sides immediately ceased fighting. The reason of this was, that they were universally believed to be prophets as well as poets, or, in other words, gifted with a double inspiration; and it was therefore thought dangerous as well as injurious to disobey what was supposed to emanate from the gods. These prophetic poets and philosophers kept academies, which were resorted to, not only by a great number of their own youth, but also by the youth of other countries; insomuch that Aristotle says their philosophy passed from them into Greece, and not from Greece to them. Diodorus likewise quotes a remarkable passage from Hecatæus, in which it is stated that the druids had some kinds of instruments by which they could draw distant objects nearer, and make them appear larger and plainer; and by which they could discover even seas, mountains, and valleys, in the moon. Can it be possible that this strange fraternity of priests were really in possession of the telescope? But whatever may have been their learning, it is certain, that in process of time they adopted several barbarous customs, such as that of sacrificing to their gods human victims, which they believed to be more acceptable to them than those of any other animals. Another inhuman practice which they observed in their divinations, especially on great matters, consisted in killing some of their slaves, or some prisoners of war if they had any, with a scimitar, in order to draw an augury from the manner in which the blood flowed from the mangled limbs of the victim.

Such is a brief sketch of the origin of the Celts, and of the more prominent peculiarities by which they were distinguished in ancient times. As a subordinate race, or rather as a more ancient offset from the parent stock, they were inferior to the Scythians or Goths, and generally yielded, though not without a gallant struggle, to the incessant pressure of the mighty tide of emigration which, from a very early period, flowed from the north towards the south and west of Europe, and which at length overwhelmed the Roman empire, burying in its ruins the civilization of fourteen centuries. (J. B—E.)

CELTES, ancient instruments of a wedge-like form, found in different parts of Great Britain, and which, on the supposition that they were weapons of the Celtæ, have received the above unmeaning appellation. Whitaker and other antiquaries, however, are of opinion that they were British battle-axes. See *Battle-Axe*.

CELTIBERIA, the country of the Celtiberi, was an extensive inland division of Spain, stretching from the mountains Indubeda and Orospeda westwards to the sources of the Tagus, the Douro, and Guadiana, and comprehending the modern provinces of Cuença and Soria, part of Aragon and part of Burgos. In the later times of the Roman empire, however, the name came to be almost synonymous with Hispania Citerior. It was a mountainous and barren region, intersected with valleys of great fertility and beauty, and containing some prosperous and celebrated cities. Of these the most famous were Segobriga, the capital; Numantia, which endured a siege of ten years from the Romans, and was only taken by the younger Scipio, B.C. 133; Bilbilis, the birthplace of the poet Martial, and many other towns of less note and importance. The inhabitants, as their name imports, were the descendants of the Celts who crossed the Pyrenees from Gaul, and settling in this part of Spain, intermarried with the aboriginal Iberians. They were characterized by the better qualities of both the races from which they sprang, and, as a people, were superior to either. Their valour and military skill were proved in their long and obstinate contest with the Romans, whom they not unfrequently defeated. These qualities were all the more formidable, as, unlike the surrounding tribes, the Celtiberi had brought their soldiers to a high pitch of discipline in their wars with their neighbours and the Carthaginians. They were at last subdued; and though they again revolted, they were unable to make head against the younger Scipio, after the destruction of Numantia. Under Sertorius they once more became formidable to the Roman empire in Spain; but after the fall of that general they quietly submitted, and do not appear again in history as a separate and independent people.

CEMENT. Any substance which is employed in uniting together things of the same or of different kinds may be termed a cement. The following are some of the principal of those used for various purposes.

To unite pieces of Derbyshire spar, or other stone, take

seven or eight parts of resin and one of wax; then melt them together, and mix them with a small quantity of plaster of Paris. The stone should be made sufficiently hot to melt the cement, and the pieces should be pressed so closely together that the smallest quantity possible of the cement may remain between them. It is a rule of general application, that the thinner the stratum interposed the firmer the junction will be.

Jewellers unite precious stones which have been accidentally broken, by means of gum-mastic. The parts of the gem must be previously heated to a degree sufficient to melt the cement. Cameos of white enamel or coloured glass are also in this way joined to a real stone as a ground. Mastic is likewise employed by jewellers in various ways as a cement. The jewellers in Turkey ornament trinkets and weapons with gems, by uniting them together with the following composition:—Isinglass, soaked in water till it swells up and becomes soft, is dissolved in French brandy or rum, so as to form a strong glue; then two small bits of gum galbanum, or gum ammoniacum, are dissolved in two ounces of this by trituration; and five or six pieces of mastic about the size of peas are to be dissolved in as much alcohol as will render them fluid, and mixed with the compound by means of a gentle heat. This cement must be kept in a phial closely stopped; and when used it must be liquefied by immersing the phial in warm water. It will be found to resist moisture.

As a cement for broken china, take quicklime and white of eggs, or thick old varnish; pound and temper them well together, and the composition is ready for use. Broken glass may be cemented in the following manner:—Let glass which is more easy of fusion than the parts to be united, be ground up like a pigment, and interposed between the pieces; then let these be subjected to a heat which will melt the cementing medium, and make the parts agglutinate without being themselves fused. Anything thus united will be found nearly as strong as ever.

If clay and oxide of iron be mixed with oil, they will form a cement which hardens under water. A cement insoluble in water is prepared from skimmed milk cheese. The cheese is cut into slices, the rind being thrown away, and boiled till it becomes a strong glue, which, however, does not dissolve in the water. It is to be afterwards washed in cold, and then kneaded in warm water. This process must be several times repeated. The glue is then to be put warm on a levigating stone, and kneaded with quicklime. Though this cement may be used cold, it is best to warm it; and it will unite marble, stone, or earthenware, so as to render the joining scarcely discernible.

Boiled linseed oil, litharge, red lead, and white lead, mixed together and laid on both sides of a piece of flannel, or even linen or paper, and then put between two pieces of metal before they are brought home or close together, will make a durable joint, capable of resisting boiling water, or even a considerable pressure of steam. The proportions of the ingredients are not material; but the more the red lead predominates the sooner the cement will dry, and the more of the white lead the contrary. This cement joins stones of any dimensions.

The following is an excellent cement for iron, as it ultimately unites with it into one mass:—Take two ounces of muriate of ammonia, one of flowers of sulphur, and sixteen of cast-iron filings; mix them well in a mortar, and keep the powder dry. When the cement is to be used, take one part of this mixture, twenty parts of clear iron borings or filings, pound them together in a mortar, mix them with water to a proper consistence, and apply the compound between the joints.

A cement often used by coppersmiths to lay over the rivets and edges of the sheets of copper in large boilers, in order to serve as an additional security to the joinings. and to secure cocks and the like from leaking, is made by mixing powdered quicklime with ox's blood. This cement dries soon, and accordingly must be used fresh.

Temporary cements are required in cutting, polishing, or grinding optical glasses, and various articles of jewellery, as these must be fixed to blocks or handles for the purpose. Four ounces of resin, a quarter of an ounce of wax, and four ounces of whitening made previously red hot, forms a good cement of this kind, as the articles may be united or separated by heat, though they adhere with great tenacity when cold.

The following composition is recommended as a good cement for electrical apparatus:—Five pounds of resin, one of bees' wax, one of red ochre, and two table-spoonfuls of plaster of Paris, all heated together. The following is an analysis by Sir Humphry Davy of Roman or Parker's patent cement, which has the property of hardening under water.

One hundred grains contain

Silex	22
Alumina	9
Oxide of iron and manganese	13
Carbonate of lime	55
	99
One hundred grains lost by heating	3·25
	102·25

An excellent artificial water cement is obtained by heating for some hours to redness a mixture of three parts clay and one part slaked lime, by measure. (Ure's *Dictionary of Chemistry; Philosophical Magazine.*)

CEMENT *for Building*. See BUILDING, vol. iii., p. 742, and MASONRY.

CEMENTATION, the chemical process of effecting the combination of a metal and a cement by means of heat. Iron is converted into steel by cementation with charcoal; and common glass cemented with sand or with gypsum forms the porcelain of Reaumur. See STEEL, and PORCELAIN.

CEMETERY (*cœmeterium*, κοιμητήριον, from κοιμάω, to put to sleep), a place set apart for the burial of the dead. See MEDICAL JURISPRUDENCE; NECROPOLIS; BURIAL.

CENCI, BEATRICE DI, a noble Roman lady of the sixteenth century, whose beauty, sufferings, and tragical fate, have invested her name with a melancholy celebrity. The violence and cruelty of her father's character were notorious at Rome, and had long rendered him an object of terror to those whom fortune had placed within his power. Stained with crimes of the darkest hue, Count Cenci had purchased pardon from the government on various occasions by the sacrifice of enormous sums of money and portions of his estates; and, indeed, he appears to have been regarded by the state as "a certain and copious source of revenue." On the Sabine hills, about three miles N.E. of Borgo San Pietro, stands the castle of Petrella, in one of the most wild and desolate spots on the Neapolitan frontiers; and here Count Cenci retired during the heats of summer with his family, consisting of Beatrice, Bernardo, her youngest brother, and her stepmother Lucrezia. The loneliness of this place was well suited for the indulgence of his malignant and vindictive spirit, which wantoned in every species of cruelty that ingenuity could devise to aggravate the miseries of his long persecuted family.

> "That savage rock, the castle of Petrella,
> 'Tis safely wall'd and moated round about:
> Its dungeons underground, and its thick towers
> Never told tales; though they have heard and seen
> What might make dumb things speak."

The surpassing beauty of Beatrice, now on the verge of womanhood, excited in the breast of this unnatural parent feelings at which nature shudders; and to this crime was

added every circumstance of violence and cruelty. The attempts of his victim to escape by flight were frustrated by his vigilance; and Beatrice sunk into the lethargy of despair. The accumulated villanies of Count Cenci having at length aroused the vengeance of his wife, she conspired with the steward of the castle and several other persons to destroy their common tyrant. They accomplished their purpose by means of a hired assassin; and in order that the fatal wound might appear the result of accident, the body of the count was thrown from the walls among the branches of a jagged tree that grew in the fosse. Suspicions, however, being excited, the unhappy Cenci were apprehended, sent to Rome, and consigned to the castle of St Angelo, where they were subjected to tortures of the most frightful description. Beatrice, in the midst of her protracted sufferings, maintained the most heroic firmness; and even when suspended by her long and beautiful hair, her fortitude remained unshaken. Moved at last, however, by the entreaties of her relations to relieve them from their sufferings, she yielded so far as to reply to each interrogation of the judge—"*E vero*,"—adding, "O God, thou knowest if this be true." On this admission she was condemned to death.

The excitement caused in Rome by this decision was extraordinary. Many of the most illustrious families besought Clement VIII. (Aldobrandini) to reconsider the case; and some of the ablest advocates undertook to prove her innocence. But all their attempts to move compassion in the breast of the stern pontiff were unavailing. Counter influences, too, were at work; for the temptation of the princely possessions of the Cenci were too strong to be resisted by some who had an interest in the total extinction of her line. Beatrice was beheaded on the 11th September 1599. On the scaffold, when the executioner bound her hands she said—"You bind my body for destruction, but free my soul for immortality." A vast concourse of people assembled on the occasion, deeply commiserating the fate of one so young and gentle, a being "formed to adorn and be admired." More than one attempt was made to rescue her, and many lives were lost in the fray. In the church of San Pietro in Montorio, and before the high altar, were interred the remains of the beautiful, the noble-minded, the ill-fated Beatrice Cenci.

For a long period the MSS. recording these details were preserved with scrupulous secrecy, on account of the connection of the Cenci with many of the most illustrious houses in Rome; and it is only within a few years that they have been made accessible. A complete English version of this terrible tragedy, entitled *The True Story of Beatrice Cenci*, is to be found in Whiteside's *Italy*, vol. ii. pp. 128–72. In the Palazzo Barberini at Rome is preserved Guido's celebrated portrait of Beatrice, taken just before her execution. The story of the Cenci has been dramatized with great power by Shelley; who has, however, used a poet's license in implicating Beatrice unjustly in the guilt of her family.

CENEDA, a town of Venetian Lombardy, province and 27 miles north of the town of Treviso. It is the seat of a bishopric, and has a cathedral, several churches, episcopal gymnasium, seminary, and manufactures of woollens, paper, and leather. Pop. 5000.

CENEGILL, in Saxon antiquity, an expiatory mulct paid by one who had killed a man to the kindred of the deceased. The word is compounded of the Saxon *cinne*, relation, and *gild*, payment.

CENOBITE. See Cœnobite.

CENOTAPH (*cenotaphium*, from κενὸς, *empty*, and τάφος, *a tomb*), an empty tomb erected as a memorial of some person deceased; a funeral monument in honour of one buried elsewhere. Among the Greeks and Romans cenotaphs were erected as memorials of persons who had received the rites of sepulture elsewhere, as well as of those whose bodies were not found for burial at all. A common sign by which honorary sepulchres were distinguished was the wreck of a ship, to indicate the decease of the person in a foreign land.

CENSER, a vase containing incense to be used in sacrifices. Among the Greeks and Romans it was called *thuribulum*, λιβανωτρίς, and *acerra*. See Acerra.

The Jewish censer was a small sort of chafing dish, sometimes furnished with a handle, and probably of various shapes. The Jewish censers appear to have been unlike those of the classical ancients, with which the sculptures of Greece and Rome have made us familiar; as well as those (with perforated lids and swung by chains) used in the Church of Rome. Josephus tells us that Solomon made 20,000 golden censers for the temple of Jerusalem, and 50,000 others to carry fire in.

CENSIO, in *Antiquity*, the act or office of censor, which included both the valuation of a man's estate and the imposition of mulcts and penalties. See Censor.

CENSITUS, a person censed or entered in the tables of the census. In an ancient monument found at Ancyra, containing the actions of the Emperor Octavius (Augustus), we read—

> Quo lustro civium Romanorum
> Censita sunt capita quadragies
> Centum millia et sexaginta tria:

or that the number of Roman citizens entered in the censor's rolls was then upwards of 4,000,000.

Censitus is also used in the civil law for a servile sort of tenant who pays capitation to his lord for the lands he holds of him. See *Capite Censi*.

CENSOR (from *censere*, to estimate or judge), the title of two magistrates of high authority in the Roman republic. It was their duty to take a *census* or register of the effects of the citizens, to impose taxes in proportion to what each man possessed, and to superintend the public morals. In virtue of this last part of their office they had authority to censure vice and immorality, by inflicting some public mark of ignominy on the offender. They had even a power to create the *princeps senatus*, and to expel from the senate such as they deemed unworthy of that office. But this power they sometimes exercised without sufficient grounds; and therefore a law was at length passed that no senator should be degraded or disgraced in any manner until he had been formally accused and found guilty by both the censors. It was also a part of the censorial jurisdiction to fill up the vacancies in the senate, upon any remarkable deficiency in their number; to let out to farm all the lands, revenues, and customs of the republic; and to contract with artificers for the charge of building and repairing the public works and edifices, both in Rome and the colonies of Italy. In all parts of their office, however, they were subject to the jurisdiction of the people; and an appeal always lay from the judgment of the censors to that of an assembly of the people.

The first two censors were created in the year of Rome 311 (B.C. 442), upon the senate observing that the consuls were so much occupied with war as not to have time to look into other matters. The office continued to the time of the emperors, who assumed the censorial power, calling themselves *morum præfecti*; though Vespasian and his son took also the title of censors. Decius attempted to restore the dignity to a particular magistrate. But after this we hear no more of it till the time of Constantine, who made his brother censor; and he seems to have been the last who filled the office.

The office of censor was so considerable, that for a long time no one aspired to it till he had passed all the rest; and hence it was thought aspiring in Crassus to seek to be admitted as censor without having been either consul or prætor. At first the censors enjoyed their dignity for five

years; but in B.C. 433 the dictator Mamercus made a law restraining it to a year and a half, which was afterwards observed very strictly. At first one of the censors was elected from a patrician and the other from a plebeian family; and upon the death of either the other was discharged from his office, and new censors were elected, though not till the next lustrum. In the year B.C. 132, both censors were chosen from among the plebeians; and after that time the office was shared between the senate and the people. On their election in the *comitia centuriata*, the censors proceeded to the capitol, where they took an oath not to be guided either by favour or disaffection, but to act equitably and impartially throughout the whole course of their administration. See CENSUS.

CENSORS *of Books*, persons authorized in different countries to examine all publications before they go to press, that they contain nothing contrary to faith and good manners. In England there was formerly an officer of this kind under the title of licenser of the press; but since the Revolution our press has been laid under no such restraint. See BIBLIOGRAPHY.

CENSORINUS, a grammarian and philosopher of the third century, known by his treatise *De Die Natali*, which was written about the year 238, and is of considerable importance in regard both to the chronology and astrology of antiquity. It was first printed at Bologna in 1497, folio, with two fragments by unknown authors, entitled *Indigitamenta* and *De Naturali Institutione*. But the best editions are those of Havercamp, Leyden, 8vo, 1743, reprinted in 1767, and that of Gruber, 8vo, Nuremberg, 1805.

CENSURE, a judgment which condemns some book, person, or action. An ecclesiastical censure is a sentence of condemnation or penalty inflicted on a member of the church for mal-conduct, whereby he is deprived of the communion of the church, or prohibited from exercising the sacerdotal office.

CENSUS is now almost solely used to denote that enumeration of the people made at intervals in most European countries, and in Britain decennially. The term had its origin in Rome, where a group of the many functions performed by the high officer called censor received the name of *census*. An enumeration of the people was only one of them, but they were chiefly of a statistical character. They were especially directed to fiscal objects; and it does not appear that the enumeration of the people was then deemed of value as a source of statistical knowledge which might influence morals and legislation. It was connected with the Servian constitution, which apportioned the rights and duties of citizens to the amount of property, dividing them into six classes, which were subdivided into centuries by a mixed ratio of wealth and numbers. Had the enumeration been deemed of value for any such other purposes besides the adjustment of rights and obligations, as those for which statistical knowledge is now deemed so valuable, the notices preserved of the vast collection of statistical facts thus made would have been less scanty and meagre, and we would not have found it so impracticable to come to any conclusion about the population and extent of the city of Rome itself. The Roman census must have been minute and full. It indicated not only the number and respective classes of all free persons, but their domestic position as husbands and wives, fathers and mothers, and sons and daughters. The slaves and freedmen were indicated in connection with the possessions of the head of the house, and landed property was analyzed into several classes according to its character and produce. The important practical effect of the census caused it to be conducted at intervals generally so frequent as every fifth year. It was followed by a sacrifice of purification or lustration, whence the term of five years came to be denoted a lustrum. There were highly penal consequences to the citizen who neglected his registration for the census, to whom as an unregistered person the name of *incensus* was given. From the mixed functions to which it was applied, we have the word used among the Romans to signify the patrimony or property qualification of a particular grade—as census senatorius and census equester; and we have it employed in later times to indicate taxation. Hence *census dominicatus*, implying a feudal tax to the superior; *census duplicatus*, a double tax or feudal casualty; and the word *cense* used by old English writers was abbreviated in modern use into *cess*.

While the word census was thus applied to the taxation of the middle ages, it will readily be understood that in its modern sense it received no practical application, since neither taxation nor the adjustment of social rank required a numbering of the people; and the statistic or economic ends of such a process were as little known as they had been to the Romans. Under the despotic governments of the Continent, however, the tendency to central organization for purposes of administration and police, prepared the way for statistical inquiries into the numbers of the inhabitants of particular areas whenever there should occur an occasion for enumerating them. It was in Britain, with its abstinent government and unrestrained people, that the want of population statistics became most flagrantly conspicuous. It is difficult at present to realize the idea that, long after Adam Smith's day the number of the inhabitants of the British empire could only be guessed at as the populousness of China is at the present day; and, as in all matters of statistics, which have their own simple solution through specific inquiry, the guesses about the population of the empire were not only vague but extravagantly contradictory. During the eighteenth century, the most trustworthy geographers were generally those who did not venture on an estimate of the population even in those European states which had the best means of enumeration at their command.

The first effort to take a census of the population of Great Britain was made in 1801; it did not then extend to Ireland. The success which attended this and the two succeeding efforts was mainly owing to the zeal and ability of Mr Rickman, the assistant-clerk of the House of Commons. Where there is an organization like that of many in the European states for preserving a constant official record of all the fluctuations of the population, not only in their absolute numbers throughout a whole territory but in the relative numbers in its respective parts as they may be affected by fluctuations, systematic arrangements are thus prepared not only for obtaining a general census at any one moment, but for checking its accuracy and classifying its elements. But to deal at once with the raw material in the self-governed British empire, required great ingenuity and sagacity. A census, to be accurate, must be taken on a uniform system, and must be taken simultaneously. Any enumeration going over a tract of time, were it but two days, must be more or less inaccurate, and destitute of the means of correcting its own inaccuracies. Besides the mere abstract numbers of the people, there is much collateral information to be recorded. This, besides its own intrinsic value, is necessary as a check on the numbers; since a distribution into elements according to sex, age, social condition, occupation, and the like, affords a self-acting control on the accuracy of mere figures. In a census, indeed, it is a simple rule, that the information returned should be ramified as far beyond the main facts as with safety to these it can be carried. The tendency towards complexity in the nature of the returns must always be checked by the liability of the people at large to make blunders and create confusion where they are required to attest facts not of the most obvious nature, and by the difficulty of getting a number of subordinate officers to understand and carry out a complex classification. Hence there

has been great difficulty in obtaining a classification according to occupation, from its complex intermixture with the classification according to families. Thus, even in the first census, there was an attempt to classify the people under three divisions—(1.) Persons chiefly employed in agriculture; (2.) Persons chiefly employed in trade, manufactures, or handicraft; and (3.) All other persons not comprised in the two preceding classes. But Mr Rickman found the returns unsatisfactory, from the difficulty of deciding "whether the females of the family, children and servants, were to be classed as of no occupation, or of the occupation of the adult males of the family." In the two subsequent enumerations, the rule adopted was to record the occupation of the head of the family; but here comes a new element of confusion, in the difficulty of defining the head of a family. Experience, and an anxious desire to accomplish simplicity and comprehensiveness in the returns, were the only means by which such difficulties could be mitigated.

The enumerations of 1841 and 1851 in England were much facilitated by the uniform system of registration of births, marriages, and deaths, established in 1836, which not only afforded the means of checking the accuracy of the returns, but provided a prompt and skilled machinery accustomed to statistical work. Far more dependence could now be placed on the discretion and skill of the officers to whom the local duties were committed; and the returns were made more minute and complete. Scotland and Ireland are perhaps the only considerable countries in Christian Europe where there is no uniform system of registration. In Scotland it was necessary to adopt the clumsy method of employing the parish schoolmasters to perform the local duty in the country districts. In Ireland the first attempt at a general census was made in 1811, but it was decidedly unsuccessful. It was repeated in 1821, but went no further than a bare enumeration, of doubtful accuracy. The census there taken in 1831 was subject to correction in 1834, to make it the basis of the new system of national education. In the two subsequent enumerations the aid of the admirable constabulary force, and the use of an ordnance survey, nearly complete in 1841, have gone far to supply the want of permanent local statistical machinery.

The census of 1851 was taken on the 31st day of March, the previously distributed schedules being then collected. They embraced a return of the local and other conditions of the population during the preceding night. "At the present census," say the commissioners, "it was resolved to exhibit, not merely the statistics, as before, of parishes, and more completely of parliamentary and municipal boroughs, but also of such other large towns in England and Scotland as appeared sufficiently important for separate mention, and of all the ecclesiastical districts and new ecclesiastical parishes which, under the provision of various acts of parliament, have, during the last forty years, been created in England and Wales. In additon also to the inquiry concerning the occupation, age, and birth-place of the population, it was determined to ascertain the various relationships (such as husband, wife, son, daughter), the civil condition (as married, unmarried, widower, or widow), and the number of persons blind, deaf, and dumb." The relation of our large towns to parochial divisions has always been felt as a statistical want, but it may be questioned if it has been quite accurately supplied; and at least one important blunder has occurred in reference to Glasgow.

Another novel feature in the census of 1851 was an attempt to supply the statistics of the ecclesiastical and educational condition of the country. It stated the amount of church accommodation at the command of each religious denomination; while a return was procured of those in attendance in the several churches on Sunday 30th March. The attendance throughout thirty-five religious communities in England on that forenoon was returned as 4,428,338, of which the proportion assigned to the Establishment was 2,371,732. The returns for Scotland, admittedly very imperfect, give a total of 943,951, of which 351,454 belonged to the Establishment. These results are mentioned as characteristics of this novel feature in the periodical enumerations,—they were accompanied by many others of a startling and interesting character, on which the present is no fit occasion for enlarging. The English report was accompanied by an elaborate history of the several religious communities, valuable certainly in itself, though a questionable service to be performed by officers whose duties are purely statistical.

The two later enumerations in Ireland exhibit statistical novelties of a totally different kind. In 1841 it was resolved, as that country so totally depended on the amount of its agricultural produce, to obtain the statistics of its rural economy. The surface of the country was divided under five heads—arable, plantations, uncultivated, towns, and water; and, with a view to these divisions, a return was made of the character of each farm or other agricultural allotment, with the quantity of live stock, and other relevant facts. The attempt was found so successful, that it was renewed on the same principle, and with more full effect in 1851, producing 727 tabular folio pages of very valuable information.

For the results of census enumerations, and their connection with statistics, reference must be made to the different geographical heads, and to the articles POPULATION and STATISTICS. (J. H. B.)

CENT, a contraction of the Latin *centum*, a hundred, is used in commerce to denote a certain rate by the hundred: thus ten per cent. profit or ten per cent. loss upon the sale of any merchandise, implies that the seller has gained or lost L.10 on every L.100 of the price at which he bought that merchandise. The rate is termed *percentage.*

Cent is also the name of a copper coin of the United States of America; equal to the hundredth part of a dollar, or rather more than a halfpenny.

CENTALLO, a town of Piedmont, Sardinia, near the right bank of the Grana, province, and 7 miles N.N.E. of Coni. Pop. 5000. It was formerly of considerable importance, and its ancient castle was the residence of the Marquis of Susa.

CENTAUR, in *Astronomy*, a part of a southern constellation, in form half man and half horse; usually joined with the Wolf. See ASTRONOMY.

CENTAURI, CENTAURS, a wild race of shepherds and herdsmen inhabiting Mount Pelion in Thessaly, and who were represented in ancient fable as beings of a double form—the upper part human and the lower part that of a horse. They were the reputed offspring of Centaurus, son of Apollo, and the mares of Magnesia; or of Ixion and a cloud in the shape of Juno. The accounts of their origin are different. It is related by Palæphatus, in his *Book of Wonders*, that in the time of the Thessalian king Ixion the adjacent country was devastated by a herd of wild bulls; and that a large reward having been offered for their destruction, some young men, mounted on horses they had trained for the purpose, pursued and slew the bulls—and hence received the appellation of *Centauri, i.e. bull-killers.*

The bull-chase was a national sport among the Thes salians; and it is not improbable that their dexterity in horsemanship may have given rise to the fable of monsters half men and half horses: or perhaps it may be ascribed to the ignorance of those who, on first beholding a man mounted on horseback, supposed (as the American Indians on a like occasion) that the horse and his rider were one animal.

The battle of the Centaurs with their neighbours the Lapithæ is celebrated in ancient story. This quarrel arose at the marriage of Hippodamia with Pirithous; on which

occasion the Centaurs, flushed with wine, offered gross indignities to the assembled company. They were severely chastised for their insolence by Hercules, Theseus, and the other Lapithæ, and compelled to take refuge in Arcadia. Here they were defeated a second time by Hercules, and almost extirpated. The most famous of the Centaurs was Chiron, the friend and preceptor of Hercules, and who was accidentally slain by that hero.

CENTENARIUS, in the middle ages, an officer who had the government and administration of justice in a village. We find them among the Franks, Germans, Lombards, Goths, and other nations. Centenarius also denoted a centurion or officer who had the command of 100 men.

CENTESIMÆ USURÆ, in ancient Rome, a rate of interest which in a hundred months became equal to the principal, that is, where the money was laid out at one per cent. per month, answering to twelve per cent. per annum. The Romans reckoned their interest not by the year but by the month.

CENTESIMATION, a kind of military punishment for mutiny and the like, milder than decimation, but one man in every hundred being selected for punishment.

CENTIGRADE THERMOMETER. See BAROMETER, vol. iv. p. 457.

CENTILOQUIUM, a collection of a hundred sentences, opinions, or sayings. The centiloquium of Hermes contains a hundred aphorisms, or astrological sentences, supposed to have been written by some Arab, and falsely ascribed to Hermes Trismegistus. The famous centiloquium of Ptolemy consists likewise of a hundred sentences or doctrines, divided into short aphorisms, entitled also in Greek *καρπος*, as being the fruit or result of the former writings of that celebrated astronomer, namely his *Quadripartitum* and *Almagestum;* or rather because the use of astrological calculations is therein explained.

CENTLIVRE, SUSANNA (1667–1723), a dramatic writer, was the daughter of Mr Freeman of Holbeach, in Lincolnshire; and exhibited such an early turn for poetry, that she is said to have written a song when only seven years old. On the death of her father she was committed to the care of a stepmother, from whose treatment she determined to flee to London, where, after some equivocal adventures, she was married to a nephew of Sir Stephen Fox. About twelve months afterwards her husband died; and she was then married to an officer in the army of the name of Carrol. Carrol was killed in a duel about a year and a half after their marriage; and his widow was left to support herself by her pen. Under the name of Carrol some of her earlier pieces were published. Her first attempt was a tragic piece called the *Perjured Husband;* but her natural vivacity inclining her rather to comedy, we find but one more attempt of this kind among eighteen dramatic pieces which she afterwards wrote. In 1706 she married Mr Joseph Centlivre, principal cook to her Majesty, with whom she lived till her death in 1723. Mrs Centlivre for many years enjoyed the intimacy of Sir Richard Steele, Rowe, Budgell, Farquhar, Dr Sewell, and other persons of note, and received numerous tokens of esteem and patronage from the great. Her dramatic works were published in 3 vols. 12mo, 1761.

CENTO (Latin *cento*, patch-work), a composition formed of verses or passages from other authors, disposed in a new order.

CENTO, a town of the Papal States, 16 miles north by west of Bologna, situated in a fertile plain near the Reno. Pop. 4572. It is chiefly remarkable as the birthplace of the painter Guercino, whose house is still preserved.

CENTORBI, the ancient *Centuripo*, a town of Sicily, on a rugged mountain, province and 20 miles W.N.W. of Catania. Pop. 4500. Near it are ruins of the ancient city.

CENTRAL AMERICA. See AMERICA, GUATEMALA, &c.

CENTRAL FORCES, the powers which cause a moving body to tend towards, or recede from, the centre of motion.

CENTRE.

CENTRE, or CENTER, a word borrowed from the French name *ceintre* or *cintre*, given to the frame of timber by which the brick or stone of arched vaulting is supported during its erection, and from which it receives its form and curvature.

It is not our intention to describe the variety of constructions which may be adopted in easy situations, where the arches are of small extent, and where sufficient foundation can be had in every part of it for supporting the frame. In such cases the frequency of the props which we can set up dispenses with much care; and a frame of very slight timbers, connected together in an ordinary way, will suffice for carrying the weight, and for keeping it in exact shape. But when the arches have a wide span, and consequently a very great weight, and when we cannot set up intermediate pillars, either for want of a foundation in the soft bottom of a river, or because the arch is turned between two lofty piers, as in the dome of a stately cathedral, we are then obliged to rest every thing on the piers themselves; and the framing which is to support our arch before the keystone is set must itself be an arch, depending on the mutual abutment of its beams. One should think that this view of the construction of a centre would offer itself at the first, naturally derived from the erection it was to assist; but it has not been so. When intermediate pillars were not employed, it was usual to frame the mould for the arch with little attention to any thing but its shape, and then to cross it and recross it in all directions with other pieces of timber, till it was thought so bound together that it could be lifted in any position, and, when loaded with any weight, could not change its shape. The frame was then raised in a lump, like any solid body of the same shape, and set in its place. This is the way still practised by many country artists, who, having no clear principles to guide them, do not stop till they have made a load of timber almost equal to the weight which it is to carry.

But this artless method, besides leading the employer into great expense, is frequently fatal to the undertaker, from the unskilfulness of the construction. The beams which connect its extremities are made also to support the middle by means of posts which rest on them. They are therefore exposed to a transverse or cross strain, which they are not able to bear. Their number must therefore be increased, and this increases the load. Some of these cross strains are derived from beams which are pressed very obliquely, and therefore exert a prodigious thrust on their supports. The beams are also greatly weakened by the mortises which are cut in them to receive the tenons of the crossing beams; and thus the whole is exceedingly weak, in proportion to what the same quantity of timber may be made by a proper disposition of its parts.

General principles of construction.

The principles from which we are to derive this disposition are the general mechanical principles of carpentry, of which an account has already been given under the proper head. See CARPENTRY. These furnish one general rule. When we would give the utmost strength possible to a frame of carpentry, every piece should be so disposed that it is subject to no strain but what either pushes or draws it in the direction of its length; and, if we

would be indebted to timber alone for the force or strength of the centre, we must rest all on the first of these strains; for when the straining force tends to *draw* a beam out of its place, it must be held there by a mortise and tenon, which possesses but a very trifling force, or by iron straps and bolts. Cases occur where it may be very difficult to make every strain a thrust, and the best artists admit of ties; and indeed where we can admit a tie-beam connecting the two feet of our frame, we need seek no better security. But this may sometimes be very inconvenient. When it is the arch of a bridge that we are to support, such a tie-beam would totally stop the passage of small craft up and down the river. It would often be in the water, and thus exposed to the most fatal accidents by freshes, &c. Interrupted ties, therefore, must be employed, whose joint or meetings must be supported by something analogous to the king-posts of roofs. When this is judiciously done, the security is abundantly good. But great judgment is necessary, and a very scrupulous attention to the disposition of the pieces. It is by no means an easy matter to discern whether a beam, which makes a part of our centre, is in a state of compression or in a state of extension. In some works of the most eminent carpenters even of this day, we see pieces considered as struts, and considerable dependence had on them in this capacity, while they are certainly performing the office of tie-beams, and should be secured accordingly. This was the case in the boldest centre, we think, that has been executed in Europe, that of the bridge of Orleans, by M. Hupeau. Yet it is evidently of great consequence not to be mistaken in this point; for when we are mistaken, and the piece is stretched which we imagine to be compressed, we not only are deprived of some support that we expected, but the expected support has become an additional load.

How to distinguish a strut from a tie.

To ascertain this point, we may suppose the piers to yield a little to the pressure of the arch-stones on the centre frames. The feet, therefore, fly outwards, and the shape is altered by the sinking of the crown. We must draw our frame anew for this new state of things, and must notice what pieces must be made longer than before. All such pieces have been acting the part of tie-beams.

But a centre has still another office to sustain; it must keep the arch in its form; that is, while the load on the centre is continually increasing as the masons lay on more courses of arch-stones, the frame must not yield and go out of shape, sinking under the weight on the haunches, and rising in the crown, which is not yet carrying any load. The frame must not be supple, and must derive its stiffness, not from the closeness and strength of its joints, which are quite insignificant when set in competition with such immense strains, but from struts or ties, properly disposed, which hinder any of the angles from changing its amplitude.

How to secure stiffness and strength.

It is obvious, from all that has been said, that the strength and stiffness of the whole must be found in the triangles into which this frame of carpentry may be resolved. We have seen that the strains which one piece produces on two others with which it meets in one point, depend on the angles of their intersection; and that it is greater as an obtuse angle is more obtuse, or an acute angle more acute. And this suggests to us the general maxim, "to avoid as much as possible all very obtuse angles." Acute angles, which are not necessarily accompanied by obtuse ones, are not so hurtful, because the strain here can never exceed the straining force; whereas, in the case of an obtuse angle, it may surpass it in any degree.

Such are the general rules on this subject. Although something of the mutual abutment of timbers, and the support derived from it, has been long perceived, and employed by the carpenters in roofing, and also, doubtless, in the forming of centres, yet it is a matter of historical fact, that no general and distinct views had been taken of it till about the beginning of last century, or a little earlier. Fontana has preserved the figure of the frames on which the arches of St Peter's at Rome were turned. The one employed for the dome is constructed with very little skill; and those for the arches of the nave and transepts, though incomparably superior, and of considerable simplicity and strength, are yet far inferior to others which have been employed in later times. It is much to be regretted that no trace remains of the forms employed by the great architect and consummate mechanician Sir Christopher Wren. We should doubtless have seen in them every thing that science and great sagacity could suggest. We are told, indeed, that his centring for the dome of St Paul's was a wonder of its kind; begun in the air at the height of 160 feet from the ground, and without making use of even a projecting cornice whereon to rest.

The earliest theory on scientific principles.

The earliest theory of the kind that we have met with, that is proposed on scientific principles, and with the express purpose of serving as a lesson, are two centres by M. Pitot of the Academy of Sciences, about the beginning of last century. As they have considerable merit, greatly resembling those employed by Michael Angelo in the nave of St Peter's, and afford some good maxims, we shall give a short account of them. We crave the excuse of the artists if we should employ their terms of art somewhat awkwardly, not being very familiarly acquainted with them. Indeed, we observe very great differences, and even ambiguity, in the terms employed.

What we shall describe under the name of a *centre* is, properly speaking, only one frame, truss, or rib, of a centre. They are set up in vertical planes, parallel to each other, at the distance of five, six, seven, or eight feet, like the trusses or main couples of a roof. Bridging joists are laid across them. In smaller works these are laid sparingly, but of considerable scantling, and are boarded over; but for great arches, a bridging joist is laid for every course of arch-stones, with blockings between to keep them at their proper distances. The stones are not laid immediately on these joists, but beams of soft wood are laid along each joist, on which the stone is laid. These beams are afterwards cut out with the chisel, in order to separate the centre from the ring of stones, which must now support each other by their mutual abutment.

Illustrated Pl. CLXV

The centre is distinguishable into two parts, ALLB (fig. 1) and LDL, which are pretty independent of each other, or at least act separately. The horizontal stretcher LL cuts the semicircle ADB half way between the spring and the crown of the arch; the arches AL, LD, being 45° each. This stretcher is divided in the same proportion in the points G and H; that is, GH is one half of LL, and LG, HL, are each one fourth of LL nearly. Each end is supported by two struts EI, GI, which rest below on a sole or bed properly supported. The interval between the heads of the struts GI, HK, is filled up by the straining beam GH, abutting in a proper manner on the struts (see Carpentry). The extremities L, L, are united in like manner by butting joints, with the heads of the outer struts. The arch moulds AP, BP, are connected with the struts by cross pieces PQ, which we shall call bridles, which come inwards on each side of the struts, being double, and are bolted to them. This may be called the lower part of the frame. The upper part consists of the king-post DR, supported on each side by the two struts or braces ML, ON, mortised into the post, and also mortised into the stretcher, at the points L, N, where it is supported by the struts below. The arches LD, LD, are connect-

ed with the struts by the bridles PQ, in the same manner as below.

Propriety of this arrangement.

There is a great propriety in many parts of this arrangement. The lower parts or haunches of the arch press very lightly on the centres. Each arch-stone is lying on an inclined plane, and tends to slide down only with its relative weight; that is, its weight is to its tendency to slide down the joint as radius to the sine of elevation of the joint. Now it is only by this tendency to slide down the joint that they press on the centring, which in every part of the arch is perpendicular to the joint: but the pressure on the joint arising from this cause is much less than this, by reason of the friction of the joints. A block of dry freestone will not slide down at all, and therefore will not press on the centring, if the joint be not elevated thirty-five degrees at least. But the arch-stones are not laid in this manner, by sliding them down along the joint, but are laid on the centres, and slide down *their* slope, till they touch the blocks on which they are to rest; so that, in laying the arch-stones, we are by no means allowed to make the great deduction from their weight just now mentioned, and which M. Couplet prescribes (*Mém. Acad. Sciences*, 1729.) But there is another cause which diminishes the pressure on the centres: each block slides down the planks on which it is laid, and presses on the block below it, in the direction of the tangent to the arch. This pressure is transmitted through this block, in the same direction, to the next, and through it to the third, &c. In this manner it is plain that, as the arch advances, there is a tangential pressure on the lower arch-stones, which diminishes their pressure on the frame, and, if sufficiently great, might even push them away from it. M. Couplet has given an analysis of this pressure, and shows, that in a semicircular arch of uniform thickness none of the arch-stones below thirty degrees press on the frames. But he, without saying so, calculates on the supposition that the blocks descend along the circumference of this frame in the same manner as if it were perfectly smooth. As this is far from being the case, and as the obstructions are to the last degree various and irregular, it is quite useless to institute any calculation on the subject. A little reflection will convince the reader, that in this case the obstruction arising from friction *must* be taken into account, and that it *must not* be taken into account in estimating the pressure of each successive course of stones as they are laid. It is enough that we see that the pressure of the lower courses of arch-stones on the frame is diminished. M. Couplet says, that the whole pressure of a semicircular arch is but four ninths of its weight; but it is much greater, for the reason just now given. We have tried, with a well-made wooden model (of which the circumference was rubbed with black lead, to render it more slippery) whether *any* part of the wooden blocks representing the arch-stones were detached from the frame by the tangential pressure of the superior blocks; but we could not say confidently that any were so detached. We perceived that all kept hold of a thin slip of Chinese paper (also rubbed with black lead) between them and the frame, so that a sensible force was required to pull it out. From a combination of circumstances, which it would be tedious to relate, we believe that the centres carry more than two thirds of the weight of the arch before the keystone is set. In elliptical and lower pitched circular arches, the proportion is still greater.

By a centre of M. Pitot's.

It seems reasonable enough, therefore, to dispose the framing in the manner proposed by Pitot, directing the main support to the upper mass of the arch, which presses most on the frame. We shall derive another advantage from this construction, which has not occurred to M. Pitot.

There is an evident propriety in the manner in which he has distributed the supports of the upper part. The struts which carry the king-post spring from those points of the stretcher where it rests on the struts below. Thus the stretcher, on which all depends, bears no transverse strains. It is stretched by the strut above it, and it is compressed in a small degree between the struts below it, at least by the outer ones. M. Pitot proposes the straining beam GH as a lateral support to the stretcher, which may therefore be of two pieces; but although it *does* augment its strength, it does not seem necessary for it. The stretcher is abundantly carried by the strap, which may and should suspend it from the king-post. The great use of the straining piece is to give a firm abutment to the inner struts, without allowing any lateral strain on the stretcher.—*N. B.* Great care must be taken to make the hold sufficiently firm and extensive between the stretcher and the upper struts, so that its cohesion to resist the thrusts from these struts may be much employed.

The only imperfection that we find in this frame is the lateral strains which are brought upon the upper struts by the bridles, which certainly transmit to them part of the weight of the arch-stones on the curves. The space between the curves and ML should also have been trussed. M. Pitot's form is, however, extremely stiff; and the causing of the middle bridle to reach down to the stretcher seems to secure the upper struts from all risk of bending.

This centre gives a very distinct view of the offices of all the parts, and makes therefore a proper introduction to the general subject. It is the simplest that can be in its principle, because all the essential parts are subjected to one kind of strain. The stretcher LL is the only exception, and its extension is rather a collateral circumstance than a step in the general support.

Strength of this frame

The examination of the strength of the frame is extremely easy. M. Pitot gives it for an arch of sixty feet span, and supposes the arch-stones seven feet long, which is a monstrous thickness for so small an arch; four feet is an abundant allowance; but we shall abide by his construction. He gives the following scantlings of the parts:—

The ring or circumference consists of pieces of oak twelve inches broad and six thick.

The stretcher LL is twelve inches square.

The straining piece GH is also twelve by twelve.

The lower struts ten by eight.

The king-post twelve by twelve.

The upper struts ten by six.

The bridles twenty by eight.

These dimensions are French, which is about one seventeenth larger than ours, and the superficial dimensions (by which the section and the absolute strength is measured) are almost one eighth larger than ours. The cubic foot, by which the stones are measured, exceeds ours by nearly one fifth. The pound is deficient about one thirteenth. But since very nice calculation is neither easy nor necessary on this subject, it is needless to depart from the French measures, which would occasion many fractional parts, and a troublesome reduction.

The arch is supposed to be built of stone which weighed a hundred and sixty pounds per foot. M. Pitot, by a computation, in which he has committed a mistake, says, that only eleven fourteenths of this weight is carried by the frame. We believe, however, that this is nearer the truth than M. Couplet's assumption of four ninths, already mentioned.

M. Pitot further assumes, that a square inch of sound oak will carry 8640 pounds. By his language we should imagine that it will not carry much more; but this is very far below the strength of any British oak that we have tried; so far, indeed, that we rather imagine that he means

Centre. that this load may be laid on it with perfect security for any time. But to compensate for knots and other accidental imperfections, he assumes 7200 as the measure of its absolute force.

He computes the load on each frame to be 707,520 pounds, which he reduces to $\frac{11}{14}$ths, or 555,908 pounds.

The absolute force of each of the lower struts is 576,000 (at 7200 per inch), and that of the curves 518,400. M. Pitot, considering that the curves are kept from bending outwards by the arch-stones which press on them, thinks that they may be considered as acting precisely as the outer struts EI. We have no objection to this supposition.

computed. With these data we may compute the load which the lower truss can safely bear, by the rule delivered in the article Carpentry. We therefore proceed as follows:

Measure off by a scale of equal parts as, at, each 576,000, and add tv 518,400. Complete the parallelogram $avxs$, and draw the vertical xc, meeting the horizontal line aC in c. Make cb equal to ca. Join xb, and complete the parallelogram $axby$. It is evident that the diagonal xy will represent the load which these pieces can carry; for the line av is the united force of the curve AP and the strut IE, and as is the strength of IG. These two are equivalent to ax. xb is, in like manner, equivalent to the support on the other side, and xy is the load which will just balance the two supports ax and bx.

When xy is measured on the same scale, it will be found =2,850,000 pounds. This is more than five times the load which actually lies on the frame. It is therefore vastly stronger than is necessary. Half of each of the linear dimensions would have been quite sufficient, and the struts needed only to be five inches by four. Even this would have carried twice the weight, and would have borne the load really laid on it with perfect safety.

We proceed to measure the strength of the upper part. The force of each strut is 432,000, and that of the curve is 518,400; therefore, having drawn Mv parallel to the strut ON, make Mv = 432,000, and Ms = 432,000 + 518,400. Complete the parallelogram Msrv. Draw the horizontal line rk, cutting the vertical MC in k, and make ky = Mk. It is plain, from what was done for the lower part, that My will measure the load which can be carried by the upper part. This will be found =1,160,000. This is also greatly superior to the load, but not in so great a proportion as the other part. The chief part of the load lies on the upper part, but the chief reason of the difference is the greater obliquity of the upper struts. This shortens the diagonal My of the parallelogram of forces. M. Pitot should have adverted to this, and instead of making the upper struts more slender than the lower, he should have made them stouter.

The strain on the stretcher LL is not calculated. It is measured by rk, when My is the load actually lying on the upper part. Less than the sixth part of the cohesion of the stretcher is more than sufficient for the horizontal thrust, and there is no difficulty in making the foot joints of the struts abundantly strong for the purpose.

The reader will perceive that the computation just now given does not state the proportions of the strains *actually exerted* on the different pieces, but the load on the whole, on the supposition that each piece is subjected to a strain proportioned to its strength. The other calculation is much more complicated, but is not necessary here.

This centre has a very palpable defect. If the piers should yield to the load, and the feet of the centre fly out, the lower part will exert a very considerable strain on the stretcher, tending to break it across between N and L, and on the other side. HKF of the lower part is firmly bound together, and cannot change its shape, and will therefore act like a lever, turning round the point F. It will draw the strut HK away from its abutment with GH, and the stretcher will be strained across at the place between H and F, where it is bolted with the bridle. This may be resisted in some degree by an iron strap uniting ON and HK, but there will still be a want of proportional strength. Indeed, in an arch of such height, a semicircle, there is but little risk of this yielding of the piers, but it is an imperfection. Centre.

A centre on the same principles for an elliptical arch. The centre (fig. 2, No. 1) is constructed on the same principle precisely for an elliptical arch.[1] The calculation of its strength is nearly the same also; only the two upper struts of a side being parallel, the parallelogram Msrv (of fig. 1) is not needed, and in its stead we measure off on ON a line to represent twice its strength. This comes in place of Mr of fig. 1.—*N. B.* The calculation proceeds on the supposition that the short straining piece MM makes but one firm body with the king-post. Mr Pitot employed this piece, we presume, to separate the heads of the struts, that their obliquity might be lessened thereby; and this is a good thought, for when the angle formed by the struts on each side is very open, the strain on them becomes very great.

The stretcher of this frame is scarfed in the middle. Suppose this joint to yield a little, there is a danger of the lower strut ON losing its hold, and ceasing to join in the support; for when the crown sinks by the lengthening of the stretcher, the triangle ORN of fig. 2 will be more distorted than the space above it, and ON will be loosened. But this will not be the case when the sinking of the crown arises from the mere compression of the struts. Nor will it happen at all in the centre, fig. 1. On the contrary, the strut ON will abut more firmly by the yielding of the foot of ML.

The figure of this arch of M. Pitot's consists of three arches of circles, each of 60 degrees. As it is elegant, it will not be unacceptable to the artist to have a construction for this purpose.

How to construct such an arch. Make BY = CD, and CZ′ = $\frac{1}{2}$ CY. Describe the semicircle ZÆY, and make ZS′ = ZÆ. S is the centre of the side arches, each of 60 degrees. The centre T of the arch, which unites these two, is at the angle of an equilateral triangle STS′.

This construction of M. Pitot's makes a handsome oval, and very nearly an ellipsis, but lies a little without it. We shall add another of our own, which coincides with the ellipse in eight points, and furnishes the artist, by the way, with a rule for drawing an infinite variety of ovals.

Let AB, DE (fig. 2, No. 2), be the axes of an ellipse, C the centre, and F f the two foci. Make C b = CD, and describe a circle AD b e passing through the three given points A, D, and b. It may be demonstrated, that if from any point P of the arch AD be drawn a cord PD, and if a line PR r be drawn, making the angle DPR = PDC, and meeting the two axes in the points R and r, then R and r will be the centres of circles, which will form a quarter APD of an oval, which has AB and DE for its two axes.

We want an oval which shall coincide as much as possible with an ellipsis. The most likely method for this is to find the very point P where the ellipsis cuts the circle AD b e. The easiest way for the artist is to describe an arch of a circle a m, having AB for its radius, and the remote focus f for its centre. Then set one foot of the com-

[1] It is the middle arch of the bridge at L'Ile Adam, of which M. Pitot had the direction. It is of eighty feet span, and rises thirty-one feet.

passes on any point P, and try whether the distance PF from the nearest focus F is exactly equal to its distance P m from that circle. Shifting the foot of the compasses from one point of the arch to another will soon discover the point. This being found, draw PD, make the angle DP r = PD r, and R and r are the centres wanted. Then make CS = CR, and we get the centres for the other side.

The geometer will not relish this mechanical construction. He may therefore proceed as follows: "Draw ed the diameter of the circle, cutting AB in N; join Dd, and produce it so that dH may be equal to CD, and join eH, meeting AB in Q. On B and Q, as centres with any radius, describe arcs cutting each other in X, and on C and N with the same radius describe arcs cutting each other in Y. Take the distance XN in the compasses, and on Y as a centre describe an arc cutting AB in M and M′, and draw MP, M′P′ perpendicular to AB. These ordinates will cut the circle in the points P and P, where it is cut by the ellipse."[1] We leave the demonstration as an exercise for the *dilettante*.

Centre for the nave of St Peter's.

We said that this centring of M. Pitot's resembled in principle the one employed by Michael Angelo for the nave and transepts of St Peter's church at Rome. Fontana, who has preserved this, ascribes the construction of it to one of the name of San Gallo. A sketch of it is given in fig. 3. It is, however, so much superior, and so different in principle, from that employed for the cupola, that we cannot think it the invention of the same person. It is, like Pitot's, not only divisible, but really divided into two parts, of which the upper carries by much the greatest part of the load. The pieces are judiciously disposed, and every important beam is amply secured against all transverse strains. Its only fault is a great profusion of strength. The innermost polygon $aghb$ is quite superfluous, because no strain can force in the struts which rest on the angles. Should the piers yield outwards, this polygon will be loose, and can do no service. Nor is the triangle gih of any use, if the king-post above it be strapped to the tie-beam and straining sill. Perhaps the inventor considered the king-post as a pillar, and wished to secure the tie-beam against its cross strain. This centring, however, must be allowed to be very well composed; and we expect that the well-informed reader will join us in preferring it to M. Pitot's, both for simplicity of principle and scientific propriety, as well as for strength.

There is one considerable advantage which may be derived from the actual division of the truss into two parts. If the tie-beam LL, instead of resting on the stretcher EF, had rested on a row of chocks formed like double wedges, placed above each other head to point, the upper part of the centring might be struck independent of the lower, and this might be done gradually, beginning at the outer ends of the stretcher. By this procedure the joints of the arch-stones will close on the haunches, and will almost relieve the lower centring, so that all can be pulled out together. Thus may the arch settle and consolidate in perfect safety, without any chance of breaking the bond of the mortar in any part; an accident which frequently happens in great arches. This procedure is peculiarly advisable for low pitched or elliptical arches. But this will be more clearly seen afterwards, when we treat of the internal movements of an arch of masonry.

This may suffice for an account of the more simple construction of trussed centres; and we proceed to such as have a much greater complication of principle. We shall take for examples some constructed by M. Perronet, a very celebrated French architect.

Perronet's maxim of construction.

M. Perronet's general maxim of construction is to make the truss consist of several courses of separate trusses, independent, as he thinks, of each other, and thus to employ the joint support of them all. In this construction it is not intended to make use of one truss, or part of one truss, to support another, as in the former set, and as is practised in the roofs of St Paul's church, Covent Garden, and in Drury Lane theatre. Each truss spans over the whole distance of the piers, and would stand alone (having, however, a tottering equilibrium). It consists of a number of struts, set end to end, and forming a polygon. These trusses are so arranged that the angles of one are in the middle of the sides of the next, as when a polygon is inscribed in a circle, and another (of the same number of sides) is circumscribed by lines which touch the circle in the angles of the inscribed polygon. By this construction the angles of the alternate trusses lie in lines pointing towards the centre of the curve. King-posts are therefore placed in this direction, between the adjoining beams of the trusses. These king-posts consist of two beams, one on each side of the truss, and embrace the truss-beams between them, meeting in the middle of their thickness. The abutting beams are mortised, half into each half of the post. The other beam, which makes the base of the triangle, passes through the post, and a strong bolt is driven through the joint, and secured by a key or a nut. In this manner is the whole united; and it is expected, that when the load is laid on the uppermost truss, it will all butt together, forcing down the king-posts, and therefore pressing them on the beams of all the inferior trusses, causing them also to abut on each other, and thus bear a share of the load. M. Perronet does not assume the invention to himself, but says that it was invented and practised by M. Mansard de Sagonne at the great bridge of Moulins. It is much more ancient, and is the work of the celebrated physician and architect Perrault, as may be seen in the collection of machines and inventions of that gentleman, published after his death, and also in the great collection of inventions approved of by the Academy of Sciences. It is this which we propose to examine.

Centring employed for the bridge of Cravant.

Fig. 4 represents the centring employed for the bridge of Cravant. The arches are elliptical, of sixty feet span and twenty feet rise. The arch-stones are four feet thick, and weigh 176 pounds per foot. The truss-beams were from fifteen to eighteen feet long, and their section was nine inches by eight. Each half of the king-posts was about seven feet long, and its section nine inches by eight. The whole was of oak. The five trusses were five and a half feet asunder. The whole weight of the arch was 1,350,000 lbs., which we may call 600 tons (it is 558). This is about 112 tons for each truss. We must allow nearly ninety tons of this really to press the truss. A great part of this pressure is borne by the four beams which make the feet of the truss, coupled in pairs on each side. The diagonal of the parallelogram of forces drawn for these beams is, to one of the sides, in the proportion of 360 to 285. Therefore say, as 360 to 285, so is 90 to $71\frac{1}{4}$

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[1] The construction given in the Supplement to the Third Edition, by the writer of this article (the late Professor Robison), is here left out, and another more simple (that marked by inverted commas) put in its stead. If we put a for the semi-transverse cA, b for the semi-conjugate cD, and denote the distance of the ordinates CM, CM′, from the centre by x, then CM and CM′ will be the roots of this quadratic equation:

$$x^2 - \frac{a-b}{a+b}ax = \frac{2a^3b}{(a+b)^2}.$$

The above construction has been derived from this equation. (E.)

Centre.

tons, the thrust on each foot. The section of each is 144 inches. We may with the utmost safety lay three tons on every inch for ever. This amounts to 432 tons, which is more than six times the strain really pressing the foot-beams in the direction of their length; nay, the upper truss alone is able to carry much more than its load. The absolute strength of its foot-beam is 216 tons. It is much more advantageously placed, for the diagonal of the parallelogram of forces corresponding to its position is to the side as 438 to 285. This gives $58\frac{6}{10}$th tons for the strain on each foot, which is not much above the fourth part of what it is able to carry for ever. No doubt can therefore be entertained of the superabundant strength of this centring. We see that the upper row of struts is quite sufficient, and all that is wanted is to procure stiffness for it; for it must be carefully kept in mind that this upper row is not like an equilibrated arch. It will be very unequally loaded as the work advances. The haunches of the frame will be pressed down, and the joints at the crown raised up. This must be resisted.

Here then we may gather by the way a useful lesson. Let the outer row of struts be appropriated to the carriage of the load, and let the rest be employed for giving stiffness. For this purpose let the outer row have abundant strength. The advantages of this method are considerable. The position of the beams of the exterior row is more advantageous when, as in this example, the whole is made to rest on a narrow foot; for this obliges us to make the last angle, at least of the lower row, more open, which increases the strain on the strut; besides, it is next to impossible to distribute the compressing thrusts among the different rows of the truss-beams; and a beam which, during one period of the mason work, is acting the part of a strut, in another period is bearing no strain but its own weight, and in another it is stretched as a tie. A third advantage is, that, in a case like this, where all rests on a narrow foot, and the lower row of beams are bearing a great part of the thrust, the horizontal thrust on the pier is very great, and may push it aside. This is the most ruinous accident that can happen. An inch or two of yielding will cause the crown of the arch to sink prodigiously, and will instantly derange all the bearings of the abutting beams; but when the lower beams already act as ties, and are quite adequate to their office, we render the frame perfectly stiff or unchangeable in its form, and take away the horizontal thrust from the piers *entirely*. This advantage is the more valuable, because the very circumstance which obliges us to rest all on a narrow foot, places this foot on the very top of the pier, and makes the horizontal thrust the more dangerous.

But, to proceed in our examination of the centring of Cravant Bridge, let us suppose that the king-posts are removed, and that the beams are joined by compass joints. If the pier shall yield in the smallest degree, both rows of struts must sink; and since the angles, at least the outermost, of the lower rows are more open than those of the upper row, the crown of the lower row will sink more than that of the upper.

The angles of the alternate rows must therefore separate a little. Now restore the king-posts, they prevent this separation. Therefore *they are stretched;* therefore the beams of the lower row are also stretched; consequently they no longer butt on their mortises, and must be held in their places by bolts. Thus it appears that, in this kind of sagging, the original distribution of the load among the different rows of beams is changed, and the upper row becomes loaded beyond our expectation.

If the sagging of the whole truss proceed only from the compression of the timbers, the case is different, and we *may* preserve the original distribution of mutual abutment more accurately. But in this case the stiffness of the frame arises chiefly from cross strains. Suppose that the frame is loaded with arch-stones on each side up to the posts HC, *hc;* the angles E and *e* are pressed down and the beams EOF, *eo* F, push up the point F. This cannot rise without bending the beams EOF, *eo* F; because O and *o* are held down by the double king-posts, which grasp the beams between them. There is therefore a cross strain on the beams. Observe also that the triangle EHF does not preserve its shape by the connection of its joints; for although the strut-beams are mortised into the king-post, they are in very shallow mortises, rather for steadying them than for holding them together. M. Perronet did not even pin them, thinking that their abutment was very great. The triangle is kept in shape by the base EF, which is firmly bolted into the middle post at O. Had these intersections not been strongly bolted, we imagine that the centres of some of M. Perronet's bridges would have yielded much more than they did; yet some of them yielded to a degree that our artists would have thought very dangerous. M. Perronet was obliged to load the crown of the centring with very great weights, increasing them as the work advanced, to prevent the frames from going out of shape; in one arch of 120 feet he laid on forty-five tons. Notwithstanding this imperfection, which is perhaps unavoidable, this mode of framing is undoubtedly very judicious, and perhaps the best which can be employed without depending on iron work.

Fig. 5 represents another, constructed by Perronet, for an arch of ninety feet span and twenty-eight feet rise. The trusses were seven feet apart, and the arch was four and a half thick; so that the unreduced load on each frame was very nearly 235 tons. The scantling of the struts was fifteen by twelve inches. The principle is the same as that of the former. The chief difference is, that in this centre the outer truss-beam of the lower row is not coupled with the middle row, but kept nearly parallel to the outer beam of the upper row. This adds greatly to the strength of the foot, and takes off much of the horizontal thrust from the pier.

For the bridge of Nogent.

M. Perronet has shown great judgment in causing the polygon of the inner row of truss-beams gradually to approach the polygon of the outer row. By this disposition, the angles of the inner polygon are more acute than those of the outer. A little attention will show that the general sagging of all the polygons will keep the abutments of the lower one nearer, or exactly, to their original quantity. We must indeed except the foot-beam. It is still too oblique; and, instead of converging to the foot of the upper row, it should have diverged from it. Had this been done, this centre is almost perfect in its kind. As it is, it is at least six times stronger than was absolutely necessary. We shall have occasion to refer to this figure on another occasion.

This maxim is better exemplified by M. Perronet in the centring of the bridge of St Maxence, exhibited in fig. 5, No. 2, than in that of Nogent, fig. 5, No. 1. But we think that a horizontal truss-beam *ab* should have been inserted, in a subordinate manner, between the king-posts next the crown on each side. This would prevent the crown from rising while the haunches only are loaded, without impairing the fine abutments of *cd, cd,* when the arch is nearly completed. This is an excellent centring, but is not likely to be of much use in these kingdoms, because the arch itself will be considered as ungraceful and ugly, looking like a huge lintel. Perronet says that he preferred it to the ellipse, because it was lighter on the piers, which were thin. But the failure of one arch must be immediately followed by the ruin of all We know much better methods of lightening the piers.

St Maxence,

Centre. Neuilly, and

Fig. 6 represents the centring of the bridge of Neuilly, near Paris, also by Perronet. The arch has 120 feet span and thirty feet rise, and is five feet thick. The frames are six feet apart, and each carries an absolute (that is, not reduced to $\frac{11}{14}$ths or to $\frac{4}{5}$ths) load of 350 tons. The strut-beams are seventeen by fourteen inches in scantling. The king-posts are fifteen by nine each half; and the horizontal bridles, which bind the different frames together in five places, are also fifteen by nine each half. There are eight other horizontal binders of nine inches square.

This is one of the most remarkable arches in the world; not altogether on account of its width, for there are several much wider, but for the flatness at the crown; for about twenty-six feet on each side of the middle it was intended to be a portion of a circle of 150 feet radius. An arch (semicircular) of 300 feet span might therefore be easily constructed, and would be much stronger than this, because its horizontal thrust at the crown would be vastly greater, and would keep it more firmly united.

The bolts of this centre are differently placed from those of the former, and the change is judicious. M. Perronet had doubtless found by this time that the stiffness of his framing depended on the transverse strength of the beams, and therefore he was careful not to weaken them by the bolts. But notwithstanding all his care, the framing sunk upwards of thirteen inches before the keystones were laid; and during the progress of the work, the crown rose and sunk, by various steps, as the loading was extended along it. When twenty courses were laid on each side, and about sixteen tons laid on the crown of each frame, it sunk about an inch. When forty-six courses were laid, and the crown loaded with fifty tons, it sunk about half an inch more. It continued sinking as the work advanced; and when the keystone was set it had sunk thirteen inches and a quarter. But this sinking was not general; on the contrary, the frame had risen greatly at the very haunches, so as to open the upper part of the joints, many of which gaped an inch; and this opening of the joints gradually extended from the haunches towards the crown, in the neighbourhood of which they opened on the under side. This evidently arose from a want of stiffness in the frame. But these joints closed again when the centres were struck, as will be mentioned afterwards.

We have taken particular notice of the movements and twisting of this centre, because we think that they indicate a deficiency, not only of stiffness, but of abutment among the truss-beams. The whole has been too flexible, because the angles are too obtuse: this arises from their multiplicity. When the intercepted arches have so little curvature, the power of the load to press it inward increases very fast. When the intercepted arch is reduced to one half, this power is more than doubled; and it is also doubled when the radius of curvature is doubled. The king-posts should have been farther apart near the crown, so that the quantity of arch between them should compensate for its diminished curvature.

The power of withstanding any given inequality of load would therefore have been greater had the centre consisted of fewer pieces, and their angles of meeting been proportionally more acute. The greatest improvement would have been to place the foot of the lower tier of truss-beams on the very foot of the pier, and to have also separated it at the head from the rest with a longer king-post, and thus to have made the distances of the beams on the king-posts increase gradually from the crown to the spring. This would have made all the angles of abutment more acute, and would have produced a greater pressure on all the lower tiers when the frames sagged.

Orleans.

Fig. 7 represents the centring of the bridge of Orleans. The arch has 100 feet span, and rises thirty, and the arch-stones are six feet long. It is the construction of M. Hupeau, the first architect of the bridge. It is the boldest work of the kind that we have seen, and is constructed on clear principles. The main abutments are few in number. Because the beams of the outer polygon are long, they are very well supported by straining beams in the middle; and the struts or braces which support and butt on them are made to rest on points carried entirely by *ties*. The inventor, however, seems to have thought that the angles of the inner polygon were supported by mutual compression, as in the outer polygon. But it is plain that the whole inner polygon may be formed of iron rods. Not but that both polygons *may* be in a state of compression; this is very possible; but the smallest sagging of the frame will change the proportions of the pressures at the angles of the two polygons. The pressures on the exterior angles will increase, and those on the lower or interior angles will diminish most rapidly; so that the abutments in the lower polygons will be next to nothing. Such points could bear very little pressure from the braces which support the middle of the long bearings of the upper beams, and their pressures must be borne chiefly by the joints supported by the king-posts. The king-posts would then be in a state of extension. It is difficult, however, to decide what is the precise state of the pressure at these interior angles.

Instructive history of the centre.

The history of the erection of this bridge will throw much light on this point, and is very instructive. M. Hupeau died before any of the arches were carried farther than a very few of the first courses. M. Perronet succeeded to the charge, and finished the bridge. As the work advanced, the crown of the frame rose very much. It was loaded; and it sunk as remarkably. This showed that the lower polygon was giving very little aid. M. Perronet then thought the frame too weak, and inserted the long beam DE, making the diagonal of the quadrangle, and very nearly in the direction of the lower beam $a\,b$, but falling rather below this line. He now found the frame abundantly strong. It is evident that the truss is now changed exceedingly, and consists of only the two long sides, and the short straining beam lying horizontally between their heads. The whole centring consists now of one great truss, $a\,\mathrm{E}\,e\,b$, and its long sides, $a\,\mathrm{E}$, $e\,b$, are trussed up at B and f. Had this simple idea been made the principle of the construction, it would have been excellent. The angle $a\,\mathrm{DE}$ might have been about 176°, and the polygon $\mathrm{D}\,c\,g\,h$ employed only for giving a slight support to this great angle, so as not to allow it to exceed 180°. But M. Perronet found that the joint c, at the foot of the post E c, was about to *draw loose*, and he was obliged to bolt long pieces of timber on each side of the joint, embracing both beams. These were evidently acting the same part as iron straps would have done; a complete proof that, whatever may have been the original pressures, there was no abutment now at the point c, and that the beams that met there were not in a state of compression, but were on the stretch. M. Perronet says that he put these cheeks to the joints *to stiffen* them. But this was not their office, because the adjoining beams were not struts, but ties, as we have now proved.

We may therefore conclude that the outer polygon, with the assistance of the pieces $a\,b$, DE, were carrying the whole load. We do not know the distance between the frames; but supposing them seven feet apart, and the arch six feet thick, and weighing 170 pounds per foot, we learn the load. The beams were sixteen inches square. If we now calculate what they would bear at the same very moderate rate allowed to the other centres, we find that the beams AB and $a\,b$ are not loaded to one sixth of their strength.

We have given this centre as a fine example of what carpentry is able to perform, and because, by its simplicity, it is a sort of text on which the intelligent artist may make many comments. We may see plainly that, if the lower polygon had been formed of iron rods, firmly bolted into the feet of the king-posts, it would have maintained its shape completely. The service done by the beam DE was not so much an increase of abutment as a discharge of the weight and of the *pull* at the joint *c*. Therefore, in cases where the feet of the truss are *necessarily* confined to a very narrow space, we should be careful to make the upper polygon sufficient to carry the whole load, say by doubling its beams, and we may then make the lower polygon of slender dimensions, provided we secure the joints on the king-posts by iron straps which embrace a considerable portion of the tie on each side of the joint.

All these centres good in their kind.

We are far from thinking that these centres are of the best kind that could be employed in their situation; but they are excellent in their kind, and a careful study of them will teach the artist much of his profession. When we have a clear conception of the state of strain in which the parts of a frame really are, we know what should be done in order to draw all the advantages possible from our materials. We have said in another place, that where we can give our joints sufficient connection, as by straps and bolts, or by cheeks or fishes, it is better to use ties than struts, because ties never bend.

We do not approve of M. Perronet's practice of giving his trusses such narrow feet. By bringing the foot of the lower polygon farther down, we greatly diminish all the strains, and throw more load on the lower polygon; and we do not see any of M. Perronet's centres where this might not have been done. He seems to affect a great span, to show the wonders of his art; but our object is to teach how to make the best centre of a given quantity of materials, and how to make the most perfect centre, when we are not limited in this respect, nor in the extent of our fixed points.

Excellence of the centre employed for Blackfriars Bridge.

We shall conclude this series of examples with one where no such affectation takes place. This is the centring of the bridge at Blackfriars, London. The span of the arch is one hundred feet, and its height from the spring is about forty-three. The drawing, fig. 8, is sufficiently minute to convey a distinct notion of the whole construction. We need not be very particular in our observations, after what has been said on the general principles of construction. The leading maxim, in the present example, seems to be, *that every part of the arch shall be supported by a simple truss of two legs, resting, one on each pier*. H, H, &c. are called apron-pieces, to strengthen the exterior joints, and to make the ring as stiff in itself as possible. From the ends of this apron-piece proceed the two legs of each truss. These legs are twelve inches square; they are not of an entire piece, but of several, meeting in firm abutment. Some of their meetings are secured by the double king-posts, which grasp them firmly between them, and are held together by bolts. At other intersections, the beams appear halved into each other, a practice which cannot but weaken them much, and would endanger their breaking by cross strains, if it were possible for the frame to change its shape. But the great breadth of this frame is an effectual stop to any such change. The fact was, that *no sinking or twisting whatever* was observed during the progress of the mason-work. Three points in a straight line were marked on purpose for this observation, and were observed every day. The arch was more than six feet thick, and yet the sinking of the crown, before setting the keystones, did not amount to one inch.

The centre employs about one third more timber than Perronet's great centre in proportion to the span of the arch; but the circumference increases in a greater proportion than this, because it is more elevated. In every way of making a comparison of the dimensions, Mr Mylne's arch employs more timber; but it is *beyond all comparison* stronger. The great elevation is partly the reason of this. But the disposition of the timbers is also much more advantageous, and may be copied even in the low pitched arches of Neuilly. The simple truss, reaching from pier to pier for the middle point of the arch, gives the strong support where it is most of all wanted; and in the lateral points H, although one leg of the truss is very oblique, the other compensates for it by its upright position.

The chief peculiarity of this centre is to be seen in its base. This demands a more particular attention; but we must first make some observations on the condition of an arch, as it rests on the centring after the keystones are all set, and on the gradual transference of the pressure from the boards of the centring to the joints of the arch-stones.

Observations on the state of an arch as it rests on the centring.

While all the arch-stones lie on the centring, the lower courses are also leaning pretty strongly on each other. But the mortar is hardly compressed in the joints, and least of all in the joints near the crown. Suppose the arch to be Catenarean, or of any other shape that is perfectly equilibrated: when the centring is gradually withdrawn, all the arch-stones follow it. Their wedge-like form makes this impossible, without the middle ones squeezing the lateral ones aside. This compresses the mortar between them. As the stones thus come nearer to each other, those near the crown must descend more than those near the haunches, before every stone has lessened its distance from the next by the same quantity, for example, by the hundredth part of an inch. This circumstance alone must cause a sinking in the crown, and a change of shape. But the joints near the crown are *already* more open than those near the haunches. This produces a still greater change of form before all is settled. Some masons endeavour to remedy, or at least to diminish this, by using no mortar in the joints near the crown. They lay the stones dry, and even force them together by wedges and blocks laid between the stones on opposite sides of the crown: they afterwards pour in fine cement. This appears a good practice. Perronet rejects it, because the wedging sometimes breaks the stones. We should not think this any great harm, because the fracture will make them close where they would otherwise lie hollow. But, after all our care, there is still a sinking of the crown of the arch. By gradually withdrawing the centring, the joints close, the arch-stones begin to butt on each other, and to force aside the lateral courses. This abutment gradually increasing, the pressure on the haunches of the centring is gradually diminished by the mutual abutment, and ceases entirely in that course, which is the lowest that formerly pressed it; it then ceases in the course above, and then in the third, and so on. And in this manner not only the centring quits the arch gradually, from the bottom to the top, *by its own retiring from it*, but the arch also quits the centring *by changing its shape*. If the centring were now pushed up again, it would touch the arch first at the crown; and it must *lift up* that part gradually, before it come again in contact with the haunches. It is evident, therefore, that an arch built on a centre of a shape perfectly suited to equilibration, will not be in equilibrio when the centring is removed. It is therefore necessary to form the centring in such a manner, by raising the crown, that it shall *leave* the arch of a proper form. This is a very delicate task, requiring a previous knowledge of the ensuing change of form. This cannot be ascertained by the help of any theory we are acquainted with.

Centre.

But suppose this attained, there is another difficulty. While the work advances, the centring is warped by the load laid on it, and continually increasing on each side. The first pressure on the centring forces down the haunches, and raises the crown. The arch is therefore less curved at the haunches than is intended: the joints, however, accommodate themselves to this form, and are close, and filled with mortar. When the masons approach the middle of the arch, the frame sinks there, and rises up at the haunches. This opens all the joints in that place on the *upper* side. By the time that the keystones are set, this warping has gone farther, and joints are opened on the *under* side near the crown. It is true, we are here speaking rather of an extreme case, when the centring is *very* flexible; but this occurred to M. Perronet in the two great bridges of Neuilly and of Mantz. In this last one the crown sunk above a foot before the key was set, and the joints at the haunches opened above an inch *above*, while some nearer the crown opened near a quarter of an inch *below*.

A delicate business to strike the centring.

In this condition of things, it is a delicate business to strike the centring. Were it removed in an instant, all would probably come down; for the arch-stones are not yet abutting on each other, and the joints in the middle are open below. M. Perronet's method appears to us to be very judicious. He began to detach the centring at the very bottom, on each side equally, where the pressure on the centring is very slight. He cut away the blocks which were immediately under each arch-stone. He proceeded gradually upwards in this way with some speed, till all was detached that had been put out of shape by the bending of the centring. This, being no longer supported, sunk inward, till it was stopped by the abutment which it found on the arch-stones near the crown, which were still resting on their blocks. During part of this process, the open joints opened still more, and looked alarming. This was owing to the removal of the load from the haunches of the centring. This allowed the crown to sink still more, by forcing out the arch-stones at the haunches. He now paused some days, and during this time the two haunches, now hanging in the air, gradually pressed in toward the centring, their outer joints closing in the meanwhile. The haunches were now pressing pretty hard on the arch-stones nearer the crown. He then proceeded more slowly, destroying the blocks and bridgings of these upper arch-stones. As soon as he destroyed the support of one, it immediately yielded to the pressure of the haunch; and if the joint between it and the one adjoining toward the crown happened to be open, whether on the under or the upper side, it immediately closed on it. But in proceeding thus, he found every stone sink a little while it closed on its neighbour; and this was like to produce a ragged soffet, which is a deformity. He therefore did not allow them to sink so much. In the places of the blocks and bridgings which he had cut away, he set small billets, standing on their ends, between the centring and the arch-stones. These allowed the pendulous arch to push toward the crown without sensibly descending; for the billets were pushed out of the perpendicular, and some of them tumbled down. Proceeding in this way, he advanced to the very next course to the keystone on each side, the joints closing all the way as he advanced. The last job was very troublesome; we mean the detaching of the three uppermost courses from the centring; for the whole elasticity of the centring was now trying to unbend, and pressing hard against them. He found that they were lifted up; for the joints beyond them, which had closed completely, now opened again below; but this job was finished in one day, and the centre sprung up two or three inches, and the whole arch sunk about six inches. This was an anxious time; for he dreaded the great momentum of such a vast mass of matter. It was hard to say where it would stop. He had the pleasure to see that it stopped very soon, settling slowly as the mortar was compressed, and after one or two days settling no more. This settling was very considerable, both in the bridge at Neuilly and in that at Mantz. In the former, the sinking during the work amounted to thirteen inches. It sunk six inches more when the blocks and bridgings were taken out, and one and a half when the little standards were destroyed, and one and a fourth more next day; so that the whole sinking of the *pendulous* arch was nine inches and a half, besides what it had sunk by the bending and compression of the centring.

The crown of the centring was an arch of a circle described with a radius of 150 feet; but by the sinking of the arch its shape was considerably changed, and about sixty feet of it formed an arch of a circle whose radius was 244 feet. Hence M. Perronet infers that a semicircle of 500 feet span may be erected. It would no doubt be stronger than this arch, because its greater horizontal thrust would keep the stones firmer together. The sinking of the arches at Mantz was not quite so great, but every thing proceeded in the same way. It amounted in all to twenty and a half inches, of which twelve inches were owing to the compression and bending of the centring.

The foregoing observations exemplified.

In fig. 5, No. 1, may be observed an indication of this procedure of the masonry. There may be noticed a horizontal line *ac*, and a diagonal *ab*. These are supposed to be drawn on the masonry as it would have stood had the frames not yielded during the building. The dotted line A *b′c′* shows the shape which it took by the sinking of the centring. The dotted line on the other side was actually drawn on the masonry when the keystone was set; and the wavy black line on the same side shows the form which the dotted line took by the striking of the centring. The undulated part of this line cuts its former position a little below the middle, going without it below, and falling within it above. This shows very distinctly the movement of the whole masonry, distinguishing the parts that were forced out and the parts which sunk inward.

We presume that the practical reader will think this account of the internal movements of a stupendous arch very instructive and useful. As M. Perronet observed it to be uniformly the same in several very large arches which he erected, we may conclude that it is the general process of nature. We by no means have the confidence in the durability or solidity of his arches which he prudently professes to have. We have conversed with some very experienced masons, who have also erected very great arches, and in very difficult situations, which have given universal satisfaction; and we have found them uniformly of opinion, that an arch which has settled to such a proportion of its curvature as to change the radius from 150 to 244 feet, is in a very hazardous situation. They think the hazard the greater because the span of the arch is so great in proportion to its weight (as they express it very emphatically) or its height. The weight, say they, of the haunches is too small for forcing together the keystones, which have scarcely any wedgelike form to keep them from sliding down. This is very good reasoning, and expresses very familiar notions. The mechanician would say that the horizontal thrust at the crown is too small. When we questioned them about the propriety of M. Perronet's method of removing the centring, they unanimously approved of its general principle, but said that it was very ticklish indeed in the execution. The cases which he narrates were new to them. They should have almost despaired of success with arches which had gone so much out of shape by the bending of the centres; because, said

they, the slope of the centring, to a great distance from the crown, was so little, that the arch-stones could not slide outwards along it, to close even the under side of the joints which had opened above the haunches; so that *all* the arch-stones were at too great a distance from each other; and a great and *general* subsiding of the whole was necessary for bringing them even to touch each other. They had *never* observed such bendings of the centrings which they had employed, having never allowed themselves to contract the feet of their trusses into such narrow spaces. They observed that nothing but lighters with their masts down can pass under the trusses, and that the sides must be so protected by advanced works from the accidental shock of a loaded boat, that there cannot be left room for more than one. They added, that the bridges of communication necessary for the expeditious conducting of the work made all this supposed roominess useless; besides, the business can hardly be so urgent and crowded anywhere as to make the passage through every arch indispensably necessary. Nor was the inconvenience of this obstruction greatly complained of during the erection of Westminster or Blackfriars Bridges. Nothing should come in competition with the *undoubted* solidity of the centring and the future arch; and all boasting display of talent and ingenuity by an engineer, in the exhibition of the wonders of his art, is misplaced here.

These appeared to us good reasons for preferring the more cautious, and incomparably more secure, construction of Mr Mylne, in which the breadth given to each base of the trusses permitted a much more effective disposition of the abutting timbers, and also enabled the engineer to make it incomparably stiffer; so that no change need be apprehended in the joints which have already closed, and in which the mortar has already taken its set, and commenced an union that never can be restored if it be once broken in the smallest degree, no not even by greater compression.

The connection that is formed by mortar of lime, &c.

Here we beg leave to mention our notions of the connection that is formed by mortar composed of lime or gypsum. We consider it as consisting chiefly, if not solely, in a crystallization of the lime or gypsum and water. As much water is taken up as is necessary for the formation of the crystals during their gradual conversion into mild calcareous earth or alabaster, and the rest evaporates. When the free access of air is absolutely prevented, the crystallization never proceeds to that state, even although the mortar becomes extremely dry and hard. We had an opportunity of observing this accidentally, when passing through Maestricht in 1770, while they were cutting up a massy revetment of a part of the fortifications more than three hundred years old. The mortar between the bricks was harder than the bricks (which were Dutch clinkers, such as are now used only for the greatest loads); but when mixed with water it made it lime-water, seemingly as strong as if fresh lime had been used. We observed the same thing in one small part of a huge mass of ancient Roman work near Romney, in Kent; but the rest, as well as all the *very old* mortar that we have seen, was in a mild state, and was generally much harder than what produced any lime-water. Now when the mortar in the joints has begun its first crystallization, and is allowed to remain in perfect rest, we are confident that the subsequent crystals, whether of lime, or of calcareous earth, or of gypsum, will be much larger and stronger than can ever be produced if they are once broken; and the farther that this crystallization has been carried, that is, the harder that the mortar has become, less of it remains to take any new crystallization. Why should it be otherwise here than in every other crystallization that we are acquainted with?

Necessity of keeping the joints in their first state.

We think therefore that it is of great consequence to keep the joints in their *first* state if possible; and that the strength, in as far as it depends on the mortar, is greatly diminished by their opening; especially when the mortar has acquired considerable hardness, which it will do in a month or six weeks, if it be good. The cohesion given by mortar is indeed a mere trifle, when opposed to a force which tends to open the joints, acting, as it generally does, with the transverse force of a lever. But in situations where the overload on any particular arch-stones tends to push them down through between their neighbours, like wedges, the cohesion of the mortar is then of very great consequence.

We must make another observation. M. Perronet's ingenious process tended very effectually to close the joints. In doing this the forces which he brought into action had little to oppose them; but as soon as they were closed the contact of the parts formerly open opposed an obstruction incomparably greater, and immediately balanced a force which was but just able to turn the stone gently about the two edges in which it touched the adjoining stones. This is an important remark, though seemingly very trifling; and we wish the practitioner to have a very clear conception of it; but it would take a multitude of words to explain it. It is worth an experiment. Form a little arch of wooden blocks; and form one of these so, that when they are all resting on the centring, it may be open at the outer joint: remove the centring; then press on the arch at some distance from the open joint: you will find that a very small pressure will make the arch bend till that joint closes. Press a little harder, and the arch will bend more, and the next joint will open. Thus you will find, that by pressing alternately on each side of the open joint, that stone can easily be made to flap over to either side; and that immediately after this is done the resistance increases greatly. This shows clearly that a very moderate force, judiciously employed, will close the joints, but will not press the parts strongly together. The joints therefore are *closed*, but *no more than closed*, and are hanging only by the edges by which they were hanging while the joints were open. The arch, therefore, though apparently close and firm, is but loose and tottering. M. Perronet says that his arches were firm, because hardly a stone was observed to chip or splinter off at the edges by the settlement. But he had done every thing to prevent this, by digging out the mortar from between the headers, to the depth of two inches, with saws made on purpose. But we are well informed, that before the year 1791 (twenty years after the erection) the arches at Neuilly had sunk very sensibly, and that very large splinters had flown off in several places. It could not be otherwise. The original construction was too bold; we may say needlessly and ostentatiously bold. A very gentle slope of the roadway, which would not have slackened the mad gallop of a ducal carriage, nor sensibly checked the laborious pull of a loaded waggon, and a proper difference in the size of the arches, would have made this wonderful bridge incomparably stronger, and also much more elegant and pleasing to the eye. Indeed it is far from being as handsome as it might have been. The ellipse is a most pleasing figure to every beholder; but this is concealed as much as possible, and it is attempted to give the whole the appearance of a tremendous lintel. It has the oppressive look of danger. It will not be of long duration. The bridge at Mantz is still more exceptionable, because its piers are tall and slender. If any one of the arches fails, the rest must fall in a moment. An arch of Blackfriars Bridge might be blown up without disturbing its neighbours.

M. Perronet's constructions too bold.

M. Perronet mentions another mode of striking the

Centre.

A bad method of striking the centre.

centring, which he says is very usual in France. Every second bridging is cut out. Some time after every second of the remainder; after this every second of the remainder; and so on till all are removed. This is never practised in this country, and is certainly a very bad method. It leaves the arch hanging by a number of distant points; and it is wonderful that any arch can bear this treatment.

The common method in Britain.

Our architects have generally proceeded with extreme caution. Wherever they could they supported the centring by intermediate pillars, even when it was a trussed centre, having a tie-beam reaching from side to side. The centre was made to rest, not immediately on these pillars, but on pieces of timber formed like acute wedges, placed in pairs, one above the other, and having the point of the one on the thick end of the other. These wedges were well soaped and rubbed with black lead, to make them slippery. When the centres are to be struck, men are stationed at each pair of the wedges with heavy mauls. They are directed to strike together on the opposite wedges. By this operation the whole centring descends together; or when any part of the arch is observed to have opened its joints on the upper side, the wedges below that part are slackened. The framing may perhaps bend a little, and allow that part to subside. If any part of the arch is observed to open its joints on the under side, the wedges below that part are allowed to stand after the rest have been slackened. By this process the whole comes down gradually, and as slowly as we please, and the defects of every part of the arch may be attended to. Indeed the caution and moderation of our builders have commonly been such, that few defects have been allowed to show themselves. We are but little acquainted with joints opening to the extent of two inches, and in such a case would probably lift every stone of the arch again.[1] We have not employed trussed centrings so much perhaps as we should have done; nor do we see their advantage (speaking as mere builders) over centres supported all over, and unchangeable in their form. Such centres must bend a little, and require loading on the middle to keep them in shape. Their compression and their elasticity are very troublesome in the striking of the centres in M. Perronet's manner. The elasticity is indeed of use when the centres are struck in the way now described.

These observations on the management of the internal movements of a great arch will enable the reader to appreciate all the merit of Mr Mylne's very ingenious construction. We proceed therefore to complete our description.

The excellence of Mr Mylne's method.

The gradual enlargement of the base of the piers of Blackfriars Bridge enabled the architect to place a series of five posts C, C, C, C, C, one on each step of the pier, the ingenious contexture of which made it like one solid block of stone. (See ARCH.) These struts were gradually more and more oblique, till the outer one formed an obtuse angle with the lowest side of the interior polygon of the truss. On the top of these posts was laid a sloping seat or beam D of stout oak, the upper part of which was formed like a zig-zag scarfing. The posts were not perpendicular to the under side of the seat. The angles next the pier were somewhat obtuse. Short pieces of wood were placed between the heads of the posts, but not mortised into them, to prevent them from slipping back. Each face of the scarf was covered with a thick and smooth plate of copper. The feet of the truss were mortised into a similar piece F, which may be called the SOLE of the truss, having its lower side notched in the same manner with the upper side of D, and like it covered with copper. Between these two lay the STRIKING WEDGE E, the faces of which corresponded exactly with the slant faces of the seat and the sole. The wedge was so placed that the corresponding faces touched each other for about half of their length. A block of wood was put in at the broad end or base of this wedge, to keep it from slipping back during the laying of the arch-stones. Its outer end E was bound with iron, and had an iron bolt several inches long driven into it. The head of this bolt was broad enough to cover the whole wood of the wedge within the iron ferule.

We presume that the reader by this time foresees the use of this wedge. It is to be driven in between the sole and the seat, having first taken out the block at the base of the wedge. As it advances into the wider spaces, the whole truss must descend, and be freed from the arch; but it will require prodigious blows to drive it back. Mr Mylne did not think so, founding his expectation on what he saw in the launching of great ships, which slide very easily on a slope of ten or twelve degrees. He rather feared, that taking out the block behind would allow the wedge to be pushed back at once, so that the descent of the truss would be too rapid. However, to be certain of the operation, he had prepared an abundant force in a very ingenious manner. A heavy beam of oak, armed at the end with iron, was suspended from two points of the centre like a battering ram, to be used in the same manner. Nothing could be more simple in its structure, more powerful in its operation, or more easy in its management. Accordingly the success was to his wish. The wedge did not slip back of itself; and very moderate blows of the ram drove it back with the greatest ease. The whole operation was over in a very few minutes. The spectators had suspected that the space allowed for the recess of the wedge was not sufficient for the settlement of the arch, but the architect trusted to the precautions he had taken in its construction. The reader, by turning to the article ARCH, will see that there was only the arch LY (Plate XLIX., fig. 1) which could be expected to settle; accordingly, the recess of the wedge was found to be much more than was necessary. However, had this not been the case, it was only necessary to take out the pieces between the posts below the seat, and then to drive back the heads of the struts; but this was not needed, we believe, in any of the arches. We are well assured that none of the arches sunk an inch and a half. The great arch of one hundred feet span did not sink one inch at the crown. It could hardly be perceived whether the arch quitted the centring gradually or not, so small had been the changes of shape. We have no hesitation in saying, that, if we except some waste of great timber by uncommon joggling, the whole of this performance is the most perfect of any that has come to our knowledge.[2]

The subject of this article connected with the construction of wooden bridges.

The subject which we have been considering is very closely connected with the construction of wooden bridges. These are not always constructed on the sole principles of equilibrium by means of mutual abutment. They are stiff frames of carpentry, where, by a proper disposition, beams are put into a state of extension, as well as of compression, so as to stand in place of solid bodies as big as the

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[1] The writer of this article can only say, that, after much inquiry, he has no information of any arch being received from the builder as sufficient that had suffered half the change of shape mentioned by M. Perronet. The arch of Dublin Bridge, built by an excellent, but a very private mason, Mr Steven, is 105 feet wide, with only twenty-two feet rise. It was erected, but not on a trussed centring, without changing one full inch in its elevation; and when the centring was removed, it sunk only $1\frac{3}{4}$th inch, and about half an inch more when the parapets were added and the bridge completely finished.

[2] The reader will find a representation of the centring of Waterloo Bridge in Plate CXLV. article BRIDGE.

Centre.

spaces which the beams inclose; and thus we are enabled to couple two, three, or four of these together, and set them in abutment with each other like mighty arch-stones. We shall close this article, therefore, with two or three specimens of wooden bridges, disposed in a series of progressive composition, so as to serve as a sort of introduction to the art in general, and furnish a principle which will enable the intelligent and cautious artist to push it with confidence as far as it can go.

The general problem is this. Suppose that a bridge is to be thrown over the space AB (fig. 9), and that this is too wide for the strength of the size of timber which is at our command; how may this beam AB be supported with sufficient effect? There are but two ways in which the middle point C, where the greatest strain is, can be supported: 1. It may be suspended by two ropes, iron rods, or wooden ties, DC, EC, made fast to two firm points D, E, above it; or it may rest on the ridge of two rafters *d* C, *e* C, which rest on two firm points *d*, *e*, below it. 2. It may be supported by connecting it with a point so supported; and this connection may be formed, either by suspending it from this point, or by a post resting on it. Thus it may hang, by means of a rod or a king-post FC, from the ridge F of two rafters AF, BF; or it may rest on the strut C *f*, whose lower extremity *f* is carried by the ropes, rods, or wooden ties A *f*, B *f*.

Whichsoever of these methods we employ, it follows, from the principles of carpentry, that the support given to the point C is so much the more powerful, as we make the angle DCE, or *d* C *e*, or the equivalent angles AFB, or A *f* B, more acute.

The usual and simplest method of constructing such bridges.

Each of these methods may be supposed equally strong. Our choice will depend chiefly on the facility of finding the proper points of support D, E, *d*, *e*; except in the second case, where we require no fixed points but A and B. The simple forms of the first case require a great extent of figure. Very rarely can we suspend it from points situated as D and E. It is even seldom that we have depth enough of bank to allow the support of the rafters *d* C, *e* C, but we can always find room for the simple truss AFB. This, therefore, is the most usually practised.

In the construction, we must follow the maxims and directions prescribed in the article CARPENTRY and the article ROOF. The beams FA, FB, must be mortised into AB in the firmest manner, and there secured with straps and bolts; and the middle must hang by a strap attached to the king-post FC, or to the iron rod that is used for a king-post. No mortising in the point C must be employed; it is unnecessary, and it is hurtful, because it weakens the beam, and because it lodges water, and soon decays by rot. The best practice is not to suspend the beam immediately by this strap, but to let it rest, as in fig. 10, on a beam C, which crosses the bridge below, and has its other end supported in the same manner by the other truss.

It is evident that the length of the king-post has no effect on the support of C. We may therefore contract every thing, and preserve the same strength of support, by finding two points *a* and *b* (fig. 11) in the banks, at a moderate distance below A and B, and setting up the rafters *a* F, *b* F, and suspending C from the shortened king-post. In this construction, when the beam AB rests on a cross bearer, as is drawn here, the struts *a* F, *b* F, are kept clear of it. No connection between them is necessary, and it may be hurtful, by inducing cross strains on both. It will, however, greatly increase the stiffness of the whole. This construction may safely be loaded with ten times the weight that AB can carry alone.

Suppose this done, and that the scantling of AB is too weak for carrying the weight which may be brought on the parts AC, CB. We may now truss up each half, as in fig. 12, and then the whole will form a handsome bridge, of the simplest construction possible. The intersections of the secondary braces with those of the main truss will form a hand-rail of agreeable figure.

Centre.

An improvement of that method.

We are not confined to the employment of an entire piece AB, nor to a rectilineal form. We may frame the bridge as in fig. 13, and in this form we dissuade from allowing any connection with the middle points of the main braces. This construction also may be followed till each beam AC and CB is loaded to ten times what it can safely bear without the secondary trussing.

Another method.

There is another way by which a bridge of one beam may be supported beyond the power of the first and simplest construction. This is represented in fig. 14 and fig. 15. The truss-beam FG should occupy one third of AB. The advantage of this construction is very considerable. The great elevation of the braces, which is a principal element of the strength, is preserved, and the braces are greatly shortened.

This method may be pushed still farther, as in fig. 16.

These methods combined.

And all these methods may be combined, by joining the constructions of fig. 14 and fig. 15 with that of fig. 16.

In all of them there is much room for the display of skill in the proper adjustment of the scantling of the timber, and the obliquity of the braces to the lengths of the different bearings. A very oblique strut, or a slender one, will suffice for a small load, and may often give an opportunity to increase the general strength; while the great timbers and upright supports are reserved for the main pressures. Nothing will improve the composition so much as reflecting progressively, and in the order of these examples, on the whole. This alone can preserve the great principle in its simplicity and full energy.

The elements of all that can be done in this art.

These constructions are the elements of all that can be done in the art of building wooden bridges, and are to be found more or less obviously and distinctly in all attempts of this kind. We may assert, that the more obviously they appear, the more perfect the bridge will be. It is astonishing to what extent the principle may be carried. We have seen a bridge of forty-two feet span formed of two oak trusses, the biggest timber of which did not exceed six inches square, bearing with perfect steadiness and safety a waggon loaded with more than two tons, drawn by four stout horses. It was framed as fig. 16 nearly, with the addition of the dotted lines, and was near thirty years old, protected, however, from the weather by a wooden roof, as many bridges in Germany are.

We recollect another in the neighbourhood of Stettin, which seemed constructed with great judgment and spirit. It had a carriage-road in the middle, about twenty feet, we think, wide, and on each side a footway about five feet wide. The span was not less than sixty feet, and the greatest scantling did not appear to exceed ten inches by six.

This bridge consisted of four trusses, two of which formed the outside of the bridge, and the other two made the separation between the carriage-road and the two footways. We noticed the construction of the trusses very particularly, and found it similar to the last, except in the middle division of the upper truss, which, being very long, was double trussed, as in fig. 17.

The reader will find in that volume of Leupold's *Theatrum Machinarum*, which he calls *Theatrum Pontificum*, many specimens of wooden bridges, which are very frequent in the champaign parts of Germany. They are not, in general, models of mechanic art; but the reflecting reader, who considers them *carefully*, will pick up here and there subordinate hints, which are ingenious, and may sometimes be useful.

Centre.

What we have now exhibited are not to be considered as models of construction, but as elementary examples and lessons, for leading the reader systematically into a thorough conception of the subject.

A wonderful bridge in Switzerland.

We cannot quit the subject without taking notice of a very wonderful bridge at Wittingen in Switzerland, slightly described by Mr Coxe (*Travels*, vol. i. 132). It is of a construction more simple still than the bridges we have been describing. The span is 230 feet, and it rises only twenty five. The sketch (fig. 18) will make it sufficiently intelligible. ABC is one of two great arches, approaching to a Catenarian shape, built up of seven courses of solid logs of oak, in lengths of twelve or fourteen feet, and sixteen inches or more in thickness. These are all picked of a natural shape, suited to the intended curve; so that the wood is nowhere cut across the grain to trim it into shape. These logs are laid above each other, so that their abutting joints are alternate like those of a brick wall; and it is indeed a wooden wall simply built up, by laying the pieces upon each other, taking care to make the abutting joints as close as possible. They are not fastened together by pins or bolts, or by scarfings of any kind. They are, however, held together by iron straps, which surround them, at the distance of five feet from each other, where they are fastened by bolts and keys.

These two arches having been erected (by the help, we presume, of pillars, or a centring of some kind), and well butted against the rock on each side, were freed from their supports, and allowed to settle. They are so placed that the intended road *a b c* intersects them about the middle of their height. The roadway is supported by cross joists, which rest on a long horizontal summer beam. This is connected with the arches on each side by uprights bolted into them. The whole is covered with a roof, which projects over the arches on each side to defend them from the weather. Three of the spaces between these uprights have struts or braces, which give the upper work a sort of trussing in that part.

This construction is simple and artless; and appears, by the attempt to truss the ends, to be the performance of a person ignorant of principle, who has taken the whole notion from a stone arch. It is, however, of a strength much more than adequate to any load that can be laid on it. Mr Coxe says, but does not explain how, that it is so contrived that any part of it can be repaired independently of the rest. It was the last work of one Ulrich Grubenhamm of Tuffen, in the canton of Appenzel, a carpenter without education, but celebrated for several works of the same kind; particularly the bridge over the Rhine at Schaffhausen, consisting of two arches, one of 172 and the other of 193 feet span, both resting on a small rock near the middle of the river.

While writing this article, we got an account of a wooden bridge erected in North America, in which this simple notion of Grubenhamm's is mightily improved. The span of the arch was said to exceed 250 feet, and its rise exceedingly small. The description we got is very general, but sufficient, we think, to make it perfectly intelligible.

Another in North America.

In fig. 19, DD, EE, FF, are supposed to be three beams of the arch. They consist of logs of timber of small lengths, suppose of ten or twelve feet, such as can be found of a curvature suited to its place in the arch without trimming it across the grain. Each beam is double, consisting of two logs applied to each other side to side, and *breaking joint*, as the workmen term it. They are kept together by wedges and keys driven through them at short intervals, as at K, L, &c.

The manner of joining and strongly binding the two side pieces of each beam is shown in fig. 20. The mortise *a i c b* and *d c i o*, which is cut in each half beam, is considerably longer on the outside than on the inside, where the two mortises meet. The two keys, BB and CC, are formed, each with a notch *b c d*, or *a i o*, on its side; which notch fits one end of the mortise. The inner side of the key is straight, but so formed that when both keys are in their places, they leave a space between them wider at one end than at the other. A wedge AA, having the same taper as the space just mentioned, is put into it and driven hard. It is evident that this must hold the two logs firmly together.

Centre.

This is a way of uniting timber not mentioned in the article CARPENTRY, and it has some peculiarities worthy of notice. In the first place, it may be employed so as to produce a very strong lateral connection, and would then co-operate finely with the other artificial methods of scarfing and tabling that we described in the article referred to. But it requires nice attention to some circumstances of construction to secure this effect. If the joints are accurately formed to each other, as if the whole had been one piece divided by an infinitely thin saw, this manner of joining will *keep* them all in their places. But no driving of the wedge AA will make them the firmer, or cause one piece to press hard on the other. If the abutment of two parts of the half beam is already close, it will remain so; but if open in the smallest degree, driving of the wedge will not make it tighter. In this respect, therefore, it is not so proper as the forms described in CARPENTRY.

In order that the method now described may have the effect of *drawing* the halves of the beams together, and of keeping them hard squeezed on each other, the joints must be made so as not to correspond exactly. The prominent angle *a i o* (fig. 21), formed by the ends of the two half mortises, must be made a little more obtuse than the angle *a f o* of the notch of the key which this prominence is intended to fill up. Moreover, the opposite side *e t* of this key should not be quite straight, but a very little convex. With these precautions, it is easy to see that, by driving the wedge AA, we cause the notch *a f o* to take hold, first at the two points *a* and *o*, and then, by continuing to drive the wedge, the sides *a f*, *o f*, of the notch gradually compress the wood of the half beams, and press them on each other. By continuing to drive the wedge, the mutual compression of the key and the beam squeezes all together, and the space *a f o i* is completely filled up. We may see, from this process, that the mutual compression and drawing together of the timber will be greater in proportion as we make the angle *a i o* more prominent, and its corresponding angle *a f o* more deep; always taking care that the key shall be thick enough not to break in the narrow part.

This adjustment of the keys to the mortise is necessary on another account. Supposing the joints to fit each other exactly before driving the wedge, and that the whole shrinks a little by drying—by this the angle *a i o* will become more prominent, and the angle *a f o* will become more shallow; the joint will open at *a* and *o*, and the mutual compressure will be at an end.

We may also observe that this method will not give any additional firmness to the abutments of the different lengths employed to piece out the arch-beam; in which respect it differs materially from the other modes of joining timber.

Having shown how each beam is pieced together, we must now show how a number of them are united, so as to compose an arch of any thickness. This is done in the very same way. The beams have other mortises worked out of their inner sides, half out of each half of the beam. The ends of the mortises are formed in the same way with those already described. Long keys, BB, CC (fig. 19), are made to fit them properly, the notches being placed

so as to keep the beams at a proper distance from each other. It is now plain that driving in a long wedge AA will bind all together.

In this manner may an arch be extended to any span, and made of any thickness of arching. The bridge over Portsmouth river in North America was more than 250 feet in length, and consisted of several parallel arches of beams. The inventor (we think his name is Bludget) said that he found the strength so great that he could with perfect confidence make one of four times the span.

We admire the ingenuity of this construction, and think it very effectual for bringing the timbers into firm and uniform abutment; but we imagine that it requires equilibration, because it is extremely flexible. There is nothing to keep it from bending, by an inequality of load, but the transverse strength of the beams. The keys and wedges can have very little power to prevent this bending. The distance between the beams will also contribute little or nothing to the stiffness; nay, we may imagine that a great distance between them will make the frame more flexible. Could the beams be placed so near each other that they could be somehow joggled on each other, the whole would be stiffer; but at present they will bend like the plates of a coach-spring. But nothing hinders us from adding diagonal pieces to this construction, which will give it any degree of stiffness, and will enable it to bear any inequality of loading. When completed in this manner, we imagine that it will be at least equal to any construction that has yet been thought of. One advantage it possesses that is very precious; any piece that fails may be taken out, and replaced by another, without disturbing the rest, and without the smallest risk. On the whole, we think it a very valuable addition to British carpentry. The method here practised, both for joining the parts of one beam and for framing the different beams together, suggests the most firm and light constructions for dome-roofs that can be conceived; incomparably superior to any that have yet been erected. The whole may be framed, without a nail or a spike, into one net-like shell, that cannot even be pulled in pieces.

Bridges combined by simple addition or by composition.

When the width of the river exceeds what is thought practicable by a single truss, we must then combine, either by simple addition or by composition, different trusses together. We compose a bridge by simple addition when we make a frame of carpentry of an unchangeable and proper shape, to serve as one of the arch-stones of a bridge of masonry. This may easily be comprehended by looking at fig. 22. Each of the frames A, B, C, D, must be considered as a separate body, and all are supported by their mutual abutment. The nature of the thing is not changed, although we suppose that the rails of the frame B, instead of being mortised into an upright $b\,b'$, unconnected with the frame C, is mortised into the upright $c\,c'$ of that frame; the direction and intensity of the mutual pressures of the two frames are the same in both cases; accordingly, this is a very common form of small wooden bridges. It is usual, indeed, to put diagonal battens into each; but we believe that this is more frequently done to please the eye than to produce an unalterable shape of each frame.

To an unskilful carpenter this bridge does not seem essentially different from the centring of M. Hupeau for the bridge of Orleans; and indeed, in many cases, it requires reflection, and sometimes very minute reflection, to distinguish between a construction which is only an addition of frame to frame till the width be covered, from a construction where one frame works on the adjoining one transversely, pushing it in one part, and drawing it in another. The ready way for an unlettered artist to form a just notion of this point, is to examine whether he may saw through the connecting piece $b'b$ from one end to the other, and make them two separate frames. Whenever this cannot be done without that part opening, it is a construction by composition. Some of the beams are on the stretch; and iron straps, extending along both pieces, are necessary for securing the joint. The bridge is no longer a piece of masonry, but a performance of pure carpentry, depending on principles peculiar to that art. Equilibration is necessary in the first construction; but, in the second, any inequality of loading is made ineffectual for hurting the edifice, by means of the stretch that is made to operate on some other piece. We are of opinion that this most simple employment of the distinguishing principle of carpentry, by which the beams are made to act as ties, will give the most perfect construction of a wide bridge. One polygon alone should contain the whole of the abutments, and one other polygon should consist entirely of ties; and the beams which form the radii, connecting the angles of the two polygons, complete the whole. By confining the attention to these two simple objects, the abutments of the outer polygon, and the joints of the inner one, may be formed in the most simple and efficient manner, without any collateral connections and dependencies, which divide the attention, increase the complication, and commonly produce unexpected and hurtful strains. It is for this reason that we have so frequently recommended the centring of the bridge of Orleans. Its office will be completely performed by a truss of the form of fig. 23, where the polygon ABCDEF, consisting of two layers of beams, if one is not sufficient, contains the whole abutments, and the other A $b\,c\,d\,e$ F is nothing but an iron rod. In this construction, the obtuseness of the angles of the lower polygon is rather an advantage. The braces G c, G d, which are wanted for trussing the middle of the outer beams, will effectually secure the angles of the exterior polygon against all risk of change. The reader must perceive that we have now terminated in the construction of the Norman roof. We indeed think it the best general form, when some moderate declivity is not an insuperable objection. When this is the case, we recommend the general plan of the centring of the bridge of Orleans. We would make the bridge (we speak of a great bridge) consist of four trusses, two to serve as the outsides of the bridge, and two inner trusses, separating the carriage-way from the footpaths. The road should follow the course of the lower polygon, and the main truss should form the rails. It might look strange, but we are here speaking of strength; and evident, but not unwieldy strength, once it becomes familiar, is the surest source of beauty in all works of this kind. (J. R.)

How to distinguish bridges formed according to these different methods.

The best general form of a wooden bridge.

Centre *of Gravity*, in *Mechanics*, that point about which all the parts of a body exactly balance each other.

Centre *of Motion*, that point which remains at rest while all the other parts of a body move round it.

CENTRIFUGAL Force (*centrum* and *fugio* to flee), that force by which all bodies that move round another body in a curve tend to fly off from the axis of their motion in a tangent to the periphery of the curve.

CENTRIPETAL Force (*centrum* and *peto* to move towards), that force by which a body is impelled towards a centre. In circular motion the centrifugal and centripetal forces constantly balance each other, otherwise the revolving body would either approach or recede from the centre, as one or the other prevailed.

CENTUMVIRI, in *Roman Antiquity*, judges appointed to decide common causes among the people. Three were

chosen out of each tribe; and, though five more than a hundred, were nevertheless called *centumviri*, from the round number *centum*, a hundred. The extent of their powers in civil causes has not been completely ascertained. Some have asserted that they also took cognizance in criminal matters, but this is doubtful.—(See Hollweg, *Über die Compentenz des Centumviralgerichts;* Tigerström, *De Judicibus apud Romanos.*)

CENTURION (*centurio*), among the Romans, an officer in the infantry, who commanded a century or a hundred men. In order to have a proper notion of the centurions, it must be remembered that every one of the thirty manipuli in a legion was divided into two *ordines*, or ranks; and consequently the three bodies of the hastati, principes, and triarii, into twenty orders and ten manipuli each. Now, every manipulus was allowed two centurions, or captains, one to each order or century; and, to determine the point of priority between them, they were created at two different elections. The thirty who were first made always took the precedence of their fellows; and therefore commanded the right-hand *ordines*, as the others did the left. The triarii, or *pilani* (so called from their weapon the *pilum*), being esteemed the most honourable, had their centurions elected first, next to them the principes, and afterwards the hastati; whence they were called *primus et secundus pilus*, *primus et secundus princeps*, *primus et secundus hastatus*, and so on. Here it may be observed, that *primi ordines* is sometimes used in historians for the centurions of these orders; and the centurions are sometimes styled *principes ordinum*, and *principes centurionum*. See ARMY, vol. iii. p. 631.

CENTURY, in a general sense, anything divided into, or consisting of, a hundred parts: also a period of 100 years. In the modern computation of time from the incarnation of Christ, the word is used in a particular sense to denote some term of a hundred years subsequent to that event; as the first century, the second century, &c.

CENTURY, in *Antiquity*, a division of the Roman people for the purpose of electing magistrates, enacting laws, or deliberating upon any public affair. They voted by centuries in order that their votes might be the more easily collected; and hence these assemblies were called *comitia centuriata*. The Roman cohorts were also divided into centuries.

CEORLES, one of the classes of the people among the Anglo-Saxons. Hence the word *churl*.

CEOS, the modern Zea, an island in the Ægean Sea, belonging to the group of the Cyclades, fourteen miles off the coast of Attica. It is celebrated as the birthplace of the lyric poets Simonides and Bacchylides; of the philosophers Prodicus and Ariston; and of the physician Erasistratus. There were anciently four towns of considerable importance in the island: Iulis, on the site of which stands the modern Zea; Coressia, the harbour of Iulis; Carthæa on the S.E., and Poieëssa on the S.W. shore. From the excellence of the laws regulating the life and morals of the ancient Ceans, the term "Cean laws" passed into a proverb. The present population of the island is about 4000.

CEPHAELIS, a newly instituted genus of the natural order of *Rubiaceæ* or cinchonaceous plants, containing many species; of which the most important is *C. ipecacuanha*, the root of which is employed in medicine as an emetic, expectorant, and diaphoretic. It is a native of the shady forests of Brazil.

CEPHALIC (κεφαλή, the head), pertaining to the head; as cephalic medicines, remedies for disorders in the head.

CEPHALONIA. See IONIAN ISLANDS.

CERAM (termed Sirang by the natives), a large and beautiful island, forming part of the government of the Moluccas, and situated between 3. 20. and 3. 40. S. Lat., and 127. 59. and 130. 45. E. Long. Its superficial extent is 5500 square miles. A vast chain of mountains, varying in elevation from 6000 to 8000 feet, but with several peaks of even greater altitude, whose height has not been exactly ascertained, extends from the western to the eastern point of the island. A great number of rivers and torrents flow from these heights towards the southern coast, which is the most accessible to commerce. Ceram enjoys a most salubrious climate, and is remarkable for the great fertility of its soil. It is covered with a luxuriant vegetation; with spice trees of all kinds, which grow without culture; and with various descriptions of useful and ornamental wood. Ceram is divided among several chiefs; those in the north being governed by the resident of Amboyna, and those in the east by the resident of Banda. A considerable portion of the central district is held by the Sultan Djelalo, a native prince, who was at one time a stipendiary of the Dutch government; but, having engaged in piracy, was seized with his accomplices in 1832 and carried to Java. The population consists of the aboriginal Alfoeres, who inhabit the interior and northern districts, and of the Malays, who are settled upon the coast. The former are described as savage and ignorant idolaters, whose principal object of worship is an evil genius whom they little regard, and who band together in frequent incursions against the Mohammedan and Christian tribes on the coast. Their houses are of wood, elevated on posts about six feet high, and surrounded by an external gallery. A Dutch resident who visited the interior describes one of their *bialos*, in which the tribe meets to deliberate upon its affairs, as adorned with sacred stones and other objects of veneration, and also with a trophy of thirty-six human skulls, the common property of the tribe. The Malays inhabiting the coast are intrepid sailors, and undertake voyages in their large vessels, which are propelled by 30, 40, or even 60 rowers, to the isles of Soende, Singapore, and Australia. Many of the natives who have come in contact with the agents of the Dutch East India Company have been nominally converted to Christianity. Its resources have not been sufficiently developed by the East India Company, but are likely eventually to prove a valuable source of profit to the Dutch. A cluster of small islands, called Ceram Lant, lies off the east end of Ceram.

CERATION (κεράτιον), the name given by the ancient Greeks to the small seed of the ceratonia (carob), used by the Arabian physicians as a weight for medicines. It was the same as the Latin *siliqua*.

CERATONIA, a genus of *Leguminosæ*, including only one species, *C. Siliqua*, the carob or locust-tree, a native of the shores of the Mediterranean. The pod contains a sweet pulp, on which it is supposed that St John the Baptist fed in the wilderness, when it is said his food was *locusts* and wild honey. It is true, however, that the Arabs and other tribes eat also the insect *locust*.

CERBERA, a genus of Apocineæ, the seeds of which—especially of *C. Tanghin*, and *C. Manghas* of Madagascar and India—are deadly poisons, and were once used in the former country as a sort of ordeal in criminal cases.

CERBERUS, in *Grecian Mythology*, a three-headed dog, born of Typhon and Echidna, and set to guard the entrance to Hades. He fawned upon those who entered, but devoured all who attempted to go back. He was, however, vanquished by Hercules, and dragged up to the light of day; when, in struggling, the foam that dropped from his mouth produced the poisonous herb called *aconite* or *wolf's bane*. Some have supposed that Cerberus is the symbol of the earth, or of all-devouring time; and that his three mouths represent the present, past, and future. The victory of Hercules over this monster denotes the conquest which that hero acquired over his passions. Bryant supposes that Cerberus was the name of a place, and that it signified the temple of the sun; deriving it from *Kir Abor, the place of light*. This temple was called also *Tor-Caph-El*, which was changed to τρικέφαλος; and hence Cerberus was supposed to have had three heads.

CERDONIANS, ancient heretics who maintained most of the errors of Simon Magus, Saturninus, and the Manicheans. Their leader Cerdo, a Syrian of the second century, went to Rome and there abjured his errors; but he was afterwards convicted of persisting in them, and cast out of the church. Cerdo maintained the existence of two first causes of all things, the one good and the other evil; and also an intermediate deity, who was the Creator of the world, and the God and the Lawgiver of the Jews. The first, whom he called *unknown*, was the Father of Jesus Christ, who, he taught, was incarnate only in appearance, and did not actually suffer death; with many other errors, in which he was succeeded by his disciple Marcion. (Reid's edition of Mosheim's *Eccles. Hist.*)

CEREALIA, in *Antiquity*, a festival of Ceres, instituted by Triptolemus, son of Celeus king of Eleusis, in gratitude for having been instructed by Ceres in agriculture and the art of making bread. The *cerealia* passed from the Greeks to the Romans, who celebrated them with games in the Circus Maximus, commencing generally on the ides or 13th of April, or as some suppose on the 7th. The spectators always appeared in white; and the wanderings of Ceres in search of Proserpine were represented by women in white robes, and holding lighted torches in their hands.

Cerealia (from the goddess *Ceres*), the esculent seeds of the grasses, or those which produce corn.

CEREBELLUM, the hinder and lower part of the brain. See Anatomy.

CEREBRUM, the brain. See Anatomy.

CEREMONIAL (*ceremoniale*), a ritual, or book containing the prescribed rules relating to the rites and ceremonies of the Romish Church.

Ceremonial is particularly applied to the forms and rites of the Jewish religion; as the *ceremonial law*, in contradistinction to the moral and the judicial law.

CEREMONY, external form of religion; outward forms of state; the forms prescribed for the purpose of civility or of magnificence, as in the levees of sovereigns, the reception of ambassadors, &c.

Ceremonies, Master of the, an officer first appointed by James I. to superintend the reception of ambassadors and strangers of rank.

CERES (called Demeter by the Greeks), the goddess of corn and harvests, and the protectress of agriculture. She was the daughter of Saturn and Rhea, and the mother of Proserpine by Jupiter. Enna in Sicily was regarded as the favourite retreat of the goddess—a legend that has reference to the fruitfulness of that island. When Proserpine was gathering flowers in the fields of Enna, Pluto carried her away; and Ceres, disconsolate at the loss of her child, resolved to discover the place of her concealment. Lighting her torch at the fires of Etna, she set forth in a chariot drawn by dragons. The search of Ceres long proved fruitless; but having at length obtained the information she desired, she immediately flew to heaven, and demanded the restitution of her daughter. Jupiter at last consented, provided that Proserpine had not partaken of food in the realms of Pluto. The unwelcome truth that Proserpine had eaten the seeds of a pomegranate was revealed by Ascalaphus, who for his pains was metamorphosed into an owl. Jupiter, moved at the overwhelming grief of Ceres, granted that Proserpine should pass only half of the year with her husband, and the remainder in the upper world. This legend obviously has reference to the seed-corn, which remains in the ground part of the year; and the return of Proserpine to her mother is the springing of the corn. As the cultivation of the earth had been neglected during the time that Ceres was wandering in quest of her daughter, the soil became barren; and in order to repair the loss occasioned by her absence, the goddess went to Attica, and there instructed Triptolemus of Eleusis in the science of agriculture. By her desire Triptolemus travelled over the earth and disseminated among men the knowledge he had received. Among the fables connected with the invention and extension of agriculture, is the story that by Iasion, who introduced agriculture into Crete, Ceres became the mother of Plutus the god of riches. The appellation of Demeter, by which she was known among the Greeks, appears to be a compound of γῆ and μήτηρ, equivalent to "mother earth." Her worship is said to have been introduced from Egypt into Greece by Erechtheus; and by some she is identified with the Egyptian Isis. In Greece her festivals were called *Thesmophoria* and *Eleusinia;* those at Rome, *Cerealia*. Ceres was greatly honoured by the Romans. Her festivals were annually celebrated by matrons, holding burning torches in their hands; and whoever ventured to appear without previous initiation was punished with death.

The adventures of Ceres during her search for Proserpine were numerous. By Neptune she became the mother of the horse Arion, and was so shocked at the monstrous birth that she withdrew from the sight of men. She was discovered in Arcadia by Pan, and induced to return to Sicily, where she was honoured with a statue veiled in black, with the head of a horse, and holding in one hand a dove, in the other a dolphin. The ram was sacrificed to Ceres, and also the sow, as being destructive to crops.

Ceres is usually represented as a majestic young woman, with the same matronly appearance as Juno, but of milder aspect, her eyes less full, the forehead lower, and instead of the high diadem, her head is adorned with a garland of ears of corn, or bound with a simple fillet. In her hand there appears a lighted torch, and sometimes a sickle, a cornucopia, a wreath, or a poppy, which was sacred to her. Sometimes she appears seated on an ox, carrying a basket on her arm, and in her hand a hoe. She is also represented riding in a chariot drawn by winged dragons.

By the poets, *Ceres* is used metaphorically for corn and bread, as *Bacchus* is used to signify wine. See Eleusinia.

Ceres, the name of a small planet between the orbits of Mars and Jupiter. It was discovered by Piazzi at Palermo in 1801. See Astronomy.

CERET, a pleasantly situated town of France, capital of an arrondissement of the same name, department of Pyrénées Orientales, 15 miles S.S.W. of Perpignan. Pop. (1851) 3575. Here, in 1660, the plenipotentiaries of France and Spain met to fix the limits between these two kingdoms.

CERIGNOLA, a well built episcopal city of Naples, province of Capitanata, situated on an eminence commanding an extensive view of the surrounding country, 23 miles S.E. of Foggia. It is divided into an old and new town, and has a college, several convents, hospital, &c., and some trade in cotton and fruits. It is celebrated for the victory gained here in 1503 by Gonsalvo de Cordova over the French forces under the command of the Duc de Nemours. Pop. (including the dependent village of Tressanti) 10,300.

CERIGO. See Cythera, and Ionian Islands.

CERINTHIANS, an ancient heretical sect, so called from Cerinthus their founder, who lived at the extreme close of the apostolic age, and is said to have been contemporary with the apostle John at Ephesus. In his opinions he seems to have combined the peculiarities of Gnosticism with the maintenance of extreme Judaism, the former element exclusively being combated by Irenæus, the latter by Caius, Dionysius, and Epiphanius. Judging from the statements of his adversaries, the doctrines which he held most prominently seem to have been the following, viz. the existence of different orders of angels in the *pleroma*, the lowest of whom only come in contact with the world of matter; the creation of the world by those angels under the control of a superior being who is yet infinitely removed in nature and intelligence from the deity; the distinction

of the man Jesus and the Christ or Logos in the person of the Saviour, the former alone being born and crucified, the latter descending on him at his baptism and ascending again at his apprehension by the Jews; and lastly, although this seems to contradict the whole tendency of his other opinions, the reign of Jesus and his attendant Logos on the earth during a millennium of sensuous enjoyment. It is probable the Gospel of John was written specially to counteract the growth of Cerinthian doctrine.

CERIUM, a grayish-white metal, first discovered in 1803 by Hisinger and Berzelius in a very rare Swedish mineral called cerite. See CHEMISTRY.

CERNE ABBAS, a market-town and parish of England, county of Dorset, on the river Cerne, an affluent of the Frome, seven miles north of Dorchester. An abbey was founded here in 987, of which some remains still exist. On Trendle Hill, N.W. of the town, is a colossal figure of a man with a club, 180 feet high, cut in the chalk. Pop. of parish (1851) 1343, chiefly employed in the manufacture of leather, gloves, and parchment.

CEROMA, in *Antiquity*, a mixture of oil and wax, with which wrestlers in the public games and bathers were anointed; likewise used for the *elæothesium* or place where this was done, as also in later times for the *palæstra* or wrestling ring itself.

CEROXYLON ANDICOLA, the only genus in this family of palms, remarkable for the large quantity of wax, mixed with two-thirds of resin, that flows from its bark, and invests its stem with a thick coating. This is collected, and with one-third of tallow is manufactured into candles. The plant attains the enormous height of 180 feet. It is found on the mountain chain separating the Rio Madalena from the Rio Cauca, in Lat. 4. 35. N. Unlike other palms, it only flourishes where the air is cooled by the vicinity of perennial snow. Its range is limited to about 20 square leagues. It is well named by the Spaniards *Palma de Cera*.

CERRETO, an agreeable and well-built town of Naples, province of Terra di Lavoro, 21 miles N.W. of Benevento. It has a fine cathedral, collegiate church, seminary, and manufactures of coarse woollens. Pop. 6000.

CERTALDO, a market-town of Tuscany, on the Elsa, province and 18 miles S.W. of Florence, celebrated as the birthplace of Boccaccio, whose house is still preserved.

CERTIORARI, in *Law*, a writ which issues out of the chancery, directed to an inferior court, to call up the records of a cause there depending, in order that justice may be done. It is not only used out of the court of chancery, but likewise out of the king's bench, in which last-mentioned court it lies where the king would be certified of a record.

CERUMEN, the waxy matter secreted by the ear. It consists of albumen, an oily matter, a colouring matter, soda, and phosphate of lime.

CERUSE (Lat. *cerussa*), or WHITE-LEAD, a carbonate of lead produced by exposing that metal in thin sheets to the vapour of acetic acid. Ceruse sometimes occurs native as white-lead spar. It is the basis of the ordinary white oil paint, and in its semi-solid form is used as a cement for stone, &c.

CERVANTES, SAAVEDRA MIGUEL DE, the inimitable author of Don Quixote, was born at Alcala de Henares, New Castile, Oct. 9, 1547. He was descended from a noble family, and was the youngest son of Rodrigo di Cervantes and Leonora de Cortinas. From his earliest years he showed an insatiable love of reading, which induced his father to send him to Madrid, that he might receive his education under Juan Lopez de Hoyos, and be fitted for the profession of theology, medicine, or law. The poetical bent of his genius, however, gradually withdrew his attention from these severer studies, and led him at last to devote his whole time to the composition of verses. His first attempt of this kind was an elegy on the death of Queen

Isabella, and was speedily followed by a pastoral entitled *Filena*, several sonnets, romances, and other poems. The apathy with which his countrymen, even his friends, received these productions, roused Cervantes to seek a more favourable field for the display of his talents abroad. In 1569 he set out for Rome, where he became valet to Cardinal Aquaviva, to whom he had been introduced at Madrid. In the following year he quitted the cardinal's service, and joined the expedition fitted out under Marco Antonio Colonna to succour the Cyprians against the invasion of Selim II. He was present at the action in the Gulf of Lepanto, and conducted himself with great bravery, but had the misfortune to receive a severe wound in his left hand, which deprived him of the use of it for life. He was carried in a Spanish ship to the hospital at Messina, and when dismissed immediately rejoined the troops at Naples, who were preparing to march on an expedition against Tunis. During this period he assiduously improved his knowledge of Italian, and had an opportunity of visiting the most celebrated cities of Italy. In 1575 he set out with his brother for Madrid in a Spanish galley called El Sol (the Sun), which had scarcely set sail when they encountered a squadron of Algerian pirates, and were taken prisoners and carried to Algiers, where they remained for four years. Cervantes made many vigorous efforts for the release of himself and his companions, and one of these was so nearly successful that having avowed himself the author of the scheme he was adjudged to death. The admiration, however, which his master entertained for his conduct procured the transmutation of the sentence, and he was soon after transferred as a slave to the service of the Dey. In this situation his enterprising mind conceived a scheme of insurrection, and though the plot was discovered the feeling of respect and even awe with which he was regarded secured him from any ignominious treatment. After many unsuccessful attempts on the part of the Spaniards to relieve the captives, Cervantes and his companions were redeemed in 1580 through the intervention of the Trinitarian Fathers Juan Gil and Antonio de la Bella, who paid down 500 gold ducats for his release. But his misfortunes had not yet cooled down his military ardour; for on his return to Spain he again resumed his arms, and went in three successive expeditions to the Azores. On his return he composed his pastoral romance of *Galatea*, in honour, it is said, of a certain Doña Catalina de Palacios Salazar, whom he shortly after married. From this period he was for ten years employed in writing plays for the Spanish stage, but of the thirty which he wrote only two have survived, viz. *Los Tratos de Argel* (Life in Algiers) and *La Numancia*. For some time he lived at Seville, where he held the office of assistant purveyor to the Indian fleet, and probably wrote the first part of *Don Quixote*, which, however, was not printed till 1605. Eight years after appeared the *Novelas Exemplares*, consisting partly of serious partly of comic pieces, in which *examples* are given of virtues to be imitated and vices to be shunned. This was followed by the *Viage el Parnasso* (Journey to Parnassus), a satirical piece written in imitation of a similar work by Cæsar Caporale, an Italian poet of the sixteenth century. In 1615 he published the continuation of *Don Quixote*, which immediately supplanted a spurious continuation written by Fernandos de Arellaneda a short while before, and placed the author still higher in popular estimation than before. The work was read by his countrymen with the utmost avidity, and immediately translated into all the European languages. The last work which Cervantes wrote was entitled *Trabajos de Persiles y Sigismunda*, a grave romance, written after the Theagenes and Chariclea of Heliodorus. At the end of the preface to this book he alludes with touching playfulness to the dropsy which was slowly consuming his life,—"the thirst attending which," he says, "all the water of the ocean, though it were

not salt, would not suffice to quench." Notwithstanding the agonies which he suffered from this constantly increasing malady, he continued writing and talking in his characteristically humorous strain, till his death on the 23d April 1616—the same day which deprived the world of Shakspeare. For a critical estimate of Cervantes' writings, see ROMANCE.

CERVERA, a town of Catalonia, Spain, 57 miles N.W. from Barcelona. It stands on an eminence, is fortified, and possesses the remains of an ancient castle. It has a fine Gothic church, and several convents. Its university (originally transferred from Lerida by Philip V.) has recently been removed to Barcelona. The inhabitants are almost exclusively engaged in agriculture. Pop. 4500.

CERVIA, an episcopal town of the Papal States, on the Adriatic, delegation and 12 miles S.E. of Ravenna. In the vicinity are extensive salt-works. Pop. 3000.

CESARE, one of the modes of the second figure of syllogisms, the minor proposition of which is a universal affirmative, and the others universal negatives; thus,

cE No immoral books ought to be read;
sA But every obscene book is immoral;
rE Therefore no obscene books ought to be read.

CESARI, GUISEPPE, called IL CAVALIERE D'ARPINO, an Italian painter much encouraged at Rome and munificently rewarded, while A. Caracci was so ill requited for his finest works. Cesari is stigmatized by Lanzi as not less the corrupter of taste in painting than Marino was in poetry. There was spirit in Cesari's heads of men and horses, and his frescoes in the capitol are well coloured; but he drew the human form ill. His perspective is faulty, his extremities monotonous, and his chiaroscuro defective. He died in 1640, at the age of 72.

CESAROTTI, MELCHIORRE, an Italian poet, born at Padua in 1730, of a noble but reduced family. He early showed a very decided inclination for literary pursuits, in which he made such progress at the college of his native city, that he was appointed to the chair of rhetoric at a period of life when others were yet attending the lectures. The first fruits of his studies were Italian translations of the Prometheus of Æschylus, and three tragedies of Voltaire, by the merit of which, and the reputation he had acquired for learning and persevering application, he procured successively the appointment of tutor to the children of Grimani, a nobleman of Venice, and the professorship of Greek and Hebrew in the university of Padua. Cesarotti had held this situation for nearly thirty years at the date of the first French invasion of Italy. This poet did not, like Alfieri, scorn the pecuniary favours of the republican government. He published several political tracts and essays by their order; and when the general of the invading army assumed the title of King of Italy, Cesarotti received two pensions of considerable amount, and was made a knight of the iron crown. He continued to reside alternately at Padua and his country house of Selvaggiano, chiefly occupied with the composition of laudatory poems in return for the favours he had received, and with the superintendence of a complete edition of his works. While thus engaged he died suddenly on the 3d November 1808.

Though held by Sismondi to be the first in point of celebrity of the modern Italian poets, Cesarotti is better known as a translator than as an original author. The Italians have always been distinguished for the elegance and spirit of their translations from the classics; the Lucretius of Marchetti, the Æneid of Annibale Caro, and Anguillara's free version of the Metamorphoses of Ovid, have deservedly exalted their reputation to the utmost height in this department of literature. Anguillara's translation of Homer, however, had been less popular and successful than his Metamorphoses, and there still remained room in Italy for a translation of the prince of poets. The work of Cesarotti, however, is far from being literal; he has modernized and accommodated the Iliad to the prevailing taste of the age; he has abridged it in some places, and added to it in others, according to his taste or fancy; and he has often been reproached with having given to the Greek bard the style and language of his favourite Ossian. In the late edition of the works of Cesarotti, the poetical version is followed by a literal prose one, accompanied with critical notes and dissertations, partly translated from Pope and Dacier.

Cesarotti acquired more fame by his version of Ossian than by that of Homer. He has completely preserved the spirit of the supposed bard of Morven, and, at the same time, has given us that harmony of versification which we desiderate in the work of Macpherson. The Italian Ossian was first published at Padua in 1763, 2 vols. 8vo, at the expense of Mr Sackville, an English traveller with whom Cesarotti had contracted a friendship. This edition was necessarily incomplete, as the translation of Macpherson at that time was so also; but the whole poems were printed at the same place about ten years afterwards, in 4 vols. small 8vo. Their appearance attracted much attention in Italy, and raised up many imitators of the Ossianic style.

Cesarotti also produced a number of valuable prose works. The *Course of Greek Literature* was his chief undertaking; but the plan on which he commenced was too vast to be completed. His essays on the *Sources of the Pleasure derived from Tragedy*, and on the *Origin and Progress of the Poetic Art*, are distinguished by elegant and ingenious criticism; while his treatises *Sulla Filosofia delle Lingue, et Sulla Filosofia de Gusto* (the last of which is principally intended as an apology for the peculiarities of his own style), show considerable acuteness and strength of understanding. In 1797 an Academy of Sciences and Belles Lettres had been established at Padua, of which Cesarotti was nominated perpetual secretary. Almost all the prose works of Cesarotti are distinguished by extensive erudition and a philosophical spirit, while his style is for the most part lively and forcible. But the Italian prose of the eighteeenth century was very different from that written by Giovanni della Casa, Machiavel, and their contemporaries in the sixteenth; and those critics who have deplored the recent innovations on the ancient purity of the Tuscan tongue, chiefly attribute to Cesarotti the introduction of those Gallicisms and new modes of expression which have so greatly corrupted the language of the golden age of Leo.

All the works of Cesarotti above mentioned, including several volumes of correspondence, have been published in a complete edition, which was commenced at Padua in the year 1800, under the author's own direction. It has been continued since his death by Guiseppe Barbieri, who was his successor in the chair of Greek and Hebrew at Padua, and who has also published Memoirs of the Life and Writings of his deceased friend, printed at Padua, 1810, 8vo. (J. C. D.)

CESENA, a neat and pleasantly situated episcopal town of the Papal States, on the Sario, in the legation and 12 miles S.E. of Forli. The *Palazzo Pubblico* is a fine building, ornamented with a statue of Pius VI., who was a native of this town, as was also his successor Pius VII. The Capuchin church contains a fine painting by Guercino. The library, the principal object of interest, was founded by Malatesta in 1452, and is rich in MSS. In the vicinity are extensive sulphur mines. Pop. 14,500.

CESSIO BONORUM, in the civil law, is the rendering up by an insolvent debtor of his property for the use of his creditors; and the term has hence come to be applied to that relaxation from the rigour of the law which the debtor obtains on making a surrender of his property. It has thus entered into the nomenclature of the modern systems derived from the civil law, with some variation of meaning. In France the *Cession de Biens* is a step in the bankruptcy system. (*Code de Commerce*, liv. iii. tit. ii.) In Scotland the process which corresponds with the English insolvent debtors' system, and gives a modified relief to bankrupts not connected with commerce, is called *Cessio Bonorum*. It is regulated by statute (6th and 7th Will. IV., cap. 56). See, for farther information on the modern application of the law of cessio, the two heads BANKRUPTCY and INSOLVENCY. The relaxation of the Roman law, which relieved

the debtor from the cruel operation of the older system, on his making a general cession of his goods, is generally attributed to Julius Cæsar. The operation of the system and the writings of the jurists did much to illustrate for modern adoption and practice the principles on which a sound insolvent debtors' system should be founded. See some curious notices in Heineccius ad Pan., lib. xlii. tit. 2; and the 3d title of the forty-second book of the Pandects.

CESTUS (from κεστός, stitched, embroidered), the zone or girdle of Venus, to which Homer ascribes the power of captivating the affections. It was the marriage-girdle of the Greeks and Romans; among whom the ceremony of unloosing the cestus of the bride on the nuptial night was performed by the husband of the bride. The word is sometimes written *cæstus*.

CESTUS also denoted a boxer's glove, as described under CÆSTUS, and BOXING.

CETTE, a seaport in the south of France, department of Hérault. N. Lat. 43. 25 ; E. Long. 3. 40. It stands on a peninsula formed by the Mediterranean and the lake of Thau, which are connected by a canal passing through the town. It possesses a deep and commodious harbour, a spacious dock, and handsome quays. The entrance to the harbour is defended by two strong forts, that of St Pierre on the left side, and that of St Louis on the right. Cette has tribunals of commerce and of primary instance, a public library, and a college, besides extensive salt-works and ship-building yards. It communicates by canal with Lyons and Bordeaux, and by rail with Marseilles, Nîmes, and Avignon. From its vicinity to the great wine districts of the south of France it has an important trade, and exports largely wine, brandy, sugar, glass, wine-casks, &c. The imports consist of corn, wool, cotton, hemp, timber, and iron. The cod and oyster fisheries off the coast engage a large number of hands. In 1853 the number of vessels that entered and cleared the harbour amounted to more than 4000. Pop. about 20,000.

Cetus || Ceylon.

CETUS, the Whale, a large constellation of the southern hemisphere, containing 97 stars.

CEUTA, or SEPTA, a Spanish fortress on the coast of Fez, Africa, on a peninsula opposite Gibraltar. N. Lat. 35. 56.; W. Long. 5. 18. It is built on the Monte del Hacho (the ancient *Abyla*, one of the pillars of Hercules), and six smaller hills that run along the coast. The town is well built, and is chiefly important as a military and convict station. It contains a cathedral, the bishop of which is suffragan to the archbishop of Seville, several religious houses and a hospital. It has a small harbour, and imports provisions and military stores from Spain. Pop. 9237, exclusive of the garrison, which may be estimated at 5000 men. Ceuta was taken from the Moors by John I., king of Portugal, in 1415, and passed into the hands of the Spaniards on the subjugation of Portugal by Philip II. in 1580. It has been several times unsuccessfully besieged by the Africans.

CEVA, the ancient *Ceba*, a town in the kingdom of Sardinia, province and 10 miles east of Mondovi, at the confluence of the Cevetta with the Tanaro. It was formerly fortified; and the rock, at the foot of which lies the town, was surmounted by a citadel. Pop. 4000, chiefly employed in the manufacture of silk, and in iron works. It is noted for its cheeses, in which it has a considerable trade.

CEVENNES, a mountain-chain in the south of France, dividing the valleys of the Lower Saône and Rhone from those of the Loire and Garonne. The highest peak is Mount Mezen, in the department of Ardèche (5970 feet). The principal formation is granite; and beds of trachyte and lava in many quarters give token of former volcanic action. The lower slopes are cultivated with great industry; the more elevated regions are pastoral; and the summits are generally clothed with forests of chestnut and pine. The Cevennes were made the retreats of the Huguenots in the beginning of the eighteenth century.

CEYLON,

AN island in the Indian Ocean, situated at the southern extremity of the Coromandel coast, from which it is separated by the Gulf of Manaar. It lies between N. Lat. 5. 54. and 9. 50., and E. Long. 79. 50. and 82. 10. Its length is 270 miles, and its greatest breadth 145 miles. It is of an oval form, pointing north and south; its broadest part being at its southern extremity, where also is to be found the great mass of its high lands. It is distant from Cape Comorin, the southernmost point of the Indian Peninsula, about 175 miles.

Aspect of the country.

The N.W. coast of Ceylon is beset with numberless sandbanks, rocks, and shoals, and may be said to be almost connected with the continent of India by the island of Ramisseram and Adam's Bridge, a succession of bold rocks reaching almost across the gulf at its narrowest point. From its position and its geological character, Ceylon would appear to have been at an early period the southern extremity of the mainland, from which it has been doubtless separated by some great convulsion of nature. Between the island and the opposite coast there exist two open channels of varying depth and width, beset by rocks and shoals. One of these, the Manaar Passage, is only navigable by very small craft. The other, called the Paumben Passage, lying between Ramisseram and the mainland, has been deepened at considerable outlay, and is now used by vessels of 300 tons in passing from the Malabar to the Coromandel coast, and which were formerly compelled in doing so to make the circuit of the island.

The west and south coasts are uniformly low, fringed their entire length by cocoa-nut trees, which grow to the water's edge in great luxuriance, and give to the island a most picturesque appearance. Along these shores there are numerous inlets and backwaters of the sea, some of which are available as harbours for small native craft. The east coast from Point de Galle to Trincomalee is of an entirely opposite character, wanting the ample vegetation of the other, and being at the same time of a bold precipitous character. The largest ships may freely approach this side of the island, taking care to avoid a few dangerous rocks, whose localities are, however, well known to navigators.

Seen from a distance at sea, this "utmost Indian isle" of the old geographers wears a truly beautiful appearance. The remarkable elevation known as "Adam's Peak," the most prominent, though not the loftiest of the hilly ranges of the interior, towering like a mountain-monarch amongst an assemblage of picturesque hills, is a sure land-mark for the weary navigator, when as yet the Colombo lighthouse is hidden from sight amidst the green groves of palms that seem to be springing from the waters of the ocean.

The low coast-line of country encircles the mountain-zone of the interior on the east, south, and west, for a varying distance of from 30 to 80 miles; but on the north the whole breadth of the island from Calpentyn to Batticaloa is one vast sandy plain, teeming with low jungle, swamps, and sterile deserts.

The great central mountain range rises in most places with considerable abruptness. Its general direction is from north to south, but is nevertheless much broken up, sending off spurs of great size and extent in many directions. These ranges are clothed with verdure to their very summits;

and along their base, stretching far into the beautiful fertile valleys which intersect them in every direction, are vast forests of gigantic trees now fast disappearing before the planter's axe.

For a long period Adam's Peak was universally supposed to be the loftiest mountain in Ceylon, but actual survey makes it but 7420 feet above the sea-level. This elevation is chiefly remarkable as the resort of pilgrims from all parts of the East, it being the belief amongst Buddhists and Mussulmans that Adam on leaving Paradise rested upon one foot on this summit. To this day the print of a human foot on the rock, $5\frac{1}{4}$ feet in length by $2\frac{1}{8}$ in breadth, is shown, carefully protected from the weather and guarded by priests who have a shrine on this lofty peak. Pedrotallagalla, a bold abrupt rock between the valleys of Maturatta and Newere Ellia, is the loftiest elevation in the island, being 8280 feet high. There are two other mountain peaks of great height, being respectively 7810 feet and 7720 feet.

The elevation of the greater portion of the fertile valleys and hill-sides of the interior, at present teeming with extensive coffee plantations, ranges between 2000 and 4000 feet. The plain of Newere Ellia, the sanatarium of the island, is at an elevation of 6210 feet, and possesses many of the attributes of an alpine country. The town of Kandy, in the central province, and formerly the capital of the ancient kings of that country, is situated 1678 feet above the sea-level.

Rivers. It might be expected that an island so completely within the influence of oceanic evaporation, and possessing an elevated table-land of considerable extent, should boast of some rivers of magnitude. This, however, is not the case. The rains which usher in each monsoon or change of season are indeed heavy, and during their fall swell the streams to torrents, the torrents to impetuous rivers. But when these cease, the water-courses fall back to their original state; the foaming streams are once more murmuring brooks, and but few of the rivers cannot be passed on horseback. The largest of the Ceylon streams, the Mahavilla-Ganga, has its source in the Pedrotallagalla mountain, whence it courses very tortuously through the Kotmalie valley to Pasbage; and thence winding to the south and west of Kandy, sweeps suddenly to the north, and finally falls into the wild and open country of Bintenne, through which it takes a course almost due north as far as Trincomalee, near which town it falls into the sea by two outlets after a course of about 200 miles. Like all the Ceylon rivers, this can only be passed with great difficulty during the rainy season, running as it does for 100 miles through a rocky and precipitous country. It is seldom wider than the Thames at Richmond, and generally of much less width. Surveys have shown that, at some outlay for blasting rocks, this river might be made navigable for a distance of 80 or 90 miles from Trincomalee. At Peradinea, $4\frac{1}{2}$ miles from Kandy, it is crossed by a beautiful bridge of satin-wood of a single span of 205 feet, erected by Colonel Fraser on the wedge principle.

The Kalany Ganga has its rise at the base of Adam's Peak, whence running almost due west as far as Ruanwella it takes its way more southerly to Colombo, where on its northern outskirt it falls into the ocean across a wide sandbar. This stream is navigable for about 40 miles by means of flat-bottomed boats. The Kalu Ganga and the Wallawe Ganga flow from the eastern vicinity of Adam's Peak through the district of Saffragam to the sea, the former south-westerly, the latter south-easterly: both are navigable for some distance by country boats. The Maha Oya or "great stream" rises in the mountains to the southwards of the Hanguranketty valley, and after a winding course of 70 miles in a west, north-west, and south-westerly direction, falls into the sea at Kaymel, dividing the districts of Putlam and Negombo. There are many other streams within the interior tributaries of the above, but unless during the heavy rains they are of no magnitude, and are in no instance navigable.

Lakes and canals. There are some lakes of considerable extent and of great beauty. Those of natural formation are situated at Colombo and Negombo. The former is but a few miles in circumference, and was deepened and extended by the Dutch with a view to the defence of the town against the natives. In these days it is more valued for its picturesque beauty than its defensive qualities. The lake of Negombo is a fine sheet of water of great extent, and is connected with that of Colombo by means of canals, partly natural and partly artificial. The Dutch whilst in possession of the island did much to improve its water communication, and this was one of their most useful works. On the west coast as far as Calpentyn, on the N.W. shores, and also along the eastern coast, there are numerous and extensive salt-water lakes or lagunes, more or less connected by means of canals and streams.

Artificial lakes appear to have been constructed by the Singhalese monarchs at very remote periods, for the purpose of irrigation. By damming across the mouths of valleys, the waters which in the rainy season would have flowed through them into the low country and have been lost in the ocean, were by these means saved until required during the time of drought, when they were allowed to flow through proper channels of solid masonry to the desired localities. The remains of some of these lakes, ruined as most of them are, attest the industry of the dense population which once filled regions that are now the abode of the buffalo and the cheetah. One of those, the lake of Minery, although constructed fifteen centuries ago, is still in excellent preservation, and serves to irrigate a large district between Trincomalee and Kandy. It is 20 miles in circumference, and has an embankment 60 feet wide at the top. Others, now in a state of dilapidation, were once of enormous extent and solidity. One appears to have had a wall of masonry 12 miles long by 100 feet thick, and in its dry bed are to be seen as many as a dozen villages, around which rice fields grow and bananas wave to the breeze that once swept over a little inland sea. The Kandy lake is built up in a similar way; and while it ministers to the convenience and salubrity of that town, adds not less to its beauty. Surrounded on every side by wooded hills, and skirted by an excellent carriage road, which is sheltered from the sun by palm trees, it offers to the visitor one of the most delightful tropical drives that can be met with.

Harbours. Although Ceylon is possessed of two excellent harbours, one of them many miles in extent and easy of entrance, they are nevertheless of little importance, since the entire European shipping business is conducted at Colombo, the English seat of government, which possesses but an open roadstead. The harbour of Trincomalee is perhaps one of the finest in the world; but, situated on the north-eastern extremity of the island out of the track of ships and far removed from the productive districts, it is only employed as an admiralty station. The harbour of Galle, though much smaller, is still capacious, but difficult of access, and is open to the same objection of being too remote for a port of shipment, except of such few products as are grown in its neighbourhood. Open, however, as is the Colombo roadstead, it affords a safe anchorage for ships during all months of the year, even in June and October, when communication with the shore is difficult if not dangerous.

Roads. The policy of the Singhalese rulers of the island having been directed to the exclusion of strangers from their country amongst the hills, they never attempted to construct roads, but rather aimed at rendering travelling a matter of impossibility to all but natives: tortuous foot-tracks were still the only means that existed of passing from one district to the other throughout the wild regions of the interior, when

the British assumed the sovereignty of the Kandian country in 1815. In the low country of the maritime province, neither the Portuguese nor the Dutch had paid much attention to roads; preferring to trust to their canals for the transport of goods, and not caring to explore a country that seemed to offer nothing but hostility to them. The necessity of opening up the interior was first seen in a military point of view; and the construction of the road between Colombo and Kandy, 72 miles in length, carried over swamps, along the edges of precipices, and up the steep sides of mountain passes, attested at once the importance of the work, and the skill and industry of the constructors. It is as wide, and in most places as good, as any European road; whilst at distances of 8 miles, rest-houses and stabling for travellers were erected at the public expense, and are only now neglected because the daily mail-coach renders them no longer necessary. An equally good road connects Galle with Colombo, and the latter with Negombo.

The rapid extension of coffee planting in the Kandian country, since the year 1841 has led to large and constant outlay upon the construction of new roads, suitable for the transport of crops from the planting districts to Colombo.

Previous to 1841, the whole extent of carriage roads throughout the island was 1572 miles, one-third of which lay along the sea-coast, and consisted of little more than wheel-tracks over sandy plains. During the five years ending with 1846, there were nearly 800 miles of new road opened through a great variety of country, and differing in their costliness from an outlay of L.20 a mile in flat country, to L.500 a mile in some of the most elevated districts, where the blasting of rocks and building up the sides of precipices form heavy items in the outlay. The sums expended on roads during those five years amounted to a total of L.201,621, the tolls collected for the same period having been L.107,066.

From that time until the passing of the road ordinance in 1848, little more was done than to keep the existing roads in repair. By the working of the new law, which called upon every able-bodied male adult to labour for six days in each year upon the roads in his district, a great deal has been done towards opening up the interior; and there are now upwards of 3000 miles of carriage road in the island, of which 600 miles are principal roads, 1700 are second class, and 700 third class roads. The outlay upon the roadways of the island in 1852 amounted to L.54,472, of which labour to the value of L.17,951 was contributed under the road ordinance, and L.36,521 was paid out of the public treasury. The latter was for skilled labour, a large force of Malabar artizans being kept up under a sort of military discipline in various parts of the country.

Seasons, climate, &c.

The seasons in Ceylon differ very slightly from those prevailing along the coasts of the Indian peninsula. The two distinctive monsoons of the year are called, from the winds which accompany them, the south-west and the north-east. The former is very regular in its approach, and may be looked for along the S.W. coast between the 10th and 20th of May. It is ushered in by heavy banks of clouds to seaward, and much lightning. Heavy squalls of wind and rain from the S. and S.W. usually prevail for three weeks, when the weather moderates, and smart showers continue to fall with more or less frequency until the beginning of August. The monsoon is then very pleasant until early in October, when the sea-breeze fails, and calms prevail until early in November. The N.E. monsoon visits this part of the island between the end of October and the middle of November less violently than the other, the rains being far more moderate, and seldom extending past December. To the north of the Kandian country the features of each monsoon are reversed; there the violence of the N.E. is greatest and first felt, whilst that of the S.W. monsoon is latest and least felt.

During the S.W. monsoon in Colombo, the temperature usually ranges about 83°, with seldom more than two or three degrees of variation during the 24 hours. In the N.E. monsoon, on the contrary, the thermometer ranges between 72° at day-break, and 87° at two P.M., which is the hottest time. At various altitudes, however, in the Kandian country, any temperature downwards to the freezing point may be attained early in the year. The *sanatarium* of Ceylon, Newere Ellia, during the cold season of January and February, shows a temperature of 31° in the morning; whilst the ordinary range upon the best coffee estates is between 56° and 80°. The quantity of rain which falls in some of the mountain districts of the interior in one month nearly equals the fall in England during an entire year—being 21 inches. During the dry season rain has been known not to fall for three months. The average annual fall of rain at Colombo is 85 inches. In the hills it often reaches 120 inches. The length of the day, owing to the proximity of the island to the equator, does not vary more than an hour at any season. Daylight may be reckoned as usually lasting from 6 A.M. until 6 P.M.

Diseases.

The salubrity of Ceylon greatly excels that of most parts of continental India. With ordinary care Europeans may pass many years in the island as free from disease as in any part of Europe. Natives attain to a great age, especially in the hilly districts, in the centre of which, at an elevation of 6000 feet is the sanatarium of the island, Newere Ellia, the favourite resort of Indian invalids.

The prevailing diseases of the country are cholera, dysentery, fever, and hepatic attacks. Elephantiasis, a disease attended by enormous swelling of the limbs, is peculiar to the natives, and of frequent occurrence. The first-named disease is mainly confined to natives and soldiers, the three following chiefly to Europeans. The only available returns of mortality showing the causes of death, are those of the English regiments doing duty in the island, tables which, looking to the reckless mode of living prevalent amongst soldiers, must not be taken as representing the average mortality amongst European residents. The following tabular statement of deaths at the central, western, southern, and north-eastern military stations of Ceylon, have been compiled from returns extending over a period of seventeen years:—

Annual Ratio of Mortality per 1000 *of mean strength.*

	Kandy.	Colombo.	Galle.	Trincomalee.
By fever	25·6	8·5	1·9	19·8
By diseases of stomach and bowels	17·9	21·5	7·8	39·7
Do. lungs	5·0	5·3	2·6	4·6
Do. liver	3·1	4·5	3·9	7·4
By cholera	·8	5·8	0·	14·1

Geology.

The geological constitution of Ceylon, equally with other circumstances, goes to show that at a remote period the island formed the southern point of the Indian peninsula. Detached from the continent at some early geological epoch, it would appear that, unlike other countries possessing similar constituents, it has not been subject to alternate submersions and upheavals; indeed, it may well be doubted if it has even once been covered with water since the time at which it first became dry land; nearly the whole of the soil, with the exception of the alluvial deposits and the sandy plains of the maritime provinces, having been formed from the decomposition of the gneiss rocks.

It is at the same time believed that the whole island is undergoing a gradual elevation; in proof of which geologists point to extensive strata of sea-shells and corallines underlying many fertile alluvial plains in the southern province at a considerable distance from the sea. In the northern, eastern, and southern districts of the island, numerous instances of post-tertiary formations may be met with in the shape of elevated terraces of shells and masses of coralline rocks, intimately blended with marine shells in every respect similar to the living specimens inhabiting the neighbouring waters. Large masses of this rock may be seen at an ele-

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vation of seven or eight feet above the ordinary sea-level and a mile or two distant from the beach; indeed a large portion of the peninsula of Jaffna is formed of these marine remains in various stages of solidification. On the east and southern coasts the hardest of these formations are quarried and employed in ordinary works of masonry, some of the best dwellings being formed of them.

The Ceylon series of rocks are few in number. The lowest and most common is gneiss, overlaid in many places in the interior by extensive beds of dolomitic limestone. This formation appears to be of great thickness; and when, as is not often the case, the under surface of the gneiss series is exposed, it is invariably found resting on granite. Veins of pure quartz and felspar of considerable extent have been frequently met with in the gneiss; whilst in the elevated lands of the interior in the Galle districts may be seen copious deposits of disintegrated felspar, or *kaolin*, commonly known as porcelain clay. At various elevations the gneiss may be found intersected by veins of trap rocks, upheaved whilst in a state of fusion subsequent to the consolidation of the former. In some localities on the sea shore these veins assume the character of pitch-stone porphyry highly impregnated with iron. Hornblende and primitive greenstone are found in the vicinity of Adam's Peak, and in the Pusilava district.

The substance known in Ceylon as *cabook*, and assimilating greatly to the *kunker* of the Indian peninsula, exists in vast quantities in many parts of the western province, and is quarried for building purposes.

Mineralogy.

As yet no traces of coal have been found, with the exception of a little anthracite; but looking to the position of the carboniferous deposits of northern India, lying as they do on the gneiss formation, it is not impossible that similar deposits may be here met with in like positions.

Specimens of tin, platina, copper, and black oxide of manganese from the southern province, have been placed in the museum of the Ceylon Asiatic Society. Quicksilver mines existed at one time in the vicinity of Colombo, and the Dutch are said to have exported the article to Europe. Plumbago is quarried to a great extent in the Caltura district of the southern province, and has for a series of years formed a considerable item in the exports of the island. It is almost entirely produced by natives, who, however, work the quarries in a very careless manner, mixing sand and stones with the mineral. It is found at depths varying from three to thirty feet, and generally exists in rich seams. In 1846 the shipments of this article amounted to 25,036 cwts., valued at L.3036. In 1851 they were 31,126 cwts., worth L.4756. Iron exists in vast quantities in the western, southern, and central provinces, of excellent quality, in many places cropping out at the surface in a state of great purity. The Singhalese have been accustomed to work the ore into tools and implements from the most remote times; and although the means they employ are rude, imperfect, and wasteful in the extreme, they nevertheless manufacture articles which are esteemed by them far above those imported from Europe. The rudely worked Singhalese iron is equal in temper to the finest Swedish metal, and English capital and skill are alone wanted to render the iron resources of the island equal in value to any other of its natural wealth.

Nitre and nitrate of lime are to be met with in many caves of the low country, whilst alum and sulphate of magnesia are known to exist, though in limited quantities. Natural deposits of common salt are found in many parts of the maritime provinces. It is also produced by artificial means in large quantities under the supervision of government, in whose hands its manufacture and sale form a monopoly which yields an annual revenue of considerable amount. In 1843 the sale of this article yielded L.36,492.

In the Saffragam district precious stones are met with in great abundance; also, though less commonly, in the Badulla and Newere Ellia districts. The most valuable are the ruby, the sapphire, the amethyst, the cats-eye, and the carbuncle, Emeralds are rarely met with in any purity; but the moonstone, cinnamon stones, and garnets, are found in great abundance and variety.

Soil.

The natural soils of Ceylon are composed of quartzose gravel, felspathic clay, and sand often of a pure white, blended with or overlaid by brown and red loams, resulting from the decay of vegetable matter, or the disintegration of the gneiss, hornblende, and cabook formations. The whole of the great northern extremity of the island consists of a sandy and calcareous admixture made to yield productive crops of grain, tobacco, cotton, and vegetables by the careful industry of the Tamul population, who spare no pains in irrigating and manuring their lands. Between the northern districts and the elevated mountain ranges which overlook the Bintenne and Ouvah countries, are extensive plains of alluvial soil washed down from the table-lands above, and where once a teeming population produced large quantities of grain. The remains of ancient works of irrigation bear testimony to the bygone agriculture of these extensive regions now covered by pestilential swamps or dense jungle.

The general character of the soil in the maritime provinces to the east, south, and west, is sandy. Large tracts of quartzose sand spread along the whole line of sea-coast, some of which, of a pure white, and very deficient in vegetable matter, is admirably adapted to the growth of the cinnamon plant. In the light sandy districts, where the soil is perfectly free, and contains a portion of vegetable and mineral loam, the cocoa-nut palm flourishes in great luxuriance. This is the case along the entire coast line from Calpentyn to Point de Galle, and further eastward and northward to Matura, stretching to a distance inland, varying from 100 yards to 3 miles. From this light sandy belt as far as the mountain-zone of the Kandian country the land is mainly composed of low hilly undulations of sandstone and ferruginous clay, incapable of almost any cultivation, but intersected in every direction with extensive valleys and wide plains of a more generous soil, not highly fertile, but still capable, with a little industry, of yielding ample crops of rice.

The soil of the central province, although frequently containing great quantities of quartzose sand and ferruginous clay is, in many of the more elevated districts, of a fine loamy character. Sand sufficiently vegetable and light for rice culture may be seen at all elevations in the hill districts; but the fine chocolate and brown loams overlaying gneiss or limestone formations, so admirably adapted for coffee cultivation, are only to be found on the steep sides or along the base of mountain ranges at an elevation varying from 2000 to 4000 feet. Such land well timbered, contains in its elements the decomposed particles of the rocks above, blended with the decayed vegetable matter of forests that have for centuries scattered beneath them the germs of fertility. The quantity of really rich coffee land in these districts is but small as compared with the extent of country, vast tracts of open valleys consisting of an indifferent yellow tenacious soil interposed with many low ranges of quartz rock.

Botany.

The characteristics of the low-growing plants of Ceylon approach as nearly to those of the coasts of southern India as do the geological features of the island to those of the Malabar and Coromandel districts. The *Rhizophoreæ* are numerous along the low muddy shores of salt lakes and stagnant pools. The acacias are equally abundant; and the list comprises *Ægiceras fragrans*, *Epithinia malayana*, *Thesepesia populnea*, *Feronia elephantum*, *Salvadora persica* (the true mustard tree of Scripture), *Eugenia bracteata*, *Eleodendron Roxburghii*, *Cassia fistula*, *Cassia Roxburghii*, &c. &c. The herbaceous plants of the low country belong mostly to the natural orders *Compositæ*, *Leguminosæ*, *Rubiaceæ*, *Scrophularineæ*, *Euphorbiaceæ*, *and Rabiaceæ*

Ceylon.

Leaving the plains of the maritime country and ascending a height of 4000 feet in the central districts, we find both herbage and trees assume an altered character. The foliage of the latter is larger and deeper coloured, and they attain a height unknown to any in the hot low country. The herbaceous vegetation is there made up of *Ferns*, *Cyrtandria*, *Compositæ*, *Scitamineæ*, and *Urticaceæ*. The dense masses of lofty forest at that altitude are interspersed with large open tracts of coarse wiry grass, called by the natives *pattanas*, and of value to them, as affording pasturage for their cattle.

Between the altitudes of 4000 and 8000 feet, many plants are to be met with partaking of European forms, yet blended with tropical characteristics. The guelder rose, St John's wort, the *Nepenthes distillatoria* or pitcher plant, violets, geraniums, buttercups, sun-dews, ladies' mantles, and campanulas, thrive by the side of *Magnoliaceæ*, *Ranunculaceæ*, *Eleocarpeæ*, &c. The most beautiful flowering shrub of this truly alpine region is the rhododendron, which in many instances grows to the height of 70 feet. It is met with in great abundance in the moist plains of the elevated land, above Newere Ellia, flowering abundantly in June and July. There are two distinct varieties, one similar to the Neilgherry plant, having its leaves broad and cordate, and of a rusty colour on the under side: the other, peculiar to Ceylon, is found only in forests at the loftiest elevations, and has narrow rounded leaves silvery on the under side, growing to enormous heights and frequently measuring three feet round the stem. At these altitudes English flowers, grapes, herbs, and vegetables have been cultivated with perfect success, as also wheat, oats, and barley. English fruit-trees grow, but do not bear.

Timber.

The timber trees indigenous to Ceylon are met with at every altitude, from the sea-beach to the loftiest mountain peak. They vary much in their hardiness and durability, from the common cashew-nut tree, which when felled decays in a month, to the ebony and satinwood which for many years resist the attacks of insects and climate. The known woods amount to 416 varieties: of these, 33 are valuable for furniture, house, and shipbuilding, and are capable of standing long exposure to weather; 80 varieties are less valuable, though still very useful for certain purposes when not exposed to weather; 160 kinds are inferior, and used only for light common purposes, whilst the remainder are used but for firewood, or for making fences, rafts, &c. The most beautiful woods adapted to furniture work are the calamander, ebony, flower-satinwood, tamarind, nadun, dell, cadoemberge, kittool, cocoa-nut, &c.; some fine specimens of the far-famed upas tree of Java (*Antiaris toxicaria*) have been discovered in the Corregalle district of the island.

Palms.

The *Cocos nucifera*, or cocoa-nut palm, is a native of the island, and may justly be considered the most valuable of its trees. It grows in vast numbers along the entire sea-coast of the west and south sides of the island, and furnishes almost all that a Singhalese villager requires. Its fruit, when green, supplies food and drink, when ripe it yields oil. Its sap gives him toddy and arrack. The fibrous casing of the fruit when woven makes him ropes, nets, and matting. The nut-shells form drinking-vessels, spoons, &c. The plaited leaves serve as plates and dishes, and as thatch for his cottage. The dried flower-stalks are used as torches, the large leaf stalks as garden fences. The trunk of the tree sawn up is employed for every possible purpose, from knife-handles to door-posts; hollowed out it forms alike a canoe or a coffin. There are four kinds of this palm, the common, the king cocoa-nut, the dwarf, and the Maldive sorts.

The Palmyra and Areca palms grow luxuriantly and abundantly, the former in the northern, the latter in the western and central districts. The one is valuable chiefly for its timber, of which large quantities are exported to the Indian coasts; the other supplies the betel-nut in such common use amongst natives of the eastern tropics as a masticatory. The export trade in this latter to India and eastern ports is very considerable, amounting in some years to L.12,000.

Cinnamon.

Next in importance to the cocoa-nut palm amongst the indigenous products of Ceylon, is the cinnamon plant yielding the well-known spice of that name. See CINNAMON.

Fruits.

The fruits indigenous to Ceylon are few and insignificant. Others of more value have been introduced with success from various tropical and extra-tropical countries; amongst these are the citron, orange, lime, shaddock, banana, pomegranate, custard-apple, guava, grape, rambatam, alligator pear, &c.

Animals.

Foremost among the animals of Ceylon is the elephant, which though far inferior to those of Africa and the Indian continent is nevertheless of considerable value when tamed, on account of its strength, sagacity, and docility. These creatures are to be met with in greater or less numbers throughout most unfrequented parts of the interior. Occasionally they make inroads in herds upon the cultivated grounds and plantations, committing great damage. In order to protect these lands, and at the same time keep up the government stud of draught elephants, "kreals" or traps on a large scale are erected in the forests, into which the wild herds are driven; and once secured, they are soon tamed and fit for service. The oxen are of small size but hardy, and capable of drawing heavy loads. Buffaloes exist in great numbers throughout the interior, where they are employed in a half-tame state for ploughing rice-fields and treading out the corn. They feed upon any coarse grass, and can therefore be maintained on the village pasture lands where oxen would not find support. Of deer, Ceylon possesses three species of axis, and the porcine deer. The little Indian musk is common, and probably the larger musk is also found, though by some described as a deer. Hares very similar to our own are common, as are the squirrel and the porcupine, the wild boar, the bear, and the jackal. The panther is said to occur in the jungles, and the tiger was once common, but is now said by Dr Davy to be extinct in Ceylon. Among numerous monkeys the most remarkable are the purple-faced, the ouanderow, and the rollaway, with the kindred tribes of the macauco and the slow lemur. Pennant states that the two-toed sloth occurs in Ceylon, but this is considered as doubtful. One species of ant-eater is also found in this island; and on its coast the dugong is frequently seen.

Birds.

The Ceylonese birds are numerous, and many of them have splendid plumage, though, as in tropical countries generally, deficient in song. The most remarkable are the Indian roller, the oriole, the hoopoe, the pompadour pigeon, the wild pea fowl, the yellow-crowned thrush, several parrakeets, several fly catchers, the Ceylonese barbet, a pheasant with double spurs; and on the coasts the ibis, the anhinga, white snipes, and ducks are abundant in suitable localities. Crows of various species are numerous, and are protected by the inhabitants as being useful scavengers of the country; while hawks and eagles are found in the mountain districts. The hirundo esculenta, which furnishes in its edible nest the celebrated Chinese dainty, is said to build in the caves on the coast of Ceylon, and perhaps might supply an article of commerce.

Reptiles.

Serpents, according to Dr Davy, are not so numerous as generally is supposed, and most of them are harmless. The largest Ceylonese snake is the *anacondaia* of the natives, or the *Python bivittatus*—erroneously termed the boa constrictor, which is confined to America. This serpent grows to 20 or even to 30 feet. Davy describes four poisonous snakes, the Naja tripudians, or *Cobra de Capello* of the Portuguese. The next in frequency is the *Trigonocephalus hypnale*, a small irascible snake called carawilla by the natives. The *Tic polonga* or *Vipera elegans* is considered the most deadly snake of

Ceylon. the island, but is fortunately rather rare. It grows to 4 or 5 feet in length. The *Trigonocephalus nigromarginatus* is the rarest of the poisonous species, and grows to above 2 feet.

The most noted of other reptiles are the crocodile; and of the smaller Lacertidæ, *L. Iguana*, *L. calotes*, *L. gekko*, and the small flying lizard, the *Draco volans*. In the Kandian region one of the terrible pests to the traveller and to our soldiers is a very small leech that infests the swampy jungles and the banks of rivers. An interesting account of it is given by Davy. Scorpions, Scolopendræ, and huge spiders of the genera Avicularia and Mygale, are the dread of new-comers, as they often enter houses or lurk near them.

Insects exist in great numbers. Musquitoes are those which prove most annoying to Europeans, especially on their first arrival in the country. Several species of ant are common, the most troublesome of which are the large white ants which make their way through walls and floors, and in a few hours destroy every article of clothing which may be within their reach. Previous to the changes of the monsoon, vast flights of small yellow butterflies are observed passing over the island at a slight elevation, coming from the direction of the Indian continent, and going towards the ocean to the south. These swarms are often many miles in extent, and the migration will be kept up not unfrequently during several days.

Fish. A great variety of fish is met with in the rivers and bays of Ceylon, many of which are eaten by the natives alone, being coarse and full of bones. There are, however, some excellent varieties, equal at certain seasons to any fish in Europe: amongst these are a species of sole, the Labrus zeylanicus, a Scorpæna, and a country salmon called seer-fish. Large quantities of this latter, and a coarser description, are salted and dried for native consumption, the trade being very extensive. Besides these, three species of Balistes or trunk-fish occur on the coast, a curious Diodon, a large sword-fish, and the Tigrine shark.

Pearl fishery. Although the once far-famed and lucrative pearl fishery of this island has ceased since the year 1837, it will be well to give in this place a passing notice of the pearl-oyster, especially as a survey of the "banks" or beds off Aripo made in 1852 holds out promise of a good fishing at no distant date.

The banks on which these oysters are usually found, lay off the northern part of the west coast of Ceylon, at a distance of from 16 to 20 miles from the shore. They extend for many miles north and south, varying considerably in their size and productiveness. The oyster arrives at maturity in its seventh year; the pearl within is then of full growth, and if the fish be not then taken up, it will shortly die, and the pearl be lost.

The fishery, which is in the hands of the local government, took place in the month of March, when the water was perfectly calm and most favourable for the work of the divers. It was formerly rented to native speculators who paid a certain sum for the privilege of fishing with a fixed number of divers during a given period. In 1797, and the following year, the rental of the fishery realized L.123,982 and L.142,780 respectively. Since that time, the government have fished on their own account, selling the produce of each boat by auction on the beach before the fish could be examined. This mode, however, had not proved so lucrative as the old method; the annual returns never having exceeded L.87,000, and frequently falling as low as L.12,000; in some cases indeed amounting to but a few hundred pounds sterling. Various causes have been assigned for the failure of these fisheries. It may, however, be properly attributed to the mismanagement of an inspector of the pearl banks, who in 1836 took charge of them, and from neglecting to attend to the instructions given him by his predecessors, caused the wrong beds to be fished. The result was a complete failure of the fishery; the oysters which should have been brought up were left to die; young beds were disturbed, and from that time this large source of revenue has been lost to the island. A survey of the pearl banks made in March 1853 has induced the local government to look for a fishery of some extent in 1855 or the following year.

History. The island of Ceylon was known to the Greeks and Romans under the name of Taprobane, and in later times Serendib, Sirinduil, and Zeylan, have been employed to designate it by writers of the western and eastern worlds. Dib being the Sanscrit for island, Serendib is literally the island of Seren or Selen. Like most oriental countries, Ceylon possesses a great mass of antiquarian records, in which the real is so intimately and largely blended with the ideal, that the student finds it difficult to determine the respective limits of history and fable. The labours of Turnour have, however, helped to dissipate much of what was before confused and contradictory, and in his admirable translation of the "Mahawansa" we may trace the true current of Singhalese history.

The first colonization of Ceylon is by no means well ascertained, though, if we allow, as there is reason for doing, that the island was at a remote period joined to the Indian continent, it will not be difficult to conceive whence it derived its first inhabitants. In the great Hindu epic, the Ramayana, we learn of the conquest of a part of Ceylon by the hero Rama and his followers, who besieged and took the capital of its king Rawana. No permanent occupation of the country took place at this time, and the island continued to be governed by a number of petty sovereigns until the advent in 543 B.C., of Hyára an Indian prince who, arriving from the mainland with a small band of followers, succeeded in establishing himself as sole ruler of the country.

To this king is attributed the introduction of *caste* into Ceylon, an institution which, although far less rigorously observed than on the continent, is still maintained.

Under him and his successors Ceylon attained a degree of civilization scarcely to be looked for in that remote age of oriental despotism. The purity of the religious and moral code, the strict administration of justice, and the well-defined and carefully protected rights of the king and his many classes of subjects, excite our admiration not less than our astonishment. It is impossible however, to follow the subsequent current of Singhalese history through its many intricate windings. It must suffice if we say, that the descendants of Hijaya the conqueror continued to hold the reins of government with varied ability and unequal success. Some of them were distinguished for their learning, their military prowess, their benevolence, and the length of their reigns. Others lived amidst civil dissensions and foreign invasions, which not unfrequently cost them their lives. The incursions of the Malabars upon their territories were not less frequent and fatal than those of the Danes in our own country; during a period of four or five centuries, these marauders continued to pour their bands of armed men into the island; and so far had the country fallen off from its ancient prosperity and strength, that when in the year 1505 the Portuguese adventurer D'Almeida landed at Colombo, he found the island divided into seven separate kingdoms.

The first settlement of the Portuguese was effected in 1517, when Albergaria succeeded in obtaining permission from the king of Cotta, whose territories closely adjoined Colombo, to erect a small factory on the latter spot for purposes of trade. Once established, the new-comers lost no opportunity of strengthening their position and extending their intercouse with the natives. Stone walls quickly took the place of palisades, the factory became a fort; whilst bristling cannon commanded alike the approaches by land and the entrance by sea. Alarmed at these unequivocal signs of military possession, the Singhalese kings attempted to expel their newly-formed friends from the island, in which they were joined by the Moorish and other traders

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opposed to the progress of the Portuguese. But their efforts were both late and ineffectual; and after a series of unequal and sanguinary conflicts, the Europeans found themselves in secure possession of the west coast of Ceylon.

The bigotry and intolerance of the Portuguese were the constant source of dissension with the natives; and when, in the year 1601, the Dutch, under Admiral Spilbergen, landed on the east coast and sought the alliance of the king of Kandy, in the interior of the island, every encouragement was held out to them with the view of inducing them to aid in expelling the Portuguese. Nothing seems to have come of this until 1639, when a Dutch expedition attacked and razed the Portuguese forts on the east coast; and in the following year landed at Negombo, without, however, establishing themselves in any strong post. In 1643 Negombo was captured and fortified by the Dutch, and fifteen years later the fall of Colombo gave that people entire possession of the sea-board of Ceylon.

Pursuing a wiser policy than their predecessors, the Dutch lost no opportunity of improving that portion of the country which owned their supremacy, and of opening a trade with the interior. More tolerant and less ambitious of military renown than the Portuguese, they so far succeeded in their object as to render their commerce between this island and Holland a source of great profit. Many new branches of industry were developed. Public works were undertaken on a large scale, and education, if not universally placed within the reach of the inhabitants of the maritime provinces, was at least well cared for on a broad plan of government supervision.

That which they had so much improved by policy they were, however, unable to defend by force when the British turned their arms against them. A century and a half passed within seven degrees of the equator had wrought great changes in the physical and mental status of the Dutch colonists. The territory which in 1653 they had slowly gained by undaunted and obstinate bravery, they as rapidly lost in 1796 by imbecility and cowardice.

The first intercourse of the English with Ceylon took place as far back as 1766, when an embassy was despatched from Madras to the king of Kandy, without, however, leading to any result. On the rupture between Great Britain and Holland in 1795, a force was sent against the Dutch possessions in Ceylon, where so slight was the opposition offered, that by the following year the whole of their forts were in the hands of the English commander.

At first the island was placed under the care of the Honourable East India Company, but in 1802 reverted to the crown, whose dominion, however, extended no further than the maritime provinces. The central tract of hilly country, hedged in by impenetrable forests and precipitous mountain ranges, remained in possession of Wickrama Singha, the last of the Malabar dynasty of kings, who showed no signs of encouraging communication with his European neighbours.

Minor differences led in 1803 to an invasion of the Kandian territory; but sickness, desertion, and fatigue proved more formidable adversaries to the British forces than the troops of the Singhalese monarch, and peace was eventually concluded upon terms by no means favourable to the English. The cruelty and oppression of the king now became so intolerable to his subjects, that disaffection spread rapidly amongst them. Executions of the most horrible kinds were perpetrated. The utmost stretch of despotism failed to repress the popular indignation; and in 1814 the British, at the urgent request of many of the Adigars and other native chiefs, proceeded against the tyrant, who was captured near Kandy, and subsequently ended his days in exile. With him ended a long line of sovereigns, whose ancestral pedigree may be traced through upwards of two thousand years.

By a convention entered into with the Kandian chiefs on the 2d of March 1815, the entire sovereignty of the island passed into the hands of the British, who in return guaranteed to the inhabitants civil and religious liberty. The religion of Buddha was declared inviolable, and its rights, ministers, and places of worship were to be maintained and protected; the laws of the country were to be preserved and administered according to established forms; and the royal dues and revenues were to be levied as before for the support of government.

With the exception of a serious outbreak in some parts of the interior in 1817, which lasted for upwards of a year, and of two minor attempts at rebellion easily put down, in 1843 and 1848, the political atmosphere of Ceylon has remained undisturbed since the deportation of the last king of Kandy.

Government.

The affairs of the colony are administered by a governor, receiving his appointment from the crown for a period of five years. He is assisted by an executive and legislative council. The former is composed of the governor and four of the higher civil servants, and the commander of the forces; the latter is presided over also by the governor, and consists of fifteen members, nine of whom are official and six unofficial, selected by the governor from the English commercial and planting body and the native and burgher community. All legislative enactments are originated in the executive council, and must be published in the local gazette for three weeks before being adopted by the legislature, and when agreed upon require the sanction of the imperial government before they can become law.

A certain portion of the colonial expenditure is fixed by the home authorities, but a large amount is left for the votes of the legislative council. The executive of the island is carried on by a civil service, the members of which enter it at an early age, and have recently been called upon to undergo an examination in the Singhalese and Malabar dialects previous to promotion. The old routine system of rising by seniority has to a great extent been abolished, and merit professedly made the door to promotion.

The island is divided into six provinces, each having its chief and assistant government agent, who carry on the affairs of the district under the direct authority of the governor; receiving the local taxes and imposts, attending to the public highways and buildings, and seeing to the general welfare of the province. These provinces are the central or Kandian, the western, the southern, the eastern, the northern, and the north-western; which divisions are again parcelled out into minor districts, under native chiefs and headsman of various ranks, called in the Kandian country Adigars, Dessaves, and Corales, and in the maritime provinces Modeliars, Mohandirans, and Aratchies.

Justice.

The administration of justice is conducted by a supreme court of three judges, one of whom is chief justice; by district judges, by police magistrates, and commissioners of courts of request. Attached to the supreme court is a Queen's advocate, assisted by a deputy, the former having a seat in the executive and legislative councils. In each of the provinces is another deputy-advocate, who conducts the legal business of the government for the district. There is also a proctor paid by the crown to defend such prisoners as may be too poor to engage counsel.

The judges of the supreme court go on circuit twice in each year for criminal cases, as well as to hear civil appeals. Trial by jury prevails in all criminal cases, and sentence of death must be confirmed by the governor before being carried into execution.

The district judges are assisted by three native assessors chosen by rotation from the community, and have civil and limited criminal jurisdiction. The functions of the police magistrates and commissioners of courts of request assimilate to those of this country, the jurisdiction of the latter

Ceylon. extending to all cases of the value of L.50 and under. A police force, composed of natives, has been established in the towns, on the model of the London police. These men are habited in strict metropolitan garb, a dress so foreign and inconvenient as seriously to impair their efficiency.

Laws. In the central province, the Kandian law is administered under the convention of 1815, and in the maritime districts the Roman-Dutch law prevails; but in the present altered state of society in the island, there are many cases which the above fail to reach: all such are disposed of according to the law of England, which has been applied in a number of ordinances enacted by the local legislature, recently published in a collected form.

Language. The indigenous language of the island is the Singhalese, the present dialect of which is the Pali or sacred language of Ceylon, and in which all their Buddhistical annals are recorded. Singhalese is the current language throughout all the maritime provinces, except in the north and north-west, where Tamul is employed: it is likewise the dialect of the Kandian country. The Tamulian tongue is derived from the Sanscrit, and is employed by the Moors and Malabars of Ceylon, who are to be met with in great numbers on the sea-board, and who constitute almost the entire population of the northern portion of the island. The Dutch and Portuguese languages are spoken by the Burghurs or mixed descendants of the early colonists from Holland and Portugal.

Literature. The Singhalese possess an extensive literature, comprising sacred and scientific works in Pali and Sanscrit, as well as many plays and poems in their ordinary tongue. The "Mahawausa," their great historical epic, was translated from the Pali by the late Mr Turnour, and the labours of Mr Gogerly have since familiarized the reading public with Ceylonese Buddhistical literature. The Malabars possess a complete version of the Puranas in Tamul verse, besides numerous works on grammar, chemistry, pharmacy, astrology, magic, &c., and a number of tragedies and comedies. The Moors are not without works of considerable merit in the Tamul tongue, on various subjects. Their great epic poem, entitled "Seera," is pronounced by competent judges a more than ordinary composition.

Religion. The religion of Buddha is the dominant creed in Ceylon, professed by the entire population of the interior, and the greater portion of the Singhalese of the low country. Buddhism is essentially atheistic, placing belief in the eternal existence of matter alone, which matter possesses within itself the power of reproduction of beings without any other agency. Transmigration of a certain kind is a leading feature of this creed, and a series of distinct existences spent in austerities and good works has helped to form a superior order of beings called Buddhas. There have been many of these, and the last, called Sakya or Gotama Buddha, revealed the present faith. Gotama was born at Patalipatra, in India, B.C. 623; and after a long course of penance, prayer, and meditation, in strict solitude, is said to have attained his Buddhaship about B.C. 588. From India the ascetic passed to Ceylon, where he succeeded in establishing his faith, and finally died at the age of eighty.

The extensive ruins to be seen on the sites of the ancient cities of Anaradjapoora and Polonaruwa, bear testimony to the former estimation in which Buddhism was held in this island, and in some respects bear comparison with the remains of the sacred edifices of Egypt, Greece, and Rome. The Buddhist acknowledges no Supreme Being, and although we meet with a carved effigy of Buddha in almost every temple, no worship is offered to him as a deity: he is regarded but as a type of earthly goodness, wisdom, and beauty, deserving the imitation of his followers. He is believed by his perfection to have attained the sublime excellency of *Nirwana*, or cessation of existence, a state capable of being attained through many successive existences by every member of the human race. This *Nirwana* is peculiar to Buddhism, and differs from the Brahmins' absorption of the spirit into the supreme divinity. It is neither eternal repose, nor destruction of being, but a complete and final cessation of existence.

The code of morality established by Buddha is one of great purity; but since his advent the sacred writings have been so overlaid with commentaries as completely to destroy the original purity of the faith. The taking of the meanest life is strictly forbidden, while falsehood, intemperance, dishonesty, anger, pride, covetousness, are all denounced as incompatible with Buddhism. At the same time, the practice of charity, gratitude, contentment, moderation, forgiveness of injuries, patience, and cheerfulness, is as strictly enjoined.

The Buddhist priests are sworn to celibacy and poverty, and being incapable of possessing property of any kind are supposed to subsist on charity. They wear robes of yellow cotton, have their heads shaven, and walk barefooted and bareheaded. Service is performed daily in their temples, consisting of recitals of certain portions of the *Pitakas*, or Buddhist Scriptures, in the Pali dialect, which is unintelligible not only to the people but to the great majority of the priesthood. By degrees the Malabar conquerors of Ceylon incorporated the worship of Hindu deities with the simple religion of Buddha, and to most of the temples of the present day are attached buildings wherein this idol worship is carried on. Lands have been set apart from time immemorial to the support of these temples and their priests; and until a recent period annual grants for the maintenance of this religion were made by the local government, which also appointed the priests of the chief temples. This is no longer the case, and the management of the temples and temple-lands and the general affairs of their religion is now vested in the body of native chiefs and priests. At the same time, the government resigned to their custody the "Dalada," or sacred tooth of Buddha, a relic of much sanctity, and which was popularly believed to confer the sovereignty of the island upon its possessor. It had remained in charge of the British authorities since the convention of Kandy in 1815.

In the northern districts the Hindu religion prevails, the inhabitants being chiefly Malabars, who inherit from their ancestors the worship of Seeva.

Although Christianity was introduced into Ceylon as early as the sixth century, no remains of the faith or vestiges of churches were seen by the first Portuguese settlers. St Francis Xavier preached the Gospel, and permanently introduced Christianity in the middle of the sixteenth century. No efforts were spared by the Portuguese to induce the natives to embrace the Catholic religion, and they do not appear to have laid much stress upon the sincerity of their converts, who flocked to their churches in great numbers. The Dutch were equally zealous in the spread of the Reformed faith, but evidently with far less nominal success than their predecessors. The simplicity of the Presbyterian form of worship is but ill calculated to make any strong impression upon the senses of Oriental races; whereas the relics and ceremonies of the Romish Church appeal so warmly to their imagination, and have been made to approach so nearly to their own heathen ritual as even to insure a favourable reception amongst them.

Ceylon has recently been erected into a see, the junior bishop being Dr Chapman, who is assisted by an archdeacon and a number of chaplains, stationed at the chief towns. There are likewise a Scotch chaplain, a Dutch Presbyterian chaplain, and Malabar and Singhalese chaplains, appointed and paid by the government; the annual grants for ecclesiastical purposes amounting to about L.8000. There are besides these, clergymen of various Christian denominations employed as missionaries and teachers by the Society for

Ceylon.

the Propagation of the Gospel, the Church Missionary Society, the Wesleyan and the Baptist Missionary Societies.

Caste.

Although *caste* formed no part of the institutes of Buddha, it has been generally adopted, and the Singhalese, equally with the Malabars and Moors, divide themselves into four great divisions, viz., the rajahs or princes, the priests, the merchants, and the labourers. In this latter class there are not fewer than twenty-four castes, the lowest of whom are the rhodias or outcasts. The Malabars, besides the three chief divisions of priests, merchants, and landlords, have twenty-eight lower orders of persons. Between all of these there is much jealousy, intermarrying being considered a disgrace to the family of the higher caste; still this sometimes happens, and on the whole there is a gradual weakening of these barriers of native society, attributable to the spread of education and the civilizing influence of European residents.

Character.

The character of the Singhalese of the low and hilly country, if presenting no very pleasing traits, at least possesses nothing very repulsive. The religion of Buddha is not disgraced by rites such as render Hinduism so debasing to the mind of its followers; its mildness is reflected in the Singhalese disposition, wherein may also be traced the chilling apathetic influence of the creed of *Nirwana*. The most detestable vice is that of falsehood, which appears to have taken such a deep root in the native character as to bid defiance to teaching or example. Industry is a quality extremely rare amongst them; they are good agriculturists, but are averse to trade, the whole of which is in the hands of Burghurs, Tamuls, Moors, and other foreigners. There is a desire for improvement springing up amongst the Kandian and low country chiefs, and modeliers, who evince a great desire to send their sons to the government schools. This feeling, however, has not yet reached many below them.

Crime.

The criminal statistics of Ceylon show some remarkable results. Of 539 prisoners in one year, 368 only were brought to trial, and of those not more than 158 were convicted. Amongst these there were but two females, and not a single Burghur. Of this number 9 were found guilty of murder, 8 of manslaughter, 27 of other offences against the person, and 111 of offences against property. In the central province the prisoners were found in the following proportions:—Buddhists 100, Mohammedans 10, Roman Catholics 2, Protestants 2. In the northern province, the figures were Gentoos 95, Buddhists 5, Mohammedans 2, Roman Catholics 7, Protestants 1.

Education.

The educational work, so admirably begun by the Dutch colonists of Ceylon, although for a long period neglected by the early English governors, has been actively followed up during the past fifteen years. Convinced that the surest means for rooting out the atheistic heathenism of the natives is by the diffusion of sound knowledge, and that Christianity will often work its silent way through the printing-press when making no progress from the pulpit, the missionaries of all classes have laboured sedulously in the establishment of schools for instruction in English and the native tongues. Government money-grants are made to aid the various missionary schools which are conducted in union with, and on the model of those maintained by the authorities. For carrying out this aid as well as for supervising the educational establishments of the government, a "school commission" has been formed of clerical and lay members of various churches who make an annual report upon the progress of education throughout the island.

The government scholastic institutions comprise the Colombo Academy, consisting of an upper and a lower school, to which pupils are admitted on payment of very small fees, a normal training school at Colombo, English schools of good standing at Kandy, Galle, Trincomalee, and Jaffna, and upwards of eighty other schools chiefly mixed and vernacular. In 1846–7 the number of pupils in the Colombo Academy was 252, whose education, after deducting the monthly fees paid by the scholars, cost the government L.4, 10s. each. Since that period the fees were raised to thrice their former amount, the effect of which was that in 1851 there were but 19 pupils in the academy, costing each L.26, 10s. The students in the normal institution cost L.18, 10s. each; those of the central school at Galle cost L.8, 19s. 9d. each; and those at the Kandy school cost L.2, 16s. The scholars at the vernacular establishments cost annually but nine shillings each.

Ceylon.

The Church Mission have principal stations at Cotta, Baddegamme, Kandy, and Nellore. At two of these places they board and educate a number of youth of both sexes gratuitously, and at Cotta they impart a very superior education to young men and women to qualify them for missionary and scholastic labours. The American missionaries have similar establishments in the northern province, where a most complete education in the English tongue is bestowed upon upwards of 150 Tamul students of both sexes. The Wesleyan and Baptist missions are equally active throughout the island, chiefly, however, in vernacular education. In addition to these there are some regimental schools, and upwards of 900 village seminaries, mostly of a very inferior grade, in which it would be difficult to ascertain that anything really useful is taught. From the majority of these no returns exist by which we can judge of the number of their pupils.

The latest educational returns published show that in 87 government schools there were 1721 boys and 580 girls; in 314 missionary schools there were 8660 boys and 2320 girls; and in 263 private schools, mostly native, the pupils numbered 4912 boys and 64 girls: giving a total of 15,293 boys and 2965 girls, a result which shows that whilst of males 1 in every 98 of the population is being educated, of females the proportion to the whole population is not more than 1 in 500. The government expenditure in aid of education was, in 1852, L.7526, 10s. 5d.

Arts and sciences.

The fine arts have no existence in Ceylon, and the sciences, though not unknown, are in the lowest possible state. Singhalese astronomy is little else than astrology, whilst the native medical science is so overlaid with senseless theories and superstitions, so compounded of absurdities and contradictions, as to be wholly unintelligible to European practitioners.

Manufactures.

Although the Singhalese of the low country are by no means deficient in mechanical skill, as carpenters, cabinet-makers, wheelwrights, smiths, carvers on wood and metal, &c., they cannot be said to be a manufacturing people. Their cotton cloths, coir rope, and cocoa-nut oil, were all produced in the most primitive manner and with little doubt by precisely the same rude methods as were employed a thousand years ago.

The manufacture of coarse cotton towelling, table-linen, and other white goods, is carried on along the east, north, and north-west coasts, whilst the make of coloured goods is chiefly confined to the vicinity of Jaffna in the north. There are about four thousand looms in the island, each of which on an average will produce about L.3 to the weaver, who is in most cases of the Chalia caste. The towels made at Batticaloe are remarkably good and very durable, the best being made from native cotton. Dyeing is practised, but in a very slow and indifferent manner. Some of the best white cloths worn by native headmen are elaborately and neatly painted by hand, in a variety of picturesque patterns, and sell for several pounds sterling each.

It would be difficult to conceive any ruder method of making rope than that practised in a Singhalese rope walk, which is usually a long strip of open ground, shaded from the noon-day heat by lofty palm trees. When the coir fibre is of good quality, and the work-people are attentive, a very fine and serviceable rope is produced, admi-

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rably adapted for use in salt water. The country trading vessels employ no other cordage or rope than this, and indeed the planks of their small vessels are held together solely by coir yarn, without the aid of a single nail. The quantity exported from the island to all parts in 1850 amounted to 32,308 cwts., and in 1851 to 28,204 cwts.

The Singhalese mode of extracting the oil from the dried kernel of the cocoa-nut is of the most primitive kind. The *checkoo* or native mill is simply a clumsy wooden mortar in which a heavy pestle of hardwood is made to revolve by means of a pair of oxen at the end of a long pole, secured to the upper part of the pestle. The dried kernel being placed, finely cut, within the mortar, is by slow degrees squeezed free of its oil, which collects in the lower part of the mortar, and is thence removed by cocoa-nut shells. There are about five hundred checkoos at work during most part of the year at Colombo, Negombo, Galle, Trincomalee, and other chief towns, but chiefly at the three former places. Each checkoo usually produces above one gallon of oil per diem. Steam-power is employed in Colombo by European merchants in manufacturing this oil, which is now produced by them of superior quality, and in large quantities. The shipments of cocoa-nut oil from the ports of Colombo and Galle amounted in the year 1850 to to 792,791 gallons.

Agriculture.

The Singhalese are more attached to the pursuit of agriculture than any other occupation; and although their implements are of the rudest kind, and their processes the most simple, they nevertheless succeed in rearing successive crops of grain of good quality, from soil of no very great fertilizing powers. The chief culture in every part of the island is that of rice, the staple food in all eastern countries. The comparative poverty of the soil in the maritime districts is a barrier to the extensive production of grain; added to which the decay of the ancient works of irrigation in the eastern, northern, and north-western provinces, so essential to rice cultivation, renders large tracts of land which were formerly highly productive utterly valueless. In the western and southern provinces the presence of numerous rivers, canals, and lakes, enables cultivators to produce alternate crops of various kinds. In the Kandian country the soil is more generous, the climate less exhausting, and the supply of water from hill-streams far more certain and abundant. The agriculturists of those regions are thus frequently enabled to raise two crops of rice within the year from the same ground. Not only is every valley and open plain capable of tillage made to yield its crop of grain, but the steep sides of lofty hills are cut into terraces from base to summit, on which may be seen waving patches of bright green rice watered by mountain streams, conducted often from a great distance by means of earthen water-courses and bamboo aqueducts, stretching across rivers and over deep valleys, from hill to hill, attesting at once the patience, the industry, and the skill of the simple Kandian villagers.

Rice.

When the ancient monarchs of Ceylon held their imperial court at the now ruined city of Anarajaphorra, the busy hum of agricultural industry was heard from the confines of Bintenne to the northernmost point of the island. Artificial tanks and embankments for the supply of water equal in extent to the present areas of London, Liverpool and Manchester, imparted fertility to a region now known but as one vast desert. In those remote times, with a population of three or four millions, Ceylon was able to export large quantities of rice as her surplus production. Since the European period, with a population of barely a million and a half, the island, unable to grow sufficient for its own wants, has been in the habit of importing grain to the annual value of a quarter of a million sterling. There are eleven varieties of rice grown, of which five are sown in March and reaped in July; four are sown in May and gathered early in August, whilst two kinds are sown in June and November, one requiring five and the other two months to arrive at maturity. The yield of crops varies from four-fold in poor sandy soils to forty-fold from rich land. Many superstitions are observed by Singhalese cultivators, both in preparing the ground, sowing the seed, and harvesting the crop.

Tobacco.

Tobacco is extensively cultivated in Jaffna, Negombo, and some parts of the Kandian and Buah country; but although well grown it is imperfectly cured and is not of much value as an article of export. Cotton has long been a product of some importance to the villagers, who, however, grow it only for their own consumption, and thus it is not found in the list of exports. There are many other vegetable productions reared with more or less skill for local use, such as arrow-root, cassava, yams, chillies, and several varieties of pulse. Of these the only exportable item is the *chili*, a small species of capsicum.

Cotton.

Cinnamon.

The export trade in cinnamon will be found noticed under CINNAMON.

Coffee.

The most important cultivation is that of coffee, a branch of industry which, since the year 1841, has assumed a position of great and growing prominence. Coffee was an article of growth and export from Ceylon so far back as the time of the Portuguese, but like the cinnamon it grew wild without any attempt at cultivation. Patches of it were to be seen around the Kandian villages in wild luxuriance, and the berry gathered before ripe, and imperfectly cured, seldom possessed much flavour, and was lightly esteemed as an article of European commerce. Coffee cultivation on the West Indian plan was first commenced by Sir E. Barnes, the then governor of Ceylon in 1824, who hoped by his example to introduce coffee-planting by Europeans into the island. Until 1834, however, public attention does not seem to have been occupied with the subject, but in that year the falling off in the supplies from other quarters brought capitalists into the field, and when in 1836 the home duty on East India coffee was reduced to 6d. the lb. a great impulse was given to coffee planting in Ceylon. During that and the following year about 7000 acres of forest land were purchased for this object; and when at the end of a few years it became matter of notoriety that the soil and climate of Ceylon were capable of yielding a coffee equal in value to most kinds, the influx of capital from England for investment in this new branch of Ceylon industry became very great. The following quantities of crown land were thus disposed of during the periods indicated:—in 1840, ac. 42,841; in 1841, ac. 78,685; in 1842, ac. 48,533; and in 1843, ac. 58,336. Since that time the sale of land has sunk to a very low amount, owing to apprehensions as to the effect of free trade on the coffee market.

There are at the present moment about 300 estates under coffee culture, comprising in the aggregate 40,000 acres. Of these 35 are of 300 acres and upwards; 230 under 300 and above 100 acres; and 35 of less than 100 acres. The heaviest yield upon any estate has been one ton per acre, but few plantations exceed 15 cwts. the acre, and the majority of them are far below that return. The heaviest shipments in any year, those of 1853, give but 250,000 cwts. of plantation coffee, which being the produce of the 40,000 acres of planted land, shows an average of not more than $6\frac{1}{4}$ cwts. per acre. An annual yield of 10 cwts. per acre is considered a very favourable return for the capital invested.

The commercial crisis of 1847 gave a great check to coffee planting in Ceylon, and added to the extravagant outlay and ill-judged operations of previous years, caused the abandonment of some estates and the neglect of many others. The economy thus taught has been productive of much good, and at the present time plantation coffee is shipped at Colombo of better quality and 20 per cent. below the cost of crops seven years since. An estate of 300 acres may now be cleared, planted, and brought into bear-

ing for L.4000, exclusive of the cost of land, which ranges from L.1, 5s. to L.6 the acre.

The labour on coffee estates is performed by Malabar coolies, who annually emigrate from the coasts of India in large numbers; about 40,000 are usually employed in this manner at one time. The superintendence of the plantations is entirely in the hands of Europeans, who receive salaries varying from L.300 to L.100 a-year. The labour is paid for at the rate of 18s. a-month. The blossom appears in February. In October the gathering of the crop commences on most estates, and by the end of December the whole will be off the trees, when pruning at once takes place. The crops are partially dried on the plantations, but the curing is completed in Colombo, and by the end of May very little coffee remains for shipment. It is packed in casks of from 6 cwts. to 8 cwts. each; a very small quantity going in bags. The native grown crop, however, still goes home in the latter packages.

Sugar.

The cultivation of sugar was commenced in the neighbourhood of Kandy in 1836, and since in several other parts of the island, but without any permanent success, and there is now not more sugar grown than can be consumed in the island.

Cocoa-nuts.

Cocoa-nut planting has proved very lucrative to some English capitalists, but owing to the slow growth of the tree this has never been a very favourite investment. The land planted by Europeans with cocoa-nuts has been as follows:—in the northern province 5000 acres; western province 4000 acres; eastern province 2000 acres; southern province 800 acres: this extent is included in 104 plantations chiefly superintended by Europeans. The palm tree begins to yield in its fifth year, and does not come into full bearing before its tenth or eleventh year.

Commerce.

The trade of Ceylon has been greatly augmented since the opening of the cinnamon trade and the commencement of coffee planting. In 1832 the imports amounted to L.351,222; the exports to L.163,587. In 1842 the imports and exports amounted to L.622,447 and L.421,413 respectively. In 1852 those amounts were L.1,000,474 and L.948,400. The largest increase in exported produce has been in coffee, which from 17,287 cwts. in 1831 grew to 77,475 cwts. in 1841, and to 287,910 cwts. in 1851. In 1854 the crops of native and plantation kinds are expected to amount to 500,000 cwts.

The cinnamon trade of Ceylon forms a remarkable exception to the rule that by the removal of fiscal restrictions the consumption of articles will be increased. Cinnamon is now exported from Ceylon duty free, yet the annual demand for the spice is found to be no greater than when burdened with an export duty of 3s. the lb.

When the island was transferred from the administration of the East India Company to that of the crown in 1802, the government entered into a contract with the company, by which the latter acquired the exclusive privilege of exporting cinnamon from the colony. It was agreed that the Ceylon government should deliver annually 400,000 lb. of cinnamon; for which the company was to grant a credit of L.60,000, making the price of the cinnamon 3s. per lb.

In 1814 the company agreed to allow to the Ceylon government a sum of L.200,000 sterling for surplus profits on their sales of cinnamon; and to give in future, L.101,000 sterling annually, instead of L.60,000, for a supply of 400,000 lb. of that commodity. This contract was entered into for seven years, and it does not appear that during this period the stipulated quantity of cinnamon was ever delivered. In 1821 the exclusive privilege of exporting cinnamon was given up by the company; and in 1833 the government abandoned their monopoly of the trade, throwing it open to the public, but levying a duty of 3s. per lb. on its exportation.

In 1835 inferior or third sort was allowed to be shipped on payment of 2s. the lb. Two years later the duty on the best sorts was lowered to 2s. 6d.; and in 1843 the duty on all kinds was fixed at 1s. It was since reduced to 4d.; and in 1853 the article was declared duty free. These periodical reductions of duty were in all cases followed by heavy shipments of the spice; the sole effect of which has been to overstock the European markets, and reduce its price beyond the reduction of duty. The annual European consumption is at the present time precisely what it was fifty years ago; thus proving that articles of mere luxury are not affected by the laws which govern the consumption of the necessaries of life. Of the exports, four-fifths are to Great Britain; of the imports, one-third is from the United Kingdom, and the remainder chiefly from India. The imported goods from Great Britain consist of cotton manufacture, glass-ware, hardware, millinery, hosiery, metals, tools, beer, wines, &c.; those from India are mainly rice and coarse cotton cloth. The exports to Europe being larger than the imports thence, the balance of value is drawn for by bills of exchange, a part of which are negotiated in India to pay for rice, the rest for rupees sent down to Ceylon to pay the Malabar coolies on the coffee estates, who carry three-fourths of their earnings out of the island.

The trade of Ceylon is carried on by upwards of twenty European firms, and eight or nine native houses; the latter confining their transactions to British India. Besides these, there are nearly a dozen European estate-agents in Kandy, and a great number of small native dealers, called "Chitters," in connection with Madras and Bombay firms.

There are no export duties, and the duty on imports is five per cent. on the declared value, with some few exceptions, such as arms, wines, spirits, and grain. In 1852 the revenue derived from customs duties was L.121,354, 8s. 9d.

The coasting and Indian trade is carried on by country-built brigs and dhomies, a craft peculiar to Ceylon. Of the former there are 56 of 3176 tons in the aggregate, and 559 dhomies, of a tonnage equal to 24,270 tons, belonging to the island. The value of the former is L.6 per ton, and of the latter L.1 per ton. In 1836 the custom-house shipping entries gave 1331 vessels inwards, and 1200 outwards; in 1852 they gave 3140 inwards, and 3074 outwards.

Banking.

The banking business of the island is conducted by branches of the Oriental Bank Corporation of London, and the Mercantile Bank of Bombay in Colombo and Kandy. The former establishment possesses the privilege of issuing notes of 10s. and upwards.

Revenue and expenditure.

Although the figures composing the revenue of Ceylon, as compared with former years, would appear to be unfavourable, they are nevertheless not so when it is remembered that upwards of L.150,000 once derived from the pearl fishery and cinnamon monopoly are no longer available. In 1821 the revenue was L.459,699; in 1831 it was L.420,170; in 1841 it was L.341,937; and in 1852 it was L.411,806.

An analysis of the income and expenditure for 1848 gives the following results: Expenditure—civil, L.177,673; military, L.75,219; judicial, L.65,224. Revenue, L.58,480; ecclesiastical, L.10,806; educational, L.9873; pensions, L.34,100; total, L.431,325. Income: Taxes on food, salt tax, import duties, grain tax, &c., L.156,108; excise and stamps, L.91,143; customs duties except on food, L.43,345; tolls, L.20,571; total taxation, L.311,167; sales of crown lands, government property, rations to troops and arrears, L.103,589; total income, L.414,756. A further analysis of the above shows that the proportion contributed by the Singhalese population of 1,491,000, is at the rate of 2s. 2d. for each individual per annum, which is paid by the various districts in the following ratio: Western province, 3·80; central province, 2·20; southern province, 1·40; northern province, 1·10; north-western province, 1·0; eastern province, 0·50. (*Parl. Papers on Ceylon*, 1848 *to* 1852;

Sir J. E. Tennent's Report on State of Ceylon, 1846; *Knighton's History of Ceylon*, 1845; *Gazetteer of Ceylon, by S. C. Chitty; Sir J. E. Tennent's Christianity in Ceylon; Journals of Asiatic Society of Ceylon*, 1846 *to* 1851; *Ceylon Magazine*, 1847; *Reports of School Commission; Ceylon Examiner*.) (J. C—R.)

CHABLIS, a town of France, on the Seray, department of Yonne, arrondissement and 10 miles east of Auxerre. It gives name to a celebrated white wine produced in the vicinity. Pop. 2500.

CHABRIAS, a celebrated Athenian general, who first assumed the command about the year B.C. 392. He defeated the Spartans at Ægina (B.C. 388), and again at Naxos (B.C. 376). With Iphicrates and Callistratus he commanded at Corcyra, and repulsed Epaminondas before the walls of Corinth. In 366 B.C. he was charged with treachery in advising the surrender of Oropus to the Thebans, and is said to have been defended by Plato. His unpopularity on this account led him to prefer a foreign command under Tachos, king of Egypt, who had revolted from the Persians. On the breaking out of the Social War (B.C. 357), Chabrias assumed the command of the Athenian fleet, and fell fighting in his ship, which had rashly penetrated the harbour of Chios. He was famous for the invention of a manœuvre, which consisted in receiving a charge on the left knee, with the spears of the front ranks pointed against the enemy, and the shields resting on the ground. For this invention a statue was erected to his honour at Athens, in which he is represented in the position described.

CHÆRONEIA, a Bœotian town on the Thermodon, a small tributary of the Cephissus, near the borders of Phocis. It is celebrated in history as having been the scene of three great battles, the first (B.C. 447) in which the Athenians were defeated by the Bœotians; the second (B.C. 388) in which Philip defeated the confederate forces of the Athenians and Bœotians; and the third (B.C. 86) in which Sulla defeated the generals of Mithridates. A tumulus still visible near the site of the modern Kapurna, marks the grave of the Bœotians who fell in the second of these engagements, and in the village itself are some remains of an ancient citadel, and a theatre excavated out of the rock on which the citadel was built. Chæroneia was the birthplace of Plutarch.

CHAFERY, a forge in which an ancony or square mass of iron, hammered at the finery into a bar in the middle, is reduced to a complete bar by hammering down the rough ends to the shape of the middle part.

CHAFFINCH. See Index to ORNITHOLOGY.

CHAGRES, a river and town. See PANAMA.

CHAIN, a series of rings or links connected or fitted into one another.

CHAIN, in surveying, a measure of length, composed of a certain number of links made of iron wire. Gunter's chain, which is that commonly used in measuring land, contains 100 such links, each of $7\frac{92}{100}$ inches; consequently it is equal to 4 poles or 66 feet.

CHAIN-BRIDGES. See IRON BRIDGES.

CHAIN-PUMP. See HYDRODYNAMICS, chap. iii.

CHAIN-SHOT, two balls connected together by a chain, and used at sea to cut down masts, and destroy the shrouds and rigging of a ship.

CHAISE, a sort of light open chariot, or calash. Aurelius Victor attributes the first introduction of post-chaises to Trajan; but it is generally ascribed to Augustus, and was probably only improved by Trajan.

CHALAZÆ (χαλαζαῖος, knotted), a name applied to the two knotty chords attached to near the poles of the yolk of an egg; being a plexus of the fibres of the membranes, connecting the yolk and white together, and serving to maintain the yolk in such a position that the cicatricula shall always be uppermost, and consequently nearest the source of heat during incubation.

CHALCEDON, or rather CALCHEDON, a maritime town of Bithynia, called also PROCERASTIS and COLPUSA, directly opposite Byzantium. It was founded by a colony from Megara, on a site so obviously inferior to that which was within their view on the opposite shore, that it received from the oracle the name of the *The City of the Blind*. In its early history it shared the fortunes of Byzantium, was taken by the satrap Otanes, vacillated long between the Lacedæmonian and Athenian interest, and at last fell into the hands of the kings of Bithynia, by the last of whom it was bequeathed to the Romans. It was taken and partly destroyed by Mithridates, but recovered during the empire. It fell under the repeated attacks of the barbarian hordes, who crossed over after having ravaged Byzantium, and furnished an encampment to the Persians under Chosroes. Its ruin was completed by the Turks, who used it as a quarry from which to draw the building materials for Constantinople. At Chalcedon was held the fourth general council (A.D. 451), which condemned the heresy of Eutyches.

CHALCIDIUS, a famous Platonic philosopher, who probably flourished during the sixth century. He was the author of an esteemed commentary on the Timæus of Plato, which Meursius edited and printed at Leyden in 1617, 4to, and which J. A. Fabricius has inserted at the end of the second volume of the works of St Hippolytus, Hamburg, 1718, fol. Critics are divided in opinion respecting this author. Fabricius asserts that he was a Christian; and Giraldi supposes that he was even a deacon of the church at Carthage. But the Abbé Goujet, in his dissertation inserted in the first volume of the *Mémoires de Littérature*, maintains the contrary opinion, on the grounds that Chalcidius adopts the opinions of Plato, doubts the inspiration of the books of Moses, and speaks of the dogmas of Christianity with indifference, or at least without indicating whether he believed them or not. Mosheim and Brucker, however, place him among the syncretist or eclectic philosophers, who amalgamated the philosophy of Plato with the doctrines of Christianity. It is the opinion of Mosheim that he never professed Christianity; Brucker again is of a contrary opinion, and says that he shared the errors of Platonism in common with many whose Christianity was never questioned.

CHALCIS. See NEGROPONT.

CHALCOCONDYLES, or CHALCONDYLES, a Byzantine historian of the fifteenth century, who was present as the ambassador of John VII. (Palæologus) during the siege of Constantinople, A.D. 1446. His history is divided into ten books, and contains many curious episodes in regard to the then condition of the European states, including descriptions of Germany and England.

CHALDEA. See BABYLONIA.

CHALDÈE LANGUAGE, a dialect of the Hebrew. See LANGUAGE.

CHALDEE *Paraphrase*. See SCRIPTURE, sect. x.

CHALDRON, an English dry measure, = 36 bushels.

CHALICE (κύλιξ, a cup), the cup used to administer the wine in the sacrament. The use of the chalice is by the Church of Rome denied to the laity, who communicate only in one kind, the clergy alone being allowed the privilege of communicating in both.

CHALET, the Swiss name for the houses of the peasants, and for the huts erected to shelter cattle in the mountains.

CHALK (from *calx*), in Latin called *creta*, a species of carbonate of lime, found abundantly in Britain, France, Norway, and other parts of Europe. The island of Candia is said to have received its ancient name of *Creta* from the quantity of chalk found there. Chalk is used as an antiacid; and from the readiness with which it imbibes liquids,

it is much employed as an absorbent. When powdered and freed from gritty particles by washing, it forms the substance called *whitening*, or Spanish white, used to polish metalline utensils and glass. It is simply prepared as follows: mix chalk that has been well triturated with a large quantity of water, allow the silicious and ferruginous particles to subside, and then decant the supernatant fluid into a very fine sieve or linen bag, where the whitening will be deposited.

Black CHALK, a mineral used by artists for drawing. It is a variety of bituminous shale, the *schiste-graphique* of Haüy.

French CHALK, steatite or soapstone, a hydrated silicate of magnesia and alumina. It occurs of several colours, as white, brown, green, &c.; and is used in the preparation of crayons, the manufacture of porcelain, for polishing marble, and as the basis of certain cosmetic powders.

Red CHALK is an indurated clayey ochre used for similar purposes. It is *reddle*, or earthy clay-ironstone of the mineralogist.

CHALK-*Formation*. See GEOLOGY.

CHALK STONES, the name given to the concretions which occur in the joints of persons who have long suffered from gout. These consist of urate of ammonia, but were once supposed to be of a chalky nature, and thence acquired the above name.

CHALLENGE (Norman *calenge*, an accusation), a cartel or invitation to a duel or combat. See DUEL.

CHALMERS, ALEXANDER, (1759–1834,) an eminent biographer, was a native of Aberdeen. His first literary performances were contributions to several London periodicals, and he was for some time editor of the Morning Herald. Besides editions of the works of Shakspeare, Beattie, Fielding, Johnson, Warton, Pope, Gibbon, Bolingbroke, and others, he published *A General Biographical Dictionary* in 32 vols.

CHALMERS, *George*, an historical, antiquarian, and political writer of considerable eminence, was descended from the family of Chalmers of Pittensear, in the county of Moray, and was born at Fochabers in the end of the year 1742. After completing his academical course at King's College Aberdeen, he removed to Edinburgh, where he studied law for several years. In 1763, he went to America to assist in recovering a considerable tract of land in Maryland. His prospects in America induced him to settle as a lawyer at Baltimore in Maryland, where he continued to practise successfully till the outbreak of the disputes between the two countries, which ended in the establishment of American independence. He espoused and advocated the cause of the Royalist party against the ablest of their opponents; but public opinion was so decidedly engaged on the opposite side, that he soon found it expedient to abandon all his professional prospects, and seek refuge in his native country. For the losses he had sustained as a colonist he received no compensation, and several years elapsed before he obtained an appointment which placed him in a state of comfort and independence.

In the mean time Mr Chalmers applied himself with great diligence and assiduity to the investigation of the history and establishment of the English colonies in North America; and enjoying free access to the state-papers, and other documents preserved among the plantation records, he obtained much original and important information. His work entitled "Political Annals of the present United Colonies, from their Settlement to the Peace of 1763, &c.;" 4to, London, 1780, was intended to have formed two volumes; but the second, which should have contained the period between the British revolution of 1688 and the peace of 1763, never appeared. The first volume, however, is complete in itself, and traces the original settlement of the different colonies, and the progressive changes in their constitutions and forms of government, as affected by the state of public affairs in the parent kingdom. Independently of its value as being compiled from original documents, it bears evidence of great diligence and research, and it has been of essential benefit to later writers.

In August 1786 Mr Chalmers was appointed chief clerk to the committee of privy-council, on matters relating to trade and foreign plantations, and continued to discharge its duties for nearly forty years. During this period he wrote most of those numerous pieces of which a list will be found at the close of this article, and devoted himself to the illustration of the antiquities and topography of Scotland.

Most of his minor pieces it is not necessary to mention particularly. His life of Ruddiman throws considerable light on the state of literature in Scotland during the earlier part of the last century; but is too stately and inflated in style. His volumes on the Shakspeare controversy are full of curious matter, but on the whole display a great waste of erudition in the attempt to show that papers which *had* been proved forgeries *might* nevertheless have been genuine. Neither was he more fortunate in fixing the authorship of Junius' Letters on Hugh Boyd. His editions of Sir David Lyndsay and Churchyard are valuable and curious. His Life of Queen Mary is founded on a MS. left by the Rev. John Whitaker, the historian of Manchester; but he informs us that he found it necessary to "rewrite the whole." The history of that ill-fated queen occupied much of Mr Chalmer's attention. One of the latest acts of his life was to expose an attempt to resuscitate some fictitious love-letters said to have passed between Mary and Bothwell, and which had fallen into deserved oblivion.

But Chalmers's greatest work is his "Caledonia." It is divided into four books, treating successively of the Roman, the Pictish, the Scottish, and the Scoto-Saxon periods from A.D. 80 to 1306. In these books there is presented, in a condensed form, an account of the people, the language, the history civil and ecclesiastical, and the agricultural and commercial state of Scotland, during the first thirteen centuries of our era. Between the publication of the 2d and 3d vols. an interval of fourteen years elapsed, and in the preface to the latter volume the author announced his expectation that the work would be completed in two years. This expectation, however, was not destined to be realized.

Besides the "Caledonia," Mr Chalmers had for many years been engaged in collecting materials for other works of not less important and laborious a nature. One of these works was a *History of Scottish Poetry*; another a *History of Printing in Scotland*. Each of them he thought likely to extend to two large quarto volumes, and on both he expended an unusual amount of enthusiasm and energy. He had also prepared for the press an elaborate history of the Life and Reign of David I., who died in 1153. In his later researches he was ably assisted by his nephew Mr James Chalmers.

Mr George Chalmers died at his house, James' Street, Buckingham Gate, London, May 31, 1825, after a few days illness, in the eighty-third year of his age. He was a member of the Royal and Antiquarian Societies of London, an honorary member of the Antiquarian Society of Scotland, and of other learned societies. In private life he was undoubtedly an amiable man, although his writings are disfigured by a dogmatic and presumptuous tone which procured him many opponents. He is besides chargeable with a want of taste, and inaccurate scholarship, which appears too prominently in his keen attempts to silence, at all hazards, those whom he considered the detractors of Mary. Among his avowed antagonists in literary warfare the most distinguished were Malone and Steevens, the Shakspeare editors; Mr Mathias, the author of the Pursuits of Literature; Dr Jamieson, the Scottish lexicographer; Mr Pinkerton, the historian; Dr Irving, the biographer of the Scottish poets; and Dr Currie of Liverpool. But with all his failings in judgment and in matters of taste, Mr Chalmers was a valuable writer. He

uniformly had recourse to original sources of information; and his patriotic endeavours to illustrate the history, literature, and antiquities of his native country, attended as they were by very great pecuniary sacrifices, deserve our gratitude and esteem.

The following is a list of his works:—1. *Life of Daniel De Foe*, prefixed to an addition of his *History of the Union*, Lond. 1786; and of *Robinson Crusoe*, 1790, 8vo. 2. *Life of Sir John Davies*, prefixed to his Historical Tracts regarding Ireland. Lond. 1786, 8vo. 3. *Collection of Treaties between Great Britain and other Powers*. Lond. 1790, 2 vols. 8vo. 4. *Life of Thomas Paine*, the author of *Rights of Man*. (Tenth edition), Lond. 1793, 8vo, published under the assumed name of "Francis Oldys, A.M. of the university of Pennsylvania." 5. *Life of Thomas Ruddiman, A M.;* to which are subjoined *New Anecdotes of Buchanan*. Lond. 1794, 8vo. 6. *Prefatory Introduction to Dr Johnson's Debates in Parliament*. Lond. 1794, 8vo. 7. *Vindication of the Privilege of the People in respect to the constitutional right of Free Discussion, &c.* Lond. 1796, 8vo. (Anonymous.) 8. *An Apology for the Believers in the Shakspeare Papers, which were exhibited in Norfolk Street*. Lond. 1797, 8vo. 9. *A Supplemental Apology for the Believers in the Shakspeare Papers, &c.* 1799, 8vo. 10. *Appendix to the Supplemental Apology*. 1800, 8vo. 11. *Life of Allan Ramsay*, prefixed to an edition of his Poems. Lond. 1800, 2 vols. 8vo. The *Remarks on Ramsay's Poetry*, prefixed to this edition, were from the pen of the late Lord Woodhouselee. 12. *Life of Gregory King*, prefixed to his *Observations on the State of England in* 1696. Lond. 1804, 8vo. 13 *The Poetical Works of Sir David Lyndsay of the Mount, with a Life of the Author, Prefatory Dissertations, &c.* Lond. 1806, 3 vols. 8vo. 14. *Caledonia, or an Account, Historical and Topographic, of North Britain, &c.* 2 vols. Lond. 1807–1810, 4to. 15. *A Chronological Account of Commerce and Coinage in Great Britain, from the Restoration till* 1810. Lond. 1810, 8vo. 16. *Considerations on Commerce, Bullion, and Coin, Circulation and Exchanges, &c.* 1811, 8vo. 17. *An Historical View of the Domestic Economy of Great Britain and Ireland, from the earliest to the present times, &c.* (being a new edition of the *Comparative Estimate*). Edinb. 1812, 8vo. 18. *Opinions of eminent Lawyers on various points of English Jurisprudence, chiefly concerning the Colonies, Fisheries, and Commerce of Great Britain*. Lond. 1814, 2 vols. 8vo. 19. *A Tract* (privately printed) *in answer to Malone's Account of Shakspeare's "Tempest."* Lond. 1815, 8vo. 20. *Comparative Views of the State of Great Britain and Ireland before and since the War*. Lond. 1817, 8vo. 21. *The Author of Junius ascertained, from a concatenation of circumstances, amounting to moral demonstration*. Lond. 1817, 8vo. 22. *Churchyard's Chips concerning Scotland; being a Collection of his Pieces relative to that Country, with Notes and a Life of the Author*. Lond. 1817, 8vo. 23. *Life of Mary Queen of Scots, drawn from the State Papers, with six Subsidiary Memoirs*. Lond. 1818, 2 vols. 4to, and reprinted in 3 vols. 8vo. 24. *The Poetical Remains of some of the Scottish Kings, now first collected*. Lond. 1824, 8vo. 25. *Robene and Makyne, and the Testament of Cresseid, by Robert Henryson*, edited and presented by Mr Chalmers as a contribution to the Bannatyne Club. Edin. 1824, 4to. 26. *Caledonia*, vol. iii. 1824, 4to. 27. *A Detection of the Love-Letters lately attributed in Hugh Campbell's work to Mary Queen of Scots*. Lond. 1825, 8vo.

Chalmers, *Dr Thomas*, a distinguished Scottish divine, was born at Anstruther in Fifeshire, on the 17th March 1780. He was early destined to the church, and while only eleven years old was enrolled as a student in the university of St Andrews. Having completed his collegiate course, in which he devoted himself almost exclusively to the study of mathematics, in January 1799 he was licensed as a preacher of the gospel by the presbytery of St Andrews. Instead of entering at once on the duties of his profession, he spent the two following winters in Edinburgh, attending the lectures of Professors Stewart, Playfair, Robison, and Hope. In May 1803 he was ordained as minister of Kilmany, a small parish in Fifeshire, about nine miles from St Andrews. During the preceding winter he had acted as assistant to Mr Vilant, professor of mathematics in the university of that city, who for many years had been laid aside by ill health. The novelty, however, of his method, and the singular enthusiasm that he exhibited and excited were distasteful to those attached to the old routine of university education; and at the close of the session he was informed that his further services would not be required. Indignant at the fancied injustice thus done him, he adopted the singular expedient of opening mathematical classes of his own during the succeeding winter, which, though discountenanced in every way by the university authorities, many of the students were attracted to attend. The winter of 1803–4 was a very busy and exciting one. During the week he taught three classes in St Andrews; prepared and delivered there a course of lectures on chemistry, largely illustrated by experiments,—appearing at the same time in the pulpit of Kilmany every Sunday. Having sufficiently redeemed his reputation by the great success which attended them, his mathematical classes were not resumed. The lectures on chemistry were frequently redelivered in his own and in many adjoining parishes, to the surprise and delight of many rural audiences. In 1805 the chair of mathematics in Edinburgh became vacant, and he appeared, but unsuccessfully, as a candidate. In 1808 he published an *Inquiry into the Extent and Stability of National Resources*, a treatise originated by the alarm which Bonaparte's commercial policy had created in Britain, and intended to elucidate some of those questions in political economy which the existing state of affairs had raised. He was preparing a new edition of this work when a series of domestic bereavements, and a severe illness that brought him to the brink of the grave, and laid him aside from all duty for upwards of a year, turned his thoughts and life into a new channel. Dr Brewster had invited him to become a contributor to the Edinburgh Encyclopædia; at his own request the article Christianity had been assigned to him, and he was now engaged in preparing it. In studying the credentials of Christianity, he received a new impression of its contents. A sustained but abortive effort to attain that pure and heavenly morality which the Gospel of Christ requires, led on to that great spiritual revolution the nature and progress of which his journal and letters enable us to trace with such distinctness. When he resumed his duties, an entire change in the character of his ministry was visible to all. The report of discourses so earnest and eloquent as those now delivered, and of household visitations conducted with such ardent zeal, soon spread beyond the limits of his own neighbourhood. His reputation as an author received at the same time a large accession by the publication in a separate form of his article on Christianity, as well as by several valuable contributions to the *Edinburgh Christian Instructor*, and the *Eclectic Review*. So strong, however, at that time was the public bias against those evangelical doctrines which he had embraced, that when a vacancy occurred in Glasgow, and his friends brought him forward as a candidate, it was only after extraordinary efforts, and by a narrow majority, that his election was carried in the town-council.

In July 1815 he was formally admitted as minister of the Tron church and parish. A blaze of unparalleled popularity at once broke around him as a preacher. A series of discourses which he had preached on the connection between the discoveries of astronomy and the Christian revelation, were published in January 1817. Never either before or since has the same reception been given to any volume of sermons in our language. Within a year, nine editions and 20,000 copies of the volume were in circulation. Soon after its appearance he visited London, and occupied for the first time one or two of the pulpits of the metropolis. The crowds were enormous, the applause loud and universal. "All the world," writes Mr Wilberforce, "wild about Dr Chalmers." His extraordinary popularity remained undiminished during the eight years that he remained in Glasgow.

His preparation for the pulpit, however, formed but a small part of his labours. In visiting his parish, which contained a population of about 11,000 souls, he speedily discovered that nearly a third of them had relinquished all connection with any Christian church, and that their children were growing up in ignorance and vice. The appalling magnitude of the evil, and the certainty of its speedy and frightful growth,

at once arrested and engrossed him. To devise and execute the means of checking and subduing it, became henceforth one of the ruling passions of his life. Attributing the evil to the absence of those parochial influences, educational and ministerial, which wrought so effectually for good in the smaller rural parishes, but which had not been brought to bear upon the overgrown parishes of our great cities, from all spiritual oversight of which the members of the Establishment had retired in despair, his grand panacea was to revivify, remodel, and extend the old parochial economy of Scotland. Taking his own parish as a specimen, and gauging by it the spiritual necessities of the city, he did not hesitate to publish it as his conviction that not less than twenty new churches and parishes should immediately be erected in Glasgow. All, however, that he could persuade the town-council to attempt, was to erect a single additional one, to which a parish containing no fewer than 10,000 souls, was attached. This church built at his suggestion was offered to him and accepted, in order that he might have free and unimpeded room for carrying out his different parochial plans.

In September 1819 he was admitted as minister of the church and parish of St John's. The population of the parish was made up principally of weavers, labourers, factory workers, and other operatives. Of its 2000 families, more than 800 had no connection with any Christian church. The number of its uneducated children was countless. In this, as in his former parish, Dr Chalmers' first care and efforts were bestowed upon the young. For their week-day instruction, two commodious school-houses were built, four well-qualified teachers were provided, each with an endowment of L.25 per annum; and at the moderate school-fees of 2s. and 3s. per quarter, 700 children had a first-rate education supplied. For the poorer and more neglected, between forty and fifty local sabbath schools were opened, in which more than 1000 children were taught. The parish was divided into 25 districts, embracing from 60 to 100 families, over each of which an elder and a deacon were placed—the former taking the oversight of their spiritual, the latter of their temporal interests. Over the whole of this complicated parochial apparatus Dr Chalmers presided, watching, impelling, controlling every movement. Nor was his work that of mere superintendence. He visited personally all the families, completing his round of them in about two years, and holding evening meetings, in which he addressed those whom he had visited during the week. Many families were thus reclaimed to the habit of church-going, and many individuals deeply and enduringly impressed by the sacred truths of Christianity.

The chief reason why Dr Chalmers removed from the Tron parish to that of St John's was that he might have an opportunity of fairly testing the efficacy of the old Scottish method of providing for the poor. At this period there were not more than 20 parishes north of the Forth and Clyde in which there was a compulsory assessment for the poor. The English method of assessment, however, was rapidly spreading over the southern districts of Scotland, and already threatened to cover the whole country. Dr Chalmers dreaded this as a great national catastrophe. Having studied in its principles, as well as in its results, the operation of a compulsory tax for the support of the poor, he was convinced that it operated prejudicially and swelled the evil it meant to mitigate. It was said, however, that though the old Scotch method of voluntary contributions at the church-door administered by the kirk-session was applicable to small rural parishes, it was inapplicable to the large and already half-pauperized parishes of our great cities. Dr Chalmers asked the magistrates of Glasgow to commit the entire management of the poor of the parish of St John's into his own hands, and he undertook to refute that allegation. He was allowed to try the experiment. At the commencement of his operations, the poor of this parish cost the city L.1400 per annum. He committed the investigation of all new applications for relief to the deacon of the district, who had so small a number of families in charge, that by spending an hour among them every week, he became minutely acquainted with their character and condition. By careful scrutiny of every case in which public relief was asked for; by a summary rejection of the idle, the drunken, and the worthless; by stimulating every effort that the poor could make to help themselves, and when necessary, aiding them in their efforts; a great proportion of these new cases were provided for without drawing upon the church-door collections; and such was the effect of the whole system of Christian oversight and influence, prudently and vigorously administered, that in four years the pauper expenditure was reduced from L.1400 to L.280 per annum.

At the commencement of his ministry in St John's, Dr Chalmers began a series of quarterly publications on *The Christian and Civic Economy of Large Towns*, devoted to the theoretic illustration of the various schemes of Christian usefulness which he was carrying on; presenting himself thus to us as at once their skilful deviser, their vigorous conductor, their eloquent expounder and advocate. But the fatigues of so toilsome a ministry began to exhaust his strength; and he was already longing to exchange the personal for the literary labours of his profession, when the vacant Chair of Moral Philosophy in the University of St Andrews was offered to him. This offer, the seventh of the same kind that had been made to him during his eight years' residence in Glasgow, he accepted, entering on his new duties in November 1823, and devoting the next four years of his life to their fulfilment. Hitherto metaphysics and ethics had been taught conjunctly by the professors of moral science in the Scotch colleges, while, in teaching the latter, allusions to the peculiar doctrines of Christianity had generally and often carefully been avoided. Looking upon mental philosophy as belonging properly to another chair, Dr Chalmers confined his prelections to the philosophy of morals, entering at large upon the duties man owes to God as well as those he owes to his fellow-men, endeavouring throughout to demonstrate the insufficiency of natural religion to serve any other purpose than that of a precursor of Christianity. Many of his lectures, as remodelled afterwards and transferred to the theological chair, are to be found now in the first and second volumes of his works. In the purely ethical department, those discussions in which he made important and original contributions to the science, are those occupied with the place and functions of volition and attention, the separate and underived character of the moral sentiments, and the distinction between the virtues of perfect and imperfect obligation. It was not so much, however, for their scientific speculations that his lectures in the moral philosophy class-room were distinguished, as for that fervour of professional enthusiasm with which they were delivered, and which proved so healthfully contagious. Beyond the intellectual impulse thus communicated, his frequent references to the great doctrines of Christianity, and still more the force of his inviting example, kindled to a very remarkable degree the religious spirit among the students of St Andrews; and not a few of them—including many men who have since highly distinguished themselves—have been led thereby to consecrate their lives to missionary labour.

In November, 1828, Dr Chalmers was transferred from the chair of moral philosophy in St Andrews to that of theology in Edinburgh. In this wider theatre he was enabled to realize all his favourite ideas as to the best methods of academical instruction. To the old practice of reading to his students a set of carefully prepared lectures he added that of regular *viva-voce* examination on what was thus delivered, and introduced besides the use of text books, communicating through them a large amount of information; and coming into the closest and most stimulating contact

with his pupils, he attempted to combine the different systems pursued in the English and the Scottish universities. In the professorial chair there have been many who, with larger stores of learning, have conducted their students to greater scientific proficiency; but none have ever gone beyond him in the glowing impulse, intellectual, moral, and religious, that he conveyed into the hearts of the ardent youths who flocked around his chair; and to that spirit with which he so largely impregnated the young ministerial mind of Scotland, may, to a large extent, be traced the Disruption of the Scottish Establishment.

The leisure for literary labour which professorial life afforded was diligently improved. At St Andrews he resumed the work which his departure from Glasgow had suspended, and in 1826 published a third volume of the *Christian and Civic Economy of Large Towns.* This was followed in 1827 by his treatise on the *Use and Abuse of Literary and Ecclesiastical Endowments*, the ablest defence of endowments in our language, a work which itself would have won celebrity for its author. For many years his chief ambition had been to complete a treatise on political economy, a science which had been a favourite one from youth. In St Andrews, besides his ordinary course on ethics, he had opened a class for instruction in this science, and had been delighted to find how attractive it had proved. As soon as he had got through his first course of theological lectures in Edinburgh, he resumed this subject, and embodied the reflections and preparations of many years in a work on *Political Economy*, published in 1832. Many of the particular doctrines of this work have not met with general acceptance. The public mind, however, has been gradually coming round to a belief in that great truth which this volume was mainly intended to enforce,—that a right moral is essential to a right economic condition of the masses,—that character is the parent of comfort. His work on *Political Economy* was scarcely through the press, when, on invitation from the trustees of the Earl of Bridgewater, Dr Chalmers was engaged on a treatise *On the Adaptation of External Nature to the Moral and Intellectual Constitution of Man*, which appeared in 1833. Literary honours, such as were never united previously in the person of any Scottish ecclesiastic, crowned these labours. In 1834 he was elected fellow of the Royal Society of Edinburgh, and soon after made one of its vice-presidents. In the same year he was elected corresponding member of the Royal Institute of France, and in 1835 the university of Oxford conferred on him the degree of D.C.L.

Hitherto Dr Chalmers had taken but little part in the public business of the church. He had given some effective help in the prosecution of two measures—the one for the abolition of pluralities, and the other for the improvement of theological education. The death of Dr Andrew Thomson, who had long been the able leader of the Evangelical party, and the obtaining by that party of the ascendancy, called him to lead the counsels and doings of the church. One of the earliest acts of the General Assembly of 1834, the first in which the Evangelical party had the majority, was to place Dr Chalmers at the head of a committee appointed to promote the extension of the church. In this office he had a double duty to discharge—to solicit the government to make a grant out of the public revenue, and to stimulate the friends of the church by their own voluntary efforts to meet the spiritual necessities of the country. In both departments extraordinary efforts were made, but with very different results. The Whig government, insecure in its hold of power and dependent to some extent on the political assistance of the Scottish Dissenters, could be induced to do nothing beyond appointing a committee of inquiry which led to no practical result. It was otherwise when Dr Chalmers appealed to the country. That appeal was made with singular ardour and eloquence. When circulars, pamphlets, and reports had done their uttermost, he made a tour through a large part of Scotland, addressing the various presbyteries and holding public meetings in the most populous districts. Year after year swelled the fund that these efforts created, till at last in 1841, when he resigned his office as convener of the Church Extension Committee, he had to announce that in seven years upwards of L.300,000 had been contributed to this object and 220 new churches had been built.

This great movement on behalf of church extension was finally checked by another in which Dr Chalmers was destined to play a still more conspicuous part. In 1834, the General Assembly, after declaring it to be a fundamental principle of the church that "no minister shall be intruded into any parish contrary to the will of the congregation," had enacted, that in every instance the dissent of the majority of the male heads of families, being communicants, should be a bar to the settlement of a minister. This act commonly called the Veto Law, was based upon the old constitutional practice of the Call in which the people invited the minister to undertake the pastoral office, on which invitation alone the spiritual act of ordination was grounded. The church believed herself to possess the power of determining what kind and amount of popular concurrence was necessary before the pastoral tie was formed by ordination. She had often exercised that power to the effect of setting aside the nominee of the patron. When invited in such instances to interfere, the civil courts had refused, on the ground that the church was acting within the limits of her acknowledged authority. In other instances the civil courts had often reviewed decisions of the church courts, but only with a view of regulating the title to the benefice. But now the power of the church to pass such a law as that of the Veto was challenged, and the civil courts claimed a right not only to regulate the destination of the benefice, but to control and overrule the decisions of the church. In the parish of Auchterarder, containing a population of 3000 souls, only two individuals signed the call, while 287 out of 300 dissented; but in an action raised at the instance of the presentee, the Court of Session decided that his rejection by the church was illegal. This decision the House of Lords, on appeal to it, confirmed; Lords Brougham and Cottenham in delivering judgment, stating it expressly to be their opinion, that in settling a minister the church had no legal right to look beyond his qualifications as to "life, literature, and morals." In this decision, as involving a forfeiture of the benefice, the church acquiesced, declaring at the same time her intention, for her own spiritual objects, to interpret for herself the statutes which established her, and announcing her unaltered purpose to protect her congregations from the intrusion of unacceptable ministers. It speedily appeared that she was not to be permitted to carry out these resolutions if the Court of Session could prevent. The presbytery of Dunkeld rejected a licentiate presented by the Crown to the parish of Lethendy on the ground of his having been vetoed by the people. The Crown acquiesced and issued a new presentation. At the instance of the first presentee the Court of Session interdicted the presbytery from ordaining the second. The church ordered the presbytery to proceed with the ordination. It did so, and was summoned in consequence to the bar of the civil court, solemnly rebuked, and informed that in the next instance of such disregard by the church of the interdict of the civil court, imprisonment would be the punishment. In the parish of Marnoch, with a population of 2800 souls, only one individual signed the call; an overwhelming majority dissented; but in defiance of the law of the church and in obedience to the Court of Session, the presbytery of Strathbogie, by a majority of 7 to 3, resolved to proceed to the ordination. To prevent this ordination the church suspended the seven ministers who formed the majority. The Court of Session not

only annulled that suspension and prohibited the church from intimating or executing it, but interdicted all ministers from preaching or administering any of the sacraments within any of the parishes of the seven suspended clergymen. The church held such interference as a violation of her spiritual independence, and proceeded as if no such sentence of the civil court had been passed; many of the most distinguished ministers, Dr Chalmers and Dr Gordon among the rest, preaching in those parishes in the face of interdicts served on them personally. The seven suspended clergymen treated in the same way the supreme ecclesiastical authority, and on the 21st January 1841, in opposition to an express order of the General Assembly, consummated the ordination. By the following General Assembly these clergymen were deposed from the office of the ministry. The Court of Session immediately thereafter pronounced the deposition null and void. Other like instances occurred. The collisions between the two supreme courts became frequent and most unseemly. Matters were running into inextricable confusion. The church appealed to the government to interfere. At first the Whigs were in power, but they declined to interfere. In 1841, Sir Robert Peel was placed at the head of a government strong enough to have applied the remedy, and the hopes of the church were excited. Still no measure was introduced. Under the guidance of Dr Chalmers the church pursued her course with steady unfaltering step; but she was not prepared to prolong the controversy indefinitely. Denying the right of the Court of Session to act as it had done, she freely conceded to the legislature the right of determining on what terms she held her temporalities; and if, fairly appealed to, the legislature declared that she held them on condition of rendering such obedience to the civil courts as they now required, she felt that she had no alternative but either to renounce her own principles or relinquish the temporalities. At a solemn convocation held in November 1842 a large number of ministers signed and published a declaration that if no measure of relief were granted they would resign their livings. Up to the last, however, it was not believed that any very extensive secession would take place. In January 1843, the government not only refused to grant the protection the church required, but put a final and peremptory negative on her claims of spiritual independence. And in March the House of Commons did the same by a large majority; the Scotch members, however, voting in the proportion of more than two to one in her favour. The controversy was now closed, and it remained only for those clergymen who felt that they could not with a good conscience submit to the civil restraint imposed upon the church, to adopt the only expedient now left to them and retire from the Establishment. On the 18th May 1843, 470 clergymen withdrew from the General Assembly and constituted themselves into the Free Church of Scotland, electing Dr Chalmers as their first moderator.

For two years previous to this final step, Dr Chalmers had foreseen the issue, and in preparation for it had drawn up a scheme for the support of the outgoing ministers. For a year or two afterwards the establishment and extension of that fund, to which the Free Church owes so much of her stability, engaged a large share of his attention. He then gradually withdrew from the public service of the church, occupying himself with his duties as Principal of the Free Church College, and in perfecting his "Institutes of Theology." In May 1847, he was summoned before a committee of the House of Commons to give evidence regarding that refusal of sites for churches in which a few of the landed proprietors of Scotland who were hostile to the Free Church were still persisting. He returned from London in his usual health, and after a peaceful Sabbath (May 30th), in the bosom of his family at Morningside, he bade them all good night. Next morning, when his room was entered and the curtains of his bed withdrawn, he was found half erect, his head leaning gently back upon the pillow, no token of pain or struggle, the brow and hand when touched so cold as to indicate that some hours had already elapsed since the spirit had peacefully departed.

During a life of the most varied and incessant activity, spent much too in society, Dr Chalmers scarcely ever allowed a day to pass without its modicum of composition. He had his faculty of writing so completely at command that at the most unseasonable times, and in the most unlikely places, he snatched his hour or two for carrying on his literary work. He was methodical indeed in all his habits, and no saying passed more frequently from his lips than that punctuality is a cardinal virtue. His writings now occupy more than 30 volumes. He would permanently perhaps have stood higher as an author had he written less, or had he indulged less in that practice of reiteration into which he was so constantly betrayed by his anxiety to impress his ideas upon others. It would be premature to attempt to estimate the place which his writings will hold in the literature of our country. We may briefly indicate however, some of the original contributions for which we are indebted to him. As a political economist he was the first to unfold the connection that subsists between the degree of the fertility of the soil and the social condition of a community, the rapid manner in which capital is reproduced, (See Mill's *Political Economy*, vol. i., p. 94), and the general doctrine of a limit to all the modes by which national wealth may accumulate. He was the first also to advance that argument in favour of religious establishments which meets upon its own ground the doctrine of Adam Smith, that religion like other things should be left to the operation of the natural law of supply and demand. In the department of natural theology and the Christian evidences, he ably advocated that method of reconciling the Mosaic narrative with the indefinite antiquity of the globe which Dr Buckland has advanced in his Bridgewater Treatise, and regarding which Dr Chalmers had previously communicated with that author. His refutation of Mr Hume's objection to the truth of miracles is perhaps his intellectual *chef d'œuvre*, and is as original as it is complete. The distinction between the laws and disposition of matter, as between the ethics and objects of theology, he was the first to indicate and enforce. And it is in his pages that the fullest and most masterly exhibition is to be met with of the superior authority as witnesses for the truth of Revelation of the Scriptural as compared with the ex-Scriptural writers, and of the Christian as compared with the heathen testimonies. In his "Institutes of Theology," no material modification is either made or attempted on the doctrines of Calvinism, which he received with all simplicity of faith, as he believed them to be revealed in the Divine word, and which he defended as in harmony with the most profound philosophy of human nature, and of the Divine providence.

The character of Dr Chalmers' intellect was eminently practical. The dearest object of his earthly existence was the elevation of the common people. Poor-laws appeared to him as calculated to retard this elevation; he therefore strenuously resisted their introduction. The Church of Scotland appeared to him as peculiarly fitted to advance it; he spoke, he wrote, he laboured in its defence and extension. "I have no veneration," he said to the royal commissioners in St Andrews, before either the Voluntary or the Non-intrusion controversies had arisen, "I have no veneration for the Church of Scotland *quasi* an establishment, but I have the utmost veneration for it *quasi* an instrument of Christian good." Forcing that church to intrude unacceptable ministers, and placing her in spiritual subjection to the civil power, in his regard stripped her as such an instrument of her strength, and he resolutely but reluctantly gave her up.

It is as a mover of his fellow men, as the reviver of evangelistic feeling in Scotland, and as a leader in that great

movement which terminated in the erection of the Free Church, that Dr Chalmers will fill the largest place in the eye of posterity, and occupy a niche in the history of Scotland and of the church. Various elements combined to clothe him with public influence—a childlike, guileless, transparent simplicity, the utter absence of everything factitious in matter or manner—a kindliness of nature that made him flexible to every human sympathy—a chivalry of sentiment that raised him above all the petty jealousies of public life—a firmness of purpose that made vacillation almost a thing impossible, a force of will and general momentum that bore all that was moveable before it—a vehement utterance and overwhelming eloquence that gave him the command of the multitude, a scientific reputation that won for him the respect and attention of the more educated—the legislative faculty that framed measures upon the broadest principles, the practical sagacity that adapted them to the ends they were intended to realize—the genius that in new and difficult circumstances could devise, coupled with the love of calculation, the capacity for business details, and the administrative talent that fitted him to execute—a purity of motive that put him above all suspicion of selfishness, and a piety unobtrusive but most profound, simple yet intensely ardent. (W. H—A.)

CHALONER, Sir Thomas, a statesman and poet, descended from a noble family in Wales, was born in London about the year 1515, and educated at Cambridge. He was introduced at the court of Henry VIII., and sent on the English embassy to the court of Charles V., whom he attended in his ill-fated expedition against Algiers in 1541. Soon after the fleet left Algiers, he was shipwrecked by night on the coast of Barbary, but had the good fortune when swimming to catch hold of a cable, by which he was drawn up into his own ship. Mr Chaloner returned soon after to England, and was appointed first clerk of the council, an office which he held during the rest of that reign. On the accession of Edward VI. he became a favourite of the Duke of Somerset, and attending that nobleman to Scotland, was knighted by him after the battle of Musselburgh in 1547. The protector's fall, however, at once put a stop to his expectations, and involved him in difficulties. During the reign of Queen Mary, his Protestantism brought him into some danger; but having many powerful friends, he had the good fortune to escape. On the accession of Queen Elizabeth he appeared again at court, and was appointed ambassador to the Emperor Ferdinand I., with marks of distinguished favour. On his return he was sent in the same capacity to Spain, when, on account of the differences which then existed between the two courts, he met with harsh and insolent treatment, which induced him to send a request to the queen for his recal. He returned accordingly in 1564, and resided in London till his death, which took place in the following year. He was buried with great pomp in St Paul's—Sir W. Cecil, then secretary of state, being chief mourner.

Sir Thomas Chaloner was a man of varied talents, and made a considerable figure as a poet.

Principal works,—*Poetical Works*, edited by Dr William Malim; *De Republica Anglorum Instaurandâ*, lib. x, written in Spain; *The Praise of Folie*, from the Latin of Erasmus; *In laudem Henrici Octavi Carmen Panegyricum*; *The Office of Servants*, from the Latin of Cognatus; and several other smaller pieces.

Chaloner, *Sir Thomas*, the younger, though inconsiderable as an author, deserves to be recorded as a skilful naturalist, and particularly as the founder of the alum works in Yorkshire, which have since proved so highly advantageous to the commerce of this kingdom. He was the only son of the preceding, and was born in the year 1559. Being very young at the time of his father's death, the lord treasurer Burghley took charge of his education, and sent him ultimately to Oxford, where, like his father, he discovered considerable talents for Latin and English poetry. About the year 1580 he made the tour of Europe, and returned to England before 1584, when he became a frequent attendant at the court of Queen Elizabeth. In 1591 he was knighted; and, some time afterwards, discovered the alum mines on his estate at Gisborough, near the river Tees, in Yorkshire.

Towards the latter end of the queen's reign, Sir Thomas visited Scotland; and rose so high in the estimation of James I. that he was appointed governor to Prince Henry, whom he constantly attended; and when his royal pupil visited Oxford, he was honoured with the degree of master of arts. How he was employed after the death of the prince is not known. He died in the year 1615, and was buried at Chiswick in Middlesex. His eldest son William was created a baronet in the year 1640; but the title became extinct in 1681.

He wrote, *Dedication to Lord Burghley*, of his father's poetical works, 1579; *The Virtue of Nitre*, 4to, Lond. 1584.

CHALONS-Sur-Marne (the ancient *Catalauni* or *Duro-catalauni*), the capital of an arrondissement of the same name, and of the department of Marne, France, stands on the right bank of the Marne, here crossed by a fine stone bridge, 93 miles east of Paris, with which it is connected by a railway. In early times this was a place of considerable importance, having been embellished and fortified by the Romans; and was the scene of two celebrated battles, the one fought in 273, when Tetricus was defeated by the forces of Aurelian, and the other in 451, when Attila, king of the Huns, was defeated by Aëtius and his allies. Chalons is irregularly and ill built, surrounded by old walls, the houses being mostly of wood, lath, and plaster. It has, however, some fine public buildings, as the cathedral, originally built about 450, and mostly rebuilt in 1672; the churches of Notre Dame, St Alpin, and St Jean, town-hall, barracks, and the residence of the prefect. It is the seat of a bishopric, and has tribunals of primary instance and commerce, an agricultural society, communal college, two seminaries, schools of arts and trades, theatre, and a public library of 20,000 volumes. The *Jard* is a magnificent promenade to the east of the town, covering an area of 19 acres. Chalons has manufactures of woollen, linen, and cotton goods, leather, &c., and a considerable trade in corn, wine, hemp, and wool. Pop. (1851) 14,468.

Chalons-*sur-Saône* (the ancient *Cabillonum*), a town of France, capital of the arrondissement of the same name in the department of Saône-et-Loire, 63 miles north of Lyons. It is a neat and well built town, pleasantly situated in an extensive plain on the right bank of the Saône, at the mouth of the *Canal du Centre*, and having on the opposite bank of the river its suburb St Laurent, with which it is connected by a fine old stone bridge. The chief structures are the cathedral, a Gothic edifice of the latter part of the thirteenth century, and occupying the site of a church founded in 532; the church of St Pierre, with two lofty steeples; the hospitals of St Laurent and St Louis; town-hall; an obelisk erected in 1793 to commemorate the opening of the canal, and several public fountains. It has tribunals of primary instance and commerce, an exchange, agricultural society, communal college, and a public library of 10,000 volumes. Its manufactures are extensive and various, among which is *essence d'orient*, prepared from the scales of the bleak (*Cyprinus Alburnus*), and used for the fabrication of mock pearls. Its commerce is very considerable and flourishing, as the town is an entrepot of goods both for the north and south of France. Pop. (1851) 15,719. Chalons was the capital of the old division of Chalonnais, in the province of Burgundy.

CHALUS, a small town of France, department of Haute Vienne, arrondissement and 16 miles N.W. of St Yrieix, on the Tardociere, which divides it into an upper and lower

town. Pop. 1200. Richard Cœur de Lion was here mortally wounded by an arrow in 1199.

CHALYBEATE (χάλυψ, steel), impregnated with particles of iron or steel; applied to medicines containing iron, as well as to mineral waters impregnated with that metal.

CHAM or KHAN, the title given to the sovereign princes of Tartary. The word in the Persian signifies *mighty lord;* in the Sclavonic, *emperor.* Sperlingius, in his dissertation on the Danish term *köning*, king, thinks the Tartar *kham* may be thence derived. The term *cham* or *kham* is also applied, among the Persians, to great lords, and governors of provinces.

CHAMADE, in war, a certain beat of a drum, or sound of a trumpet, inviting the enemy to a parley; as for making a proposition to capitulate, or for a truce. Menage derives the word from the Italian *chiamata*, from the Latin *clamare* to call aloud.

CHAMAS, ST, a town of France, department of Bouches-du-Rhône, on the north bank of the lagoon De Berre, 24 miles N.W. of Marseilles. It is well built, and is divided into two parts by a hill, through which a large tunnel has been cut. It has a fine church; a large powder magazine, which supplies Toulons; and a trade in oil and olives, which are shipped from its port on the lagoon. In the vicinity is a Roman bridge of a single arch, with a triumphal arch at each extremity. Pop. 3000.

CHAMBER (*camera*), an apartment in a house, more particularly a sleeping apartment. It also denotes a hollow or cavity; as the *chamber of a mortar*, in which the powder lies.

CHAMBERLAIN (Latin *camerarius*, from *camera*, a chamber), the keeper of the chamber. During the time of the Roman empire, the *cubicularii* or chamberlains were officers in immediate attendance on the person of the emperor. Their special duty was to announce visitors, superintend the domestic arrangements of the palace, &c.

The lord great chamberlain of England was originally a person of the highest importance, and took rank after the lord privy seal. The office is hereditary, and belonged at one time to the De Veres, from whom it descended by the female line into the family of Bertie. On the death of the second last Duke of Ancaster, it passed into the houses of Cholmondeley and Willoughby d'Eresby. From these families alternately a lord great chamberlain is appointed on the death of the reigning monarch.

The lord chamberlain of the king's household is an officer whose duty it is to appoint physicians, surgeons, chaplains, and tradesmen for the royal family. He also licenses plays, and has the right of selecting the theatrical companies that perform before the reigning monarch.

The chamberlain of the corporation of the city of London is appointed by the liverymen. His duties are to decide on differences that may arise between masters and apprentices, and to admit on oath persons entitled to the freedom of the city. Appeal is open from his decisions to the lord mayor. He is also treasurer of the corporation, and in this capacity receives the various items which compose the city revenue, and discharges such debts as it may incur. The salary of this officer from different sources varies from L.2000 to L.3000 per annum.

CHAMBERLAYNE, EDWARD, author of the *Angliæ Notitia*, was born in Gloucestershire in 1616, and made the tour of Europe during the distractions of the civil war. After the Restoration he went as secretary with the Earl of Carlisle, who carried the order of the garter to the king of Sweden. He was appointed tutor to the Duke of Grafton, natural son of Charles II., and was afterwards engaged to instruct Prince George of Denmark in the English tongue. He died in 1703, and was buried in a vault in Chelsea churchyard. His monumental inscription mentions six books of his composition which were buried along with him, and thus perished.

CHAMBERLAYNE, *John*, son of the preceding, entered Trinity College in 1685, and died in 1724.

He wrote a Continuation of the *Angliæ Notitia*, entitled *Magnæ Britanniæ Notitia; Dissertations, historical, critical, theological, and moral, on the Events of the Old Testament:* and also several translations from Ostervald, Nieuwentyt, Brandt, and others.

CHAMBERS, SIR WILLIAM (1725–1796), an eminent architect, was born at Stockholm. In his youth he made a voyage to China; and his drawings of Chinese costume and architecture were afterwards published. He was treasurer to the Royal Academy of Fine Arts in London, and furnished the design for Somerset House.

CHAMBERS, *David*, a Scotch historian, priest, and lawyer, was born about the year 1530. He was educated in the university of Aberdeen, and afterwards went to France and Italy. At Bologna, in 1556, he was a pupil of Mariannus Sozenus.

After his return to Scotland, he was appointed by Queen Mary parson of Suddy and chancellor of Ross. He was soon afterwards employed in digesting the laws of Scotland, and was engaged in 1566 in publishing the acts of the Scottish parliament by authority. He was also appointed one of the lords of session, and continued faithful to the interests of the queen till her adherents were obliged to seek refuge in other kingdoms. Chambers went to Spain, where he was received by Philip; and thence to Paris, where he was welcomed by Charles IX., to whom, in 1572, he presented his History of Scotland. He died at Paris in the year 1592.

He wrote *Histoire abrégée de tous les Roys de France, Angleterre, et Escosse; La recherche des Singularités plus remarkable concernant le Estat d'Escosse;* and a *Discours de la légitime succession des Femmes.*

CHAMBERS, *Ephraim*, author of the *Cyclopædia* which bears his name, was born at Kendal, Westmoreland. His parents were Presbyterian Dissenters, and gave him a commercial education. By them he was apprenticed to Mr Senex the globe-maker. It was during Mr Chambers's residence with this skilful mechanician that he contracted that taste for science and learning which directed all his pursuits. At this time he had formed the design of his great work, the *Cyclopædia;* and some of the articles in it were written behind the counter. In order to devote himself wholly to this undertaking, he quitted Mr Senex, and took chambers at Gray's Inn, where he chiefly resided during the rest of his days. The first edition of the *Cyclopædia*, which was the result of many years' intense application, appeared by subscription in 1728, in two vols. fol. It was dedicated to the king, and procured for Mr Chambers the honour of being elected fellow of the Royal Society. In less than ten years a second edition was printed, with corrections and additions (in 1738); and this was followed by a third in the following year.

In addition to the *Cyclopædia*, Mr Chambers was concerned in the publication of *The Literary Magazine* (begun 1735), to which he contributed a variety of articles, and particularly a review of Morgan's *Moral Philosophy*. He was likewise engaged with Mr John Martyn, professor of botany at Cambridge, in preparing for the press a translation and abridgment of the Philosophical History and Memoirs of the Royal Academy of Sciences at Paris. This undertaking was completed in 5 vols. 8vo, and published in 1742, some time after Chambers's decease, under the joint names of himself and Mr Martyn. In a subsequent publication, Mr Martyn severely censured the share which his colleague had had in the abridgment of the Parisian papers. The only other work ascribed to him is a translation of the *Jesuit's Perspective*, from the French. Mr Chambers's close attention to his studies at length impaired his health, and obliged him to go to the south of France. He died soon after his return to England in 1740, and was buried in Westminster Abbey, where a modest inscription, written by himself, marks the place of his burial.

CHAMBERY, a city of Italy, kingdom of Sardinia, capital of a province of the same name, and also of the duchy of

Savoy. It is pleasantly situated in a fertile district, between two hills, on the rivers Leisse and Albana, 46 miles S.S.W. of Geneva. The town, however, is irregularly and ill built, and has only one good street. The principal edifices are the cathedral, hotel Dieu, castle, theatre, and barracks. Several of the squares are adorned with fountains. The old ramparts of the city have been converted into public walks. It is the seat of an archbishop, of the military governor of the duchy, and of the superior tribunal; and has also a Jesuit college, royal academical society, society of agriculture and commerce, public library, museum, botanic garden, and many charitable nstitutions. It has manufactures of silk-gauze, lace, leather, soap, hats, &c.; and a considerable trade in liqueurs, wine, lead, copper, and other articles. In the vicinity is Charmettes, for some time the residence of Rousseau. Pop. (including garrison) 18,000.

CHAMBORD, a magnificent Gothic chateau of France, department of Loire-et-Cher, 10 miles east of Blois, on the left bank of the Cosson. It was commenced by Francis I. in 1532, carried on by Henry II., and at length finished by Louis XIV. It is built of black stone, with a profusion of towers, turrets, and minarets; and the interior is fitted up with great magnificence. The park is inclosed by walls seven leagues in circumference. The castle was for some time the residence of Stanislaus king of Poland, father-in-law of Louis XV., and afterwards of Marshal de Saxe. It was given by Napoleon to Marshal Berthier, from whose widow it was purchased by subscription in 1821 for the Duke of Bordeaux. It gives the title of Count to the last of the older branch of the Bourbons.

CHAMELEON. See Reptilia.

CHAMFRAIN, or Champfrein, an ancient piece of defensive armour for the head of a horse.

CHAMIER, Daniel, an eminent Protestant divine, born in Dauphiny. He was for many years preacher at Montellimart, an office which he exchanged in 1612 for the chair of divinity at Montaubon, where he was killed by a cannon-ball during the siege in 1621.

He wrote *Panstratia Catholica*, 4 vols. fol. 1620, edited by Turretin, and abridged in 1 vol. fol. by Frederic Spanheim the elder; *De Œcumenico Pontifice, libri sex*, 8vo, Geneva, 1601; and *Corpus Theologicum*, Geneva, 1653.

CHAMISSO, Adelbert von, a German naturalist and poet, born in Lorraine in 1781, of a noble family, that was obliged to emigrate to Berlin in the commencement of the first French revolution. There young Chamisso was received as one of the pages to the queen, and in 1798 entered the Prussian army, in which he served until after the peace of Tilsit. He then took up his residence in France, where he spent ten years in the assiduous cultivation of natural history. On his return to Germany he published the novel of Peter Schlemil, the man who loses his own shadow, a production of great power and originality. In 1814 he was offered the situation of naturalist to an expedition round the world, undertaken at the expense of Count Numjanzow, chancellor of the Russian empire. The expedition sailed in 1815 under Captain Kotzebue; and after a successful voyage, returned in 1818. Chamisso, in 1821, gave an account of this voyage in a quarto volume entitled *Observations and Discoveries made during a Voyage round the World*—a work that is replete with interesting information, and which established his reputation as a naturalist. Soon after his return he was appointed inspector of the botanic garden at Berlin; and in 1827 he published his *Survey of the Plants of the North of Germany, profitable, useful, or poisonous, together with a View of the Vegetable Kingdom, and of Plants in general.* During the last ten years of his life, he gave proofs of the versatility of his genius in the publication of several tales and poems, which entitle the name of Chamisso to a high place in this field of German literature. He died at Berlin August 12, 1838. (T.S.T.)

CHAMOIS, or Chamois Goat. See Mammalia.

CHAMOMILE, the popular name of the *Anthemis nobilis*, a bitter plant used in medicine, especially the flowers.

CHAMOND, St, a flourishing and well-built town of France, department of Loire, in a fine valley at the confluence of the Gier and Ban, on the railway from St Etienne to Lyons, 8 miles E. by N. of the former. It has a fine church, public baths, and several good buildings; manufactures of cotton and silk fabrics, ribbons, and laces; and considerable cast-iron and nail works. Pop. 9000.

CHAMOUNY, or Chamonix, a celebrated valley of Savoy, province of Faucigny, bounded on the S. and E. by Mont Blanc and others of the Pennine Alps, and on the W. and N. by Mont Breven and the *Aiguilles Rouges.* It is 12 miles in length from N.E. to S.W., with an average breadth of 2 miles, and forms the upper part of the basin of the Arve, which traverses its entire length. This valley is the most celebrated in the Alps for the picturesque grandeur of its mountains and its glaciers, among which is the Mer de Glace, the most remarkable of the Alpine glaciers. The inhabitants of the valley, which is much frequented by travellers, amount to about 3000; the soil is not fertile, but is well cultivated. The climate in winter is severe. The principal village is *La Chamounix* or *La Prieuré*, on the right bank of the Arve, and 3420 feet above the level of the sea.

CHAMPAGNE, an old province of France, now forming the four departments of Ardennes, Marne, Aube, and H. Marne, and part of those of Yonne, Aisne, Seine-et-Marne, and Meuse. Its capital was Troyes, and it was governed by native princes till 1284, when Philippe le Bel united it to the crown of France by marrying Jeanne, Queen of Navarre and Countess of Champagne.

Champagne, *Philippe de* (1602–1674), a celebrated painter, was born at Brussels. He was a pupil of Fouquier, and was employed by Du Chesne to paint along with Nicholas Poussin in the palace of the Luxembourg. His best works are to be found at Vincennes, and in the church of the Carmelites at Paris.

CHAMPAIN, or *Point Champain*, in *Heraldry*, a mark of dishonour in the coat of arms of him who has killed a prisoner of war after he has asked for quarter.

CHAMPION, a person who undertakes a combat in the place or cause of another; and sometimes it denotes one who fights a duel in his own cause. Champions properly were persons who fought instead of those who by custom were obliged to accept the duel, but had a just excuse for dispensing with it, as being too old or infirm, &c. Such causes as could not be decided by the course of common law were often tried by single combat; and the victor was always reputed to have justice on his side. Trial by wager of battle was suppressed by St Louis in 1270.

Champion *of the King*, an officer whose duty it is at the coronation of the English kings to ride armed *cap-à-pie* into Westminster Hall, while the king is banqueting there, and by the proclamation of a herald to make a challenge, "that if any man shall deny the king's title to the crown, he is there ready to defend it in single combat;" after which the king drinks to him, and sends him a gilt cup full of wine, which the champion drinks, retaining the cup as his fee. This office at the coronation of Richard II., when Baldwin Ferville exhibited his petition for it, was adjudged from him to his competitor Sir John Dymocke, both claiming descent from Marmion; and it has continued ever since in the family of the Dymockes, who hold the manor of Scrivelsby in Lincolnshire hereditary from the Marmions by grand serjeantry, namely that the lord of the manor shall be the champion of the king. At the coronation of George IV. in 1821, W. Dymocke being in orders, his place was supplied by his eldest son.

CHAMPLAIN, a considerable lake of North America, lying between the states of New York and Vermont, and

penetrating for a few miles into Canada. It is 140 miles in length, and from 1 to 10 in breadth, lying nearly north and south; and contains a great number of small islands, most of which belong to Vermont. The Champlain canal, 63 miles in length, connects it with the Hudson, and large steamboats and vessels of 100 tons navigate the lake from end to end. The scenery along its shores is highly picturesque, and its waters abound in salmon, salmon-trout, sturgeon, and other fish. See CANADA.

CHAMPOLLION, JEAN FRANÇOIS LE JEUNE, so called to distinguish him from Champollion Figeac, his elder brother, was born at Figeac, department Du Lot, in 1796. He was educated at Grenoble, and afterwards at Paris, where under Langlès and De Lacy he devoted himself to the study of Coptic. In 1811 he was made professor of history in the Lyceum of Grenoble, and there published his earlier works. He was sent by Charles X. in 1824, to visit the collections of Egyptian antiquities in the museums of Turin, Leghorn, Rome, and Naples; and on his return was appointed director of the Egyptian museum at the Louvre. In 1828 he was commissioned to undertake the conduct of a scientific expedition to Egypt, and accompanied Rosellini, who had received a similar appointment from Leopold II. Grand Duke of Tuscany. He remained there about a year; and soon after his return was appointed professor of Egyptian Antiquities in the Royal College at Paris. He was engaged along with Rosellini in publishing the results of his Egyptian researches at the expense of the Tuscan and French governments, when he was seized with a paralytic disorder, and died at Paris in 1831. For an account and estimate of his discoveries, see HIEROGLYPHICS and EGYPT.

He wrote *L'Egypte sous les Pharaons*, 2 vols. 8vo, 1814; *De l'Ecriture Hiératique des Anciens Egyptiens*, 1821; *Précis du Système Hiéroglyphique, &c.*, 1824; *Panthéon Egyptien, ou Collection des Personages Mythologiques de l'Ancienne Egypte*, incomplete; *Monumens de l'Egypte et de la Nubie considérés par rapport à l'Histoire, la Religion, &c.*; *Grammaire Egyptienne*, 1836, edited by his brother; and also several letters on Egyptian subjects, written at different periods to his patrons.

CHANCAY, a town of Peru, capital of a province of the same name in the department of Lima, situated in a beautiful valley, a few miles from the river Passamayo, and 40 miles N.W. of Lima. It has a tolerable port, well frequented by small trading vessels. Pop. 2000.

CHANCE, a term applied to an event that happens without being contrived, expected, or foreseen. In other words, it is the effect of an unknown, or the unexpected effect of a known cause. Those things are frequently ascribed to *chance* which do not seem necessarily to follow as the natural effects of any adequate cause; but through ignorance or precipitancy, effects proceeding from a determinate cause are often attributed to chance. The term *chance*, as commonly used, really means nothing more than that the cause of the event is unknown; not, as some have imagined, that an event can happen without a cause. The case of the painter who, in despair at his inability to express the foam at the mouth of a horse he had painted, threw his sponge at the picture and did that *by chance* which he could not before do by design, is an eminent instance of the common meaning of the term; since he did not fore-calculate the result, nor throw the sponge with a view to produce it.

Chance is frequently personified, and then corresponds to the *Fortuna* of the ancients. Chance is also used for the manner of deciding things, the direction of which is not reducible to any determinate rules, or where there is no ground for preference, as at cards, dice, lotteries, and the like. The doctrine of chances is discussed under the head PROBABILITY.

The ancient *sortilege* or *chance* was of divine origin, since in the Old Testament we find several standing laws and express commands which prescribed its use on certain occasions. We read in the Acts—"the *lot* fell upon Matthias," when it was in question who should fill Judas's place in the apostolate; and hence also arose the *sortes sanctorum*, or method of solving difficulties among the ancient Christians, by opening some of the sacred books, and regarding the first verse that arrested the eye as a prognostic. The *sortes Homericæ, Virgilianæ, Prænestinæ*, and the like, used by the heathens, were of a similar kind. St Augustin seems to approve of this method of determining things future, and even admits that he had practised it, justifying his doing so on the ground that God presides over *chance*.

CHANCEL, that part of the choir of a church between the altar or communion-table and the balustrade or rail that incloses it, or that part where the altar is placed. The word is derived from the post-classical Latin *cancellus*, from *cancelli*, lattices or cross-bars, with which the chancels were anciently encompassed, as they now are with rails. It corresponds with the *bema* of the ancient basilica, and is generally represented by the apsis in romanesque and early pointed architecture. In Britain the possession of a chancel in some shape or other is generally the distinction of a Romish or Episcopal from a Presbyterian church. In England, the right to the chief pew in the chancel is one of the privileges which belong to the rector or impropriator, but he is not entitled as of right to make a vault, or affix tablets in the chancel without leave of the ordinary.

CHANCELLOR. Various origins have been attributed to this word, so important in its modern use over the greater part of the civilized world; and all of them are of a trivial nature, bearing little reference to the subsequent application of the term. The preceding word *chancel* is connected with the most ordinary and apt of these origins. It supposes the chancellor to have been so called because he sat within a lattice or screen partitioned from the court of justice or hall of audience. There was no such office in the early civil law, and even under the later western emperors the cancellarius appears to have been a mere subordinate person, a sort of clerk of the chamber, or scribe, who saw the petitioners, and arranged about their business. Gradually he appears to have risen to the rank of an adviser or conscience keeper, on whose decision the fate of suitors in a great measure depended. In the eastern empire the chief cancellarius had become a powerful and important officer. As it was the principle of the popedom to be the spiritual counterpart of the empire, and possess a corresponding hierarchy, the office was imitated at the ecclesiastical court of Rome, and a chancery at the Vatican was repeated throughout the several bishoprics, where each diocese had its chancellor. The great monastic houses too had frequently a chancellor. In the universities, an officer of the same name was the connecting link between their republican institutions and the Romish hierarchy. While the rector was elected by the proctors of the nation, or some other corporate constituency, the bishop of the diocese, or in some cases the head of the monastic house to which the university was subordinated, was *ex officio* the chancellor.

It was the ambition of the kings who rose on the fall of the Roman empire, even of those who reigned in Saxon England, to gather round them as many as they could obtain of the attributes of the emperor or basileus, and hence each generally had his cancellarius. In central Europe the office would naturally descend from the imperial court of Charlemagne; and in France the chancellor became the head of the law and the minister of justice. The office was abolished at the first revolution. At the restoration the ministry of justice was made a separate office, and the chief function of the chancellor was to preside in the House of Peers.

It is perhaps in England that we have the most remarkable illustration of the struggle between the influence of the imperial usages and the constitutional spirit of the northern nations. The existence of common law courts

Chancellor. enforcing in its strictness what was deemed the old law of the land, and the chancery with its regal equity interfering to give redress, just presents to us the English people with their common lawyers standing for their rights and privileges, and the monarch, with his clerical advisers, endeavouring to acquire the imperial prerogatives. The chancellor was generally a churchman, who took his ideas of law from the canonists and the civilians, whose principles were intensely disliked by the common lawyers. Hence the two systems called law and equity grew up in antagonism, neither throughout a long contest being able to conquer the other; and hence it is that England has been burdened with the inconvenience of having two systems of jurisprudence, the one called common law, the other equity. The spirit of the former, indeed, may be said to have been so far triumphant, in compelling equity to depart from her digressional vagueness, and become a fixed system as securely bound to statute and precedent as the common law itself. But even in Selden's day we find the laxity of the chancellor's equity so much suspected, that he says in his *Table Talk*, "Equity is a roguish thing. For law we have a measure—know what to trust to: equity is according to the conscience of him that is chancellor, and as that is larger or narrower, so is equity. It is all one as if they should make the standard for the measure we call a foot, a chancellor's foot. What an uncertain measure would this be! One chancellor has a long foot, another a short foot, another an indifferent foot; it is the same thing in the chancellor's conscience." How little, indeed, the chancery practice had been at that time moulded into a strict system, we may infer from the seals being held by a churchman, the celebrated Archbishop Williams, and this at the time when the common law had accumulated that amazing mass of intricate precedents which it tasked all the diligence and genius of Coke to reduce into order. Clarendon, when he became chancellor, had been twenty years out of practice, and his successor Shaftesbury had no pretensions to be acquainted with law. Lord Nottingham appears to have been the first who wished to apply strict rules in the court of chancery, but it does not seem to have been in a fit condition for their application. Roger North says, "he was a formalist; and took pleasure in hearing and deciding, and gave way to all kinds of motions the counsel would offer; supposing that if he split the hair, and with his gold scales determined reasonably on one side of the motion, justice was nicely done—not imagining what torment the people endured who were drawn from the law, and there tost in a blanket." (*Life of Lord Keeper Guildford*, 423.) Guildford himself, who, in the words of Lord Campbell, "had as much law as he could contain," made light of the mere judicial business of his office, which ere then, however, had begun to show its characteristic defects, for according to his biographer, "the greatest pain he endured ensued from a sense he had of the torments the suitors underwent by the excessive charges and delays of the court."

The lord high chancellor of Great Britain is a great state officer, with varied and disconnected functions. He is in official rank the highest civil subject in the land out of the royal family, and when raised to the peerage, as he invariably is, he takes precedence immediately after the archbishop of Canterbury. His functions have sometimes been exercised by a "lord keeper of the great seal;" but there appears to be no essential differences between the two offices, save that the keeper is appointed by mere delivery of the seal, which is of itself sufficient to confer all the powers appertaining to the office, while a chancellor receives letters patent along with it. As a great officer of state, the chancellor acts for both England and Scotland, and in some respects for the United Kingdom, including Ireland. As an administrative officer, as a judge, and as head of the law, he acts merely for England. In the first class of functions, he acts as prolocutor, speaker, or chairman of the House of Lords, and in this capacity it sometimes falls to him to adjudicate in Scottish law, since he often leads the judgment of the house on appeals. (See APPEAL.) By the Treaty of Union, one great seal was appointed to be kept for all public acts. Hence, in this department, the chancellor's authority extends to the whole of Britain, and thus the commissions of the peace for Scotland as well as England issue from him. His English ministerial functions are thus briefly described by Blackstone:—"He became keeper of the king's conscience, visitor, in right of the king, of all hospitals and colleges of the king's foundation; and patron of all the king's livings under the value of twenty marks per annum, in the king's books. He is the general guardian of all infants, idiots, and lunatics; and has the general superintendence of all charitable uses in the kingdom." There is much convenience in the repetition of such vague definitions, from the difficulty of more specifically defining the chancellor's functions in these matters. His indistinct and unsatisfactory authority as to charitable foundations has been virtually superseded by the Charity Commissioners' Act of 1853 (17th Vict., cap. 137). The lord chancellor is by office a privy-councillor, and it has long been the practice to make him a cabinet minister. Hence he belongs to a political party, and is affected by its fluctuations. This has often been denounced as destructive of the independence and calm deliberativeness essential to the purity and efficiency of the bench. In defence, however, of the ministerial connection of the chancellor, it has been said, that while the other judges should be permanent, the head of the law should stand or fall with the ministry, as the best means of securing his effective responsibility to parliament for the proper use of his extensive powers. The late addition of permanent judges to the chancery court has removed many of the objections to the fluctuating character of the office.

In Ireland, there is a lord chancellor at the head of the equity system, which arose in minute imitation of the English. He is generally raised to the peerage.

In Scotland, a chancellor appears at a pretty early period in history, as the person who, being the adviser and conscience-keeper of the king, issued his writs or letters for the remedy of injustice done by judges or other persons in power. A comparison between the English and the Scottish chancellor of the thirteenth century would probably show them to have then been much alike. Subsequently, however, the civil law predominating in Scotland, the chancellor was its chief administrator, instead of leading on a system antagonistic to the common law. Hence he became the leading judge of the Court of Session on its establishment in 1533. While Episcopacy predominated he was generally an ecclesiastic, never a working lawyer; and after the revolution he became an officer of state, who was not expected to be a working lawyer. Hence, when by the Treaty of Union the great seal for public transactions was appointed to be kept in England, the lord chancellor of Scotland dropped out of existence. A keeper of the great seal continued to be appointed for sealing writs as to private matters, and the office of director of chancery remained for the transaction of routine business connected with the department. When the method of certifying hereditary successions was simplified and placed on a uniform system in 1848, it was put under the direction of an officer called the sheriff of chancery. (J.H.B.)

CHANCELLOR *of a Cathedral*, an officer who holds the courts of the bishop, and acts as his assessor or adviser in matters of ecclesiastical law. He also inspects schools, applies the seal, writes and despatches letters of the chapter, keeps the books, &c.

CHANCELLOR *of the Duchy of Lancaster*, an officer appointed of old chiefly to determine controversies between the king and his tenants of the duchy land, and otherwise to direct all the king's affairs belonging to that court. By late

practice, the office was nominally one of high dignity, but, demanding little exertion, has been given to statesmen who have grown old in other and more laborious offices, but whose services are still desired in the ministry.

CHANCELLOR *of the Exchequer*, an officer who, according to the old definitions of his functions, presides in the exchequer court, and takes care of the interest of the crown. He is always in commission with the lord treasurer for the letting of crown lands, &c., and has power, with others, to compound for forfeitures of lands upon penal statutes. While the treasury is understood to have the custody and distribution of the collected revenue, it is the function of the exchequer to realize it. Hence the chancellor of the exchequer, as the head of that department which proposes to parliament the plans for the annual revenue, and sees to its realization, is always an important member of the cabinet. Sometimes he is prime minister. His annual statement of the method by which he proposes to meet the exigencies of the exchequer, called "The Budget," is always received with great interest by parliament and the public.

CHANCELLOR *of the order of the Garter and other military orders*, an officer who seals the commissions and mandates of the chapter and assembly of the knights, keeps the register of their proceedings, and delivers their acts under the seal of their order.

CHANCELLOR *of a University*, an officer who seals the diplomas, or letters of degrees, &c. The chancellors of the universities of Oxford, Cambridge, and London, are elected by the respective corporate bodies of which they are the heads. Their duties, however, are usually discharged by the vice-chancellors. Each of the Scottish universities, likewise, with the exception of that of Edinburgh, has a chancellor elected by the senatus.

CHANCERY, the name of the highest court of justice in England and Ireland. Of its origin an account has been given under the head CHANCELLOR. In chancery there are two distinct tribunals; the one ordinary, being a court of common law; and the other extraordinary, being a court of equity.

1. The *ordinary* legal court has been accustomed to hold pleas of recognizances acknowledged in the chancery, writs of *scire facias* for repeal of letters patent, of partition of lands in coparcenary, &c., and (until the 12th and 13th Vict., cap. 109, sec. 42) of all personal actions by or against any officer of the court. Sometimes a *supersedeas*, or writ of privilege, has been granted by this court, to discharge a person out of prison: one may also obtain here a *habeas corpus* prohibition, &c. in the vacation; and a *subpœna* may be had to force witnesses to appear in other courts when they have no power to call them. If the parties to a cause are at issue in a matter of fact, this court cannot try it by jury. A transcript of the record is sent to one of the superior courts of common law (see 12th and 13th Vict., cap. 109, sec. 32), to be tried there; and after trial it is remanded into the chancery, where judgment is given. If there be a demurrer in law, it must be argued in this court. Under the 15th and 16th Vict., cap. 86, sec. 61, however, the court of chancery can no longer direct a case to be stated for the opinion of any court of common law, but it may determine any questions of law in its judgment necessary to be decided previously to the decision of the equitable question at issue. Under sec. 62, it is now no longer necessary to establish at law the legal title or right of the party seeking relief before equitable relief is granted; while in cases of difficulty, the attendance of a common law judge is procured to hear the case with the equity judge.

In this court is also kept the *officina justitiæ*, out of which all original writs that pass under the great seal, all commissions of charitable uses, sewers, idiotcy, lunacy, and the like, issue; and for which it is always open to the subject, who may there at any time demand and have, *ex debito justitiæ*, any writ which his occasions may call for. Those writs relating to the business of the subject, and the returns to them, were, according to the simplicity of ancient times, originally kept in a hamper, *in hanaperio;* and the other (relating to such matters wherein the crown was mediately or immediately concerned) were preserved in a little sack or bag, *in parva baga;* and hence has arisen the distinction of the *hanaper* office and the *petty-bag* office, which both belong to the common law court in chancery.

2. The *extraordinary* court, or court of equity, had its origin in those arrangements avowedly designed for affording relief against the rigour of the common law, which have been noticed under the head CHANCELLOR. It gives relief for and against infants notwithstanding their minority, and for or against married women notwithstanding their coverture. All frauds and deceits for which there is no redress at common law; all breaches of trust and confidence; and unavoidable casualties by which obligors, mortgagors, and others, may be held to incur penalties and forfeitures, are here remedied. This court also gives relief against the extremity of unreasonable engagements entered into without consideration; obliges creditors who are unreasonable to compound with an unfortunate debtor; and makes executors, &c. give security and pay interest for money which is to lie long in their hands. This court may confirm the title to lands, though one has lost his writings; and render conveyances which are defective through mistake or otherwise, good and perfect. In chancery, copy-holders may be relieved against the ill usage of their lords; inclosures of land which is common may be decreed; and this court may decree money or lands given to charitable uses, oblige men to account with each other, &c. But in all cases where the plaintiff can have his remedy at law, he ought not to be relieved in chancery.

The court of chancery, proverbial for the intricacy and tediousness of its procedure, has lately been the object of repeated legislative reforms, far too technical in their character to be indicated in a sketch like the present. From an early period the equity jurisdiction was shared by the master of the rolls, who was the chief of a body of officers called masters in chancery. These officers, who have been in use of late to exercise important ministerial functions, were in the sixteenth century doctors of the civil law. After many alterations in their functions, they were in 1852 (15th and 16th Vict., cap. 80) prospectively abolished with reservation of the rights, duties, and privileges of the accountant-general as master in chancery. In 1813, there was appointed an additional judge in chancery by the title of vice-chancellor of England; and on the transference to this court of the equity business of the Exchequer in 1841, two additional vice-chancellors were appointed. By an act of 1851 "to improve the administration of justice in the court of chancery, and in the judicial committee of the privy-council," an addition was made of two judges to be called "judges of the court of appeal in chancery." This is a court of appeal from the master of the rolls and the vice-chancellors. Its jurisdiction may be exercised by the two judges of appeal, either with or without the lord chancellor, by the lord chancellor and one of the judges, or by the lord chancellor alone, as of old. The act thus enables the highest judicial functions of the lord chancellor to be distributed among other functionaries, with this peculiarity, that *he* can exercise them alone, but the two new judges must act together. The court is vested with all the powers exercised by the lord chancellor "in the court of chancery," "and all powers, authorities, and duties, as well ministerial as judicial, incident to such jurisdiction;" but there is a special exception of the ministerial and other duties not exercised in the court of chancery.

CHANDERNAGORE, a French settlement in Bengal, in a healthy situation on the western bank of the Hooghly river. It is about three quarters of a mile long, and is surrounded by a small territory, consisting of 2330 acres, with

a population of 32,670, of whom 218 are Europeans, 435 of mixed descent, and the remainder of native lineage. The authorities of Chandernagore are subject to the jurisdiction of the governor of Pondicherry, to whom is confided the general government of the French possessions in India. The town has an air of ruined greatness, its fine streets and noble quay being now overgrown with grass. The height of the houses is usually two stories: they have colonnades in front, and green Venetian windows, and are built of brick and mortar, plastered over with fine chunam, both inside and out. They have generally flat roofs, on which their proprietors sit in the evening and receive company. The French having obtained this situation for their factory in 1676, they afterwards fortified it, and the factory continued to flourish till the year 1757, when it was attacked by Admiral Watson and Colonel Clive, who, having forced it to surrender, dismantled its fortifications. France recovered Chandernagore under the treaty of 1763. It was again occupied by the British in 1793 upon the breaking out of the republican war, but finally restored to the French at the general pacification in 1816. Distance north from Calcutta 17 miles. N. Lat. 22. 49.; E. Long. 88. 23.

CHANDLER, Richard, D.D., one of the most learned and judicious of British travellers during the last century, was born in 1738 at Elson in Hampshire, educated at Winchester school, and subsequently at Queen's College, Oxford. His early publication of fragments from minor Greek poets, with notes, in 1759, showed his fine literary taste; and his splendid edition of the Arundelian marbles, *Marmora Oxoniensia*, in 1763, with the accurate transcript of the venerable original, his good Latin translation, and judicious conjectures in supplying the lacunæ, established his reputation as a scholar and an antiquary.

In 1763 Chandler was sent, with Revett the architect, and Pars a painter, by the Dilettanti Society of England, to explore the antiquities of Ionia and Greece. After spending above a year in Asia Minor, the travellers passed another year in Greece examining Attica and the Peloponnesus, and returned to England in the end of 1766. The result of their joint investigations were the two magnificent folios of Ionian antiquities published in 1769. Chandler published a very valuable collection of inscriptions, entitled *Inscriptiones Antiquæ pleræque nondum editæ; in Asia Minore et Græcia præsertim Athenis collectæ*, in a folio volume, at Oxford in 1774. In 1775 he published his *Travels in Asia Minor*, and in 1776 his *Travels in Greece*, each in a quarto volume; which have not been surpassed by those of any subsequent traveller. Octavo editions of both, with a memoir of the learned author, appeared in 1835. Dr Chandler married in 1786, and soon after travelled in Switzerland and Italy. In 1800 he obtained the rectory of Tylehurst in Berkshire, in addition to church preferment which he held in Hampshire. He died in Feb. 1810. His posthumous Life of Bishop Waynflete, Lord High Chancellor to Henry VI., was published in 1811. (T. S. T.)

Chandler, *Dr Samuel*, a learned Dissenting minister, was born in 1693, at Hungerford, Berkshire, where his father was an eminent nonconformist minister. In an academy at Gloucester, conducted by Mr Samuel Jones, he contracted a friendship with Butler, afterwards bishop of Durham, and Secker, afterwards archbishop of Canterbury, which continued to the end of their lives.

Mr Chandler began to preach about July 1714; and being soon distinguished by his talents in the pulpit, was chosen in 1716 minister of the Presbyterian congregation at Peckham. Here he married; but having lost, by the fatal South Sea scheme, the whole of his wife's fortune, he was compelled to open a book shop in the Poultry, which he kept for two or three years, still continuing to discharge his pastoral duties. He also held, alternately with Dr Lardner, a winter weekly evening lecture at the meeting-house in the Old Jewry; where he was first settled as assistant preacher, and then as pastor. Here, for forty years, he ministered to a very respectable congregation with great success; and devoted the intervals of leisure to writing on a variety of important subjects. While he was thus employed, the universities of Edinburgh and Aberdeen conferred on him the degree of doctor in divinity, and he received offers of high preferment in the Established church, which he nobly declined. He had likewise the honour of being elected fellow of the Royal and Antiquarian Societies.

On the death of George II. in 1760, Dr Chandler published a sermon on that event, in which he compared King George to King David. This called forth a pamphlet entitled *The History of the Man after God's own Heart;* in which the author—resuscitating the article of Bayle—exhibited king David as an example of perfidy, lust, and cruelty; and complained of the insult offered to the memory of the late British monarch by Dr Chandler's parallel. This attack determined Dr Chandler to publish an immediate reply in the following year; and also to prepare a more elaborate work, which was afterwards published in two volumes 8vo, entitled *A Critical History of the Life of David, &c.;* refuting the objections of Bayle, and satisfactorily expounding his penitential psalms. This, the last and perhaps the best of Dr Chandler's productions, had been printed off just before the author's death, which took place May 8, 1766.

Dr Chandler was a man of very extensive learning and eminent abilities; and his talents, both in the pulpit and as a writer, procured him very great and general esteem.

In 1768 four volumes of his sermons were published by Dr Amory, according to his own directions in his last will. In 1777 another work of his was published in one volume 4to:—*A Paraphrase and Notes on the Epistles of St Paul to the Galatians and Ephesians, with doctrinal and practical Observations; together with a critical and practical Commentary on the two Epistles of St Paul to the Thessalonians.*

CHANG Chau, a town of China, province of Fo-Kien, on a river, 35 miles W. of Amoy. It is said to be well built, with streets paved with granite, but very dirty. A wooden bridge, about 800 feet long, spans the river. Pop. said to be about 800,000.

CHANNING, William Ellery, was the son of William Channing and Lucy Ellery, and was born at Newport, Rhode Island, on the 7th of April 1780. The place of his birth is situated amidst scenery of great and varied beauty; the influence of which upon his mind may be traced in many allusions in his writings, and in the vivid admiration which he ever expressed for it in after-life. To the society of the town of Newport he owed but little; it was a bustling, crowded seaport, where a certain Puritanic strictness, inherited by tradition from the founders of the state, was kept up, not only in connection with, but too much as a salvo for, a considerable amount of laxity both of speech and practice. As a bathing place it was a resort for strangers from other parts; and the interfusion of French and British officers tended to modify the peculiarities which the unmixed influence of retired sea captains, West Indian traders, and keen New England lawyers, might have rendered too strong.

As a child, Channing was remarkable for a refined delicacy of feature and temperament, which made him an object of admiration and affection in the household. From his father he inherited a fine person, simple and elegant tastes, sweetness of temper, and warmth of affection; from his mother (who appears to have been a remarkable woman) he derived the higher benefits of that strong moral discernment and straightforward rectitude of purpose and action which formed so striking a feature of his character. By both parents he was carefully instructed in those strict religious principles which were characteristic of the people of New England; and by both, but especially his mother, was his moral training most sedulously cared for. Other influences, however, were in the meantime operating upon him. The

excitement of the revolutionary war was inspiring him with a profound and ardent love of freedom. The sick chamber of an aunt of his father, who was a woman of much piety and sweetness, was the source of many serious and hallowed lessons of gentleness and goodness. An amateur Baptist preacher, who was by trade a cooper, gave him an impulse which he never lost in favour of temperance, by refusing, though very poor, to manufacture any of the articles of his trade used for containing ardent spirits. A female servant, whose religious views were of a more cheerful cast than those prevalent in his circle, used to talk to him in a way that greatly engaged him, and probably sowed the germ of not a few of the ideas which afterwards regulated his modes of religious sentiment. Able and free-minded men, like Dr Stiles and Dr Hopkins, frequented his father's house, and the quiet and thoughtful boy listened to their conversations, and laid many suggestive words that fell from them to heart. And while but a child he had begun to draw inferences from what he heard from the pulpit and elsewhere that were not quite such as his guardians would have wished him to draw; and he "was even then quite a theologian, and would chop logic with his elders according to the fashion of that controversial time," as he himself tells us.

Whilst very young, he was sent to a dame's school, who exacted from the incipient republicans the title of *Madam*, and enforced her authority and her lessons by means of "a long round stick." From this he passed under the care of two excellent women, by whose instructions he profited greatly. His next step was to the school of a Mr Rogers, considered the best at that time in the town; and in his twelfth year he was sent to New London to prepare for college, under the care of his uncle the Rev. Henry Channing. His career at school does not appear to have been marked by any remarkable aptitude for letters; on the contrary, his progress was at first somewhat slow; though, after the few initiatory difficulties were overcome, he advanced rapidly, both in a knowledge of the classics and an appreciation of their excellences. His disposition was thoughtful and retiring, though among his companions he showed no absence of relish for lively conversation or hearty amusement. A certain mingled dignity and sweetness gave him a commanding influence in the school, where he went by the name of "the Peacemaker," and "Little King Pipin," and where he was obeyed, though "small and delicate," with more readiness than mere physical strength could ever have commanded.

Shortly after going to reside with his uncle, his father died. This event, however, though it produced a great change in the circumstances of the family, was not allowed to interrupt the course of his studies. After the funeral he returned to the house of his uncle, where he remained till he had reached his fifteenth year, when he was removed to Cambridge, Massachusetts, and entered at Harvard College as freshman in 1794. Before leaving New London he came under the influence of a religious revival which took place there, a circumstance to which he was accustomed to trace the commencement of a decidedly religious life.

The four years he remained at college seem to have been most profitably spent. Besides acquiring an extensive acquaintance with classical and general literature, he read largely and thought earnestly in the department of psychology and ethics. The books which appear to have exerted most influence upon his mind and opinions were Price's Dissertations, Hutcheson on Beauty and Virtue, and Ferguson on Civil Society. To the study of Shakspeare also (the interest in whose works was then newly awakened in that quarter) he owed much; and so deep was the impression made on him by the genius of the poet, that to the close of his life one of the greatest of his intellectual treats was furnished by recitations from his writings. By patient and well-directed assiduity he trained himself to the mastery of that copious and vigorous style of composition to which his subsequent position in the world of letters is in no small measure due; and at the same time also laid the basis of his success as a public speaker, by the formal study of rhetoric, and by frequent practice in addressing assemblies of his fellow-students.

For a year and a half after leaving college in 1798, Channing was resident at Richmond, in Virginia, as tutor in the family of David Meade Randolph, Esq. Here he had time for study, which he employed chiefly on theological subjects. In regard to many points, touching both the evidences of Christianity and its doctrines, his mind was burdened with doubt and anxiety; and so earnestly did he labour to attain satisfaction, that his constitution sank under the incessant toil. When, in 1800, he returned to Newport, his friends were shocked to find him changed to "a thin and pallid invalid;" and unhappily, at this time were sown the seeds of that depressed condition of health which continued through life his severest trial. He remained in the bosom of his family for another year and a half, engaged in the pursuit of his studies, and in preparing himself, by physical and moral as well as intellectual training, for the work to which he was looking forward—that of the ministry. In 1802 he returned to Cambridge, having been elected to the office of regent in Harvard University; a situation which, without exacting from him any large amount of service, secured to him the advantage of independence, and an opportunity of prosecuting his studies within reach of a valuable library, and under influences favourable to success. In the autumn of 1802 he began to preach, having received approbation to do so from the Cambridge Association; and in the beginning of the following year he accepted the invitation of the Congregational church, Federal Street, Boston, to be their pastor. To this office he was ordained in June 1803.

Channing entered on his ministry with a deep and almost painful sense of the responsibility of the office he had assumed, and with an earnest desire to acquit himself faithfully of its obligations. His theological views were at this time considered orthodox; at least they presented no marked deflection from the standard of moderate Calvinism. In a sermon which he preached at the ordination of the Rev. J. Codman, in 1808, and which constitutes, we believe, his earliest publication, the language and sentiments are in all respects such as any evangelical divine might use. Now, as at all times, however, he refused to be inclosed within the limits of party, and acted with an indiscriminateness in his religious associations, which led to his being alternately claimed and disowned by almost every party, and which indicates that no very high importance was attached by him to differences of creed. It was not till controversy evolved into distinctness the latent tendencies of his mind in the matter of theological speculation, that it became manifest that he was irreconcilably at variance with rigid Calvinism and Trinitarianism. From the year 1815 he may be regarded as nominally a Unitarian. This, however, was not then, and never became, the Unitarianism which in this country, in the hands of Priestley and Belsham, so dogmatically asserted the mere humanity of Jesus Christ. From this Channing ever held himself aloof. "I am little of a Unitarian," he wrote in 1841; "have little sympathy with the system of Priestley and Belsham; and stand aloof from all but those who strive and pray for clearer light." It was rather an exaggerated view of the worth and dignity of man, and a sensitive dread of anything which might lead to a "gloomy theology," than a clear and firm adoption of the system of Socinus, which induced him to deny the doctrine of the trinity and the doctrines with which it stands associated in the Bible. So far, indeed, as we can judge from his writings, the question, as one of Biblical interpretation, had very little exercised his thoughts. His belief on this head was more the dictate of a sentimental theosophy, than the result of earnest and discriminating inquiry.

In 1814 Channing married his cousin, Ruth Gibbs; a union which brought him an increase of worldly substance, as well as a rich addition to his personal happiness. "Inwardly and outwardly," his biographer tells us, "his lot henceforward was singularly serene." He was now fast rising in reputation, both as a preacher and a public man. Interested in all that concerned his country and the cause of humanity, his voice was heard on most of the questions that came before the American public, and always with marked and growing effect. He had begun also to command attention as a writer for the press. His Address on War, some of his Sermons, and especially his able tract on the Evidences of Christianity, had given him a position of eminence among the writers of his country. In 1821 he received the title of D.D. from Harvard University. In 1822 he undertook a journey to Europe, in the course of which he visited Great Britain and some parts of the Continent. When in this country, he made the acquaintance of some distinguished men of letters, especially Wordsworth and Coleridge, on both of whom he appears to have left a most favourable impression. Coleridge wrote of him, "He has the love of wisdom and the wisdom of love." On his return, Dr Channing resumed his duties as a minister, but with a more decided attention than before to literature and public affairs. In 1824 he received as colleague the Rev. Ezra Stiles Gannett, at whose ordination he preached one of his published discourses. From this time forward his energies were devoted, in addition to his pulpit labours, chiefly to the furtherance of great schemes of social reform. Of the antislavery cause he was throughout the firm, eloquent, and uncompromising advocate; and in every question that bore upon the happiness of the people he took a lively interest. Of his publications, the most extensively read are his *Remarks on the Life and Character of Napoleon Bonaparte*, his *Remarks on the Character and Writings of John Milton*, his *Essay on the Character and Writings of Fénélon*, and his *Essay on the Importance and Means of a National Literature*. He died in the sixty-third year of his age, on Sunday, the 2d of October 1842, whilst on a journey, at Bennington, Vermont; and was buried at Boston, on the 7th of that month. An extended memoir of him has been published by his nephew, Wm. Henry Channing, 3 vols., London, 1848. (W. L. A.)

CHANT (*cantus*) is used for the vocal music of churches. In church history we meet with divers kinds of *chants* or *songs*. The first is the *Ambrosian*, established by St Ambrose; the second is the *Gregorian*, introduced by Pope Gregory the Great, who established schools of chanters, and corrected the church song. This, which is still retained in the church under the name of *plain song*, at first was called the *Roman song*. The *plain* or *Gregorian chant* is sung by the choir and people in unison.

CHANTIBAN, a large inland town of Siam, capital of a province of the same name, on the south bank of a river near its mouth in the Gulf of Siam, 150 miles S.E. of Bangkok. It has a considerable trade, exporting pepper, cardamoms, rosewood, dyewoods, ship timber, hides, horns, ivory, &c.; and in the vicinity are mines of precious stones.

CHANTILLY, a small village on the Nouette, department of Oise, France, 24 miles north of Amiens. It is famous for its manufacture of blonde, which is still extensively carried on, but derives its principal celebrity from the *Grand Château*, which was the residence of the Prince of Conde. The main building was destroyed during the revolution, but the Petit Chateau and the gardens still remain. The body of Admiral Coligny was buried in the parish church here after the massacre of St Bartholomew. It contains a famous hospital, built and endowed by the Prince of Conde.

CHANTREY, Sir Francis, a celebrated sculptor, was born in 1782, at Norton, near Sheffield, where his father cultivated a small property of his own. His father died when he was eight years of age; and his mother having married again, his profession was left to be chosen by his friends. In his sixteenth year he was on the point of being apprenticed to a lawyer in Sheffield, when, having seen some wood-carving in a shop-window, he requested to be made a carver instead of a solicitor, and was accordingly placed with a Mr Ramsay, wood-carver in Sheffield. When in this situation, he became acquainted with Mr Raphael Smith, a distinguished draftsman in crayon, who gave him lessons in painting; and Chantrey, eager to commence his course as an artist, procured the cancelling of his indentures, and went to try his fortune in London. Here he first obtained employment as an assistant wood-carver, but at the same time devoted himself to portrait painting and modelling in clay. His first imaginative work was the model of the head of Satan, which was exhibited at the Royal Academy in 1808. He afterwards executed for Greenwich Hospital four colossal busts of the Admirals Duncan, Howe, Vincent, and Nelson; and so rapidly did his reputation spread that the next bust which he executed, viz. that of Horne Tooke, procured him commissions to the extent of L.12,000. From this period he was almost uninterruptedly engaged in professional labour. In 1819 he visited Italy, and became acquainted with the most distinguished sculptors of Florence and Rome. He was chosen a royal academician, received the degree of A.M. from Cambridge, and that of D.C.L. from Oxford, and in 1835 was knighted by William IV. He died, after an illness of only two hours' duration, on the 25th November 1841, and was buried in a tomb constructed by himself in the church of his native village. The works of Chantrey are far too numerous to receive particular notice. The principal are the statues of George III. at London, of George IV. at Brighton, of Pitt in Hanover Square, of Watt in Westminster Abbey and Glasgow, of Roscoe and Canning at Liverpool, of Dalton at Manchester, &c. He also executed the statues of Blair and Lord Melville in Edinburgh. Of his equestrian statues the most famous are those of Sir Thomas Munro at Calcutta, and the Duke of Wellington in front of the London Exchange. But the finest of all Chantrey's works are his inimitable delineations of children. The figures of two children asleep in each other's arms, which formed a monumental design in Litchfield Cathedral, are unmatched for beauty, simplicity, and grace. So is also the statue of Lady Louisa Russell, represented as standing on tiptoe and fondling a dove in her bosom. Chantrey was a man of warm and genial temperament, and is said to have borne a striking resemblance to the usual portraits of Shakspeare. He bequeathed his valuable collection, and his whole fortune, after the death of Lady Chantrey, to the Royal Academy, for the encouragement of British sculpture and painting.

CHANTRY, or Chauntry, a little chapel or altar, commonly in some church endowed (before the Reformation) with lands or other revenue, for the maintenance of one or more priests, daily to say or sing mass for the souls of the founder and such others as he might appoint. Chantries were dissolved in England by 1st Edw. VI., cap. 14.

CHAOS, that confused mass or state of confusion in which matter is supposed to have existed before it was reduced to order by the creating power of God. The term is taken from the Greek mythology, according to which Chaos was the vacant and infinite space which existed before the creation of the world, and out of which the gods, men, and all things arose. (Hesiod, *Theog.* 116; Ovid, *Met.* i. 5.) The description which Ovid gives of Chaos itself, and of the formation of the world from the chaotic mass, bears so many striking resemblances to the Mosaic account of the creation, that one can scarcely fail to regard it as having been derived from traditions, the source of which is to be traced to the sacred record. See Creation and Geology.

CHAPEAU. See *Cap of Maintenance.*

CHAPEL, a building for religious worship. The word is derived from the Latin *capella.* In former times the kings of France during war always carried St Martin's hat into the field, and kept it in a tent as a precious relic; hence the place was called *capella,* and the priest who had the custody of the tent *capellanus.* From this circumstance the word *capella* came to be applied to private oratories.

In Britain there are several sorts of chapels. 1. Parochial chapels, distinct from the mother church. If there be a presentation *ad ecclesiam* instead of *capellam,* and an admission and institution upon it, it is no longer a chapel, but a church. 2. Chapels which adjoin to and are a part of the church. These were formerly built by honourable persons as private burying-places. 3. Chapels of ease, built in large parishes for the accommodation of the inhabitants. 4. Free chapels, such as were founded by the kings of England, and freed from all episcopal jurisdiction. 5. Chapels in the universities belonging to particular colleges. 6. Domestic chapels, built by noblemen or gentlemen for the use of their families.

The name of Chapel is also given to the body of printers engaged in any establishment, either because printing was first performed in chapels or churches, or because Caxton exercised the art in one of the chapels in Westminster Abbey. Hence *the order or laws of the chapel, the secrets of the chapel,* &c.

Knights of the Chapel, or *Poor Knights of Windsor,* were instituted by Henry VIII. in his testament. Their number was at first thirteen, but was afterwards augmented to twenty-six. They assist in the funeral services of the kings of England, are subject to the office of the canons of Windsor, and have pensions assigned them by the order of the Garter. They wear a blue or red cloak, with the arms of St George on the left shoulder.

Chapel-en-la-Frith, a market-town of England, hundred of High Peak, Derbyshire, 5 miles from Buxton, and 167 miles from London. It is surrounded by lofty hills, is well built, and has manufactures of cotton and paper, with lead and coal mines and lime works in the vicinity. It has a neat parish church, a savings-bank, national and infant schools, and (in 1851) 369 inhabitants.

Chapel-Hill, a village in the state of North Carolina, Orange county, 27 miles N.W. of Raleigh. It is the seat of the North Carolina university, founded in 1789, and has only about 400 permanent inhabitants.

CHAPELAIN, Jean (1595–1647), an eminent French poet, born at Paris, and often mentioned in the works of Balzac, Ménage, and other learned men. He wrote several works, and distinguished himself by a heroic poem called *La Pucelle, ou France Delivrée,* which has been as much decried by some as it has been extolled by others.

Chapelain translated the Spanish romance of *Guzman d'Alfarache,* and wrote *Paraphrase sur le Miserere,* 1636, 4to; several Odes; and *Mélanges de Littérature,* including *Mémoire de* [sur] *quelques gens vivans en* 1662, drawn up by order of Colbert.

CHAPERON (French), a hood or covering for the head, anciently worn both by men and women of all ranks, but afterwards appropriated to doctors and licentiates in colleges. The name eventually passed to certain little heraldic devices placed on the foreheads of horses which drew the hearse in pompous funerals. The cap worn by knights of the garter is still called a chaperon. See Cap.

CHAPLAIN, an ecclesiastic who has a chapel, or who performs service in a chapel, whether public or private.

In England there are forty-eight royal chaplains, who attend, four each month, to perform divine service for the royal family. While in waiting they have a table and attendance, but no salary. In Scotland there are six royal chaplains, with a salary of L.50 each, three of them having in addition the deanery of the chapel-royal divided among them, making up about L.600 a year to each. Their only duty at present is to say prayers at the election of representative peers for Scotland.

Chaplains *of the Pope* are the auditors or judges of causes in the sacred palace; so called because the pope anciently gave audience in his chapel, for the decision of causes sent from the several parts of Christendom. He summoned hither as assessors the most learned lawyers of his time, who hence acquired the appellation of *capellani,* chaplains. It is from the decrees formerly pronounced by these assessors that the body of Decretals is composed. Pope Sixtus IV. reduced their number to twelve. Some say the shrines of relics were covered with a kind of tent-cape, or *capella,* that is, little cape; and that hence the priests who had the care of them were called chaplains. In time these relics were deposited in a little church, either contiguous to or separate from a larger one; and the same name, *capella,* which was given to the cover, was also applied to the place where it was lodged; hence the priest who superintended it was called chaplain.

CHAPLET, a garland or wreath for the head; and frequently used to signify the circle of a crown.

Chaplet is also another name for a rosary or string of beads used by the Roman Catholics to count the number of their prayers, which consist for the most part of avemarias, paternosters, and credos. These beads are sometimes of coral, of wood, of diamonds, &c. The invention is ascribed to Peter the Hermit, who probably learnt it in the East, as the Orientals have a kind of chaplet called a *chain,* which they use in their prayers, rehearsing one of the perfections of God on each link or bead. The Turks use a similar kind of chaplet in reciting their prayers. Some, however, attribute the origin of the practice to St Dominic. The Roman Catholics have also a chaplet of our Saviour, consisting of thirty-three beads, symbolic of the years of his sojourn on earth.

CHAPMAN, George (1557–1634), the earliest English translator of Homer, was born in Kent. He studied at Trinity College, Oxford, where he was distinguished for his superior classical attainments. On his removal to London he enjoyed the friendship of Shakspeare, Spenser, Marlow, and Johnson. Besides translations from Ovid, Homer, Terence, Musæus, and Petrarch, he wrote numerous tragic and comic pieces. His translation of Homer has elicited a glowing tribute from Keats in one of his most beautiful sonnets.

CHAPPE, Claude, the inventor of the simple French telegraph, was born in Normandy in 1763. It is not now believed that he was aware of the previous devices of a similar nature by Hooke and Amontons; but he was so deeply affected by the attempts of his countrymen to deprive him of the honour of an original inventor, though the machine was adopted by the Legislative Body in 1792, that he died of deep melancholia, in 1805.

CHAPPE D'AUTEROCHE, Jean (1722–1769), a French astronomer, received his knowledge of mathematics from a Carthusian monk; and having edited a translation of the works of Dr Halley, was employed by the French government in several important observations. He observed the transit of Venus at Tobolsk in 1761, and had landed in California to make a similar observation in 1769, when he was carried off by a contagious disease.

CHAPTAL, Jean Antoine Claude, count of Chanteloup, was born at Nojaret Lozère in 1756. He early devoted himself to the study of medicine, and soon distinguished himself as a physician. His fame as a chemist had become so great, that he was called to Paris in 1793 to assist in the manufacture of gunpowder; and by his chemical knowledge and activity in the extensive factory at Grenoble, he was enabled to supply 3500 pounds per day. In the following year he returned to Montpellier, and received a

place in the administration of the department of the Hérault, with the professorship of chemistry, which had been founded there for him. He was made a member of the Institute in 1798; and having favoured the revolution of the 18th Brumaire, he was made in 1799 a councillor of state by the first consul. In the year following he was appointed minister of the interior, in which capacity he greatly encouraged the arts and sciences, and established a chemical manufactory in the vicinity of Paris. In 1804 he fell into disgrace; the reason assigned for this being that he refused to state in one of his official reports that beet-root sugar was better than that prepared from the sugar-cane. In 1805, however, the emperor bestowed on him the grand cross of the legion of honour, and a seat in the conservative senate. On Napoleon's return from Elba he was appointed director general of commerce and manufactures, and a minister of state. On the downfal of the emperor he retired to private life, and in March 1816 the king nominated him a member of the Academy of Sciences. The various vicissitudes of fortune which he underwent never diverted his attention from science, which he continued to promote and encourage till his death, which took place at Paris in August 1832.

Chaptal was director of two chemical manufactories, at Montpellier and Neuilly. He discovered the application of old wool instead of oil in the preparation of soap, and the mode of dyeing cotton with Turkish red. He invented several kinds of cement and artificial puzzolanas, by means of native calcined ochre, as also new varnishes for earthenware, without the use of lead or plumbago; and he extended the application of chemical agents in bleaching. Though Chaptal made no great or brilliant discoveries in chemistry, he was eminently distinguished as a practical chemist; and his new applications of known truths have greatly increased the obligations under which the arts lie to science.

He wrote *Elémens de Chimie*, 3 vols. 8vo, 1790; *Traité sur le Salpêtre*, 8vo, 1796; *Essai sur le Perfectionnement des Arts Chimiques en France*, 8vo, 1800; *Art de faire, de gouverner, et de perfectionner les Vins*, 1 vol. 8vo, 1801; *Traité Théorique et Pratique sur la Culture de la Vigne*, &c., 2 vols. 8vo, 1801; *Essai sur le Blanchîment*, 1801; *Chimie appliquée aux Arts*, 4 vols 8vo, 1807; *Art de la Teinture du Coton en rouge*, 8vo, 1807; *Art du Teinturier et du Dégraisseur*, 8vo, 1800; *De l'Industrie Française*, 2 vols. 8vo, 1819; *Mémoire sur le Sucre de Betteraves*, 8vo; *Chimie appliquée à l'Agriculture*, 2 vols. 8vo, 1823.

CHAPTER, in ecclesiastical polity, a society or community of clergymen belonging to a cathedral or collegiate church.

It was in the eighth century that the body of canons began to be called a chapter. The chapter of the canons of a cathedral was a standing council to the bishop, and, during the vacancy of the see, had the jurisdiction of the diocese. In the earlier ages the bishop was head of the chapter; afterwards abbots and other dignitaries, as deans, provosts, and treasurers, were preferred to this distinction. The deans and chapters had the privilege of choosing the bishops in England; but Henry VIII. had this power vested in the crown; and as the same prince expelled the monks from the cathedrals, and placed secular canons in their room, those whom he thus regulated were called deans and chapters of the new foundation, such as Canterbury, Winchester, Ely, Carlisle, &c.

CHAPU, an important maritime town of China, province of Chehkiang, 50 miles N.W. of Chinhai. It is the port of Hangchau, with which it has good canal communication, and is the only Chinese port trading with Japan. It was attacked and much injured by the British force in 1842, but was abandoned immediately after the engagement.

CHARACTER, in a general sense, signifies a mark or figure, drawn on paper, metal, stone, or other matter, with a pen, graver, chisel, or other instrument, to signify or denote any thing. The word is Greek, χαρακτηρ, formed from the verb χαρασσω, *insculpere*, to engrave or impress.

The various kinds of characters may be reduced to three heads, viz. *Literal Characters*, *Numeral Characters*, and *Abbreviations*.

I. *Literal* CHARACTER is a letter of the alphabet, serving to indicate some articulate sound.

1. These may be divided, with regard to their nature and use, into *Nominal Characters*, or those we properly call *letters*, which serve to express the names of things; *Real Characters*, those that instead of names express things and ideas; *Emblematical* or *Symbolical Characters*, which have this in common with real ones, that they express the things themselves, but, further, possess the peculiarity of in some measure personating them, and exhibiting their form, such as the hieroglyphics of the ancient Egyptians.

2. *Literal* CHARACTERS may be again divided, with regard to their invention and use, into *particular* and *general* or *universal*.

Particular CHARACTERS are those peculiar to this or that nation, such as the Roman, Italic, Greek, Hebrew, Arabic, Gothic, and Chinese *characters*.

Universal CHARACTERS are also *real characters*, and constitute what some authors call a *Philosophical Language*.

That diversity of *characters* used by several nations to express the same idea is found the chief obstacle to the advancement of learning. To remove this, several ingenious thinkers have taken occasion to propose plans of *characters* which should be universal, and which each people should read in their own language. The object is to render *character* real, not nominal; to express things and notions, not letters or sounds; yet to be mute like letters, and arbitrary, not emblematical, like hieroglyphics. Thus, every nation would retain its own language, yet every one would understand that of every other without learning it, only by seeing a real or universal *character*, which should signify the same thing to all people, by what sounds soever it might be expressed in their particular idiom. For instance, by seeing the *character* destined to signify *to drink*, an Englishman would read *to drink*; a Frenchman, *boire*; a Latin, *bibere*; a Greek, πινειν; a Jew, שתה; a German, *trincken*, and so of the rest; in the same manner as seeing a horse, each people would express it after their own manner, but all would mean the same animal.

The first and most considerable attempts at a *real character*, or philosophical language, in Europe, are those of Bishop Wilkins and Dalgarno; but they proved wholly ineffectual. M. Leibnitz, indeed, thought that those ingenious men did not hit the right method. It was probable, indeed, that by their contrivance people who do not understand one another might easily have a commerce together; but they have not hit on true *real characters*. According to him, the *characters* should resemble those used in algebra, which, in effect, are very simple, yet very expressive, without any thing superfluous or equivocal, and contain all the varieties required. M. Lodwic, in the *Philosophical Transactions*, gives us a plan of *an universal alphabet* or *character* of another description. This was to contain an enumeration of all such single sounds or letters as are used in any language, by means of which people should be enabled to pronounce truly and readily any language; to describe the pronunciation of any language that might be pronounced in their hearing, so that others accustomed to this language, though they had never heard it pronounced, should at first be able truly to pronounce it; and, lastly, this *character* was to serve as a standard to perpetuate the sounds of any language.

A new universal character was proposed by Mr Northmore of London, by which different nations might communicate their sentiments to each other. His original plan

was to make the same numerical figure represent the same word in all languages. But he found afterwards that it might be improved by using a figure, not for every word, but for every *useful* word. And even these, he thinks, might be abbreviated by adopting certain uniform fixed signs, the number of which would not exceed twenty for the various parts of speech. Words of negation he proposed to be expressed by a prefixed sign. A few instances will explain the author's meaning.

Suppose the number 5 to represent the word *see*,

6 .... *a man*,
7 .... *happy*,
8 .... *never*,
9 .... *I*.

" I would then," says he, " express the tenses, genders, cases, &c. *in all languages*, in some such *uniform* manner as the following:

(1)	5	=	*present tense*	see.
(2)	.5	=	*perfect tense*	saw.
(3)	:5	=	*perfect participle*	seen.
(4)	5:	=	*present participle*	seeing.
(5)	5.	=	*future*	will see.
(6)	$\underline{5}$	=	*substantive*	sight.
(7)	$\underline{\underline{5}}$	=	*personal substantive*	spectator.
(8)	$\underset{..}{6}$	=	*nominative case*	a man.
(9)	$.\underset{..}{6}$	=	*genitive*	of a man.
(10)	6	=	*dative*	to a man.
(11)	$\overset{\frown}{6}$	=	*feminine*	a woman.
(12)	+6	=	*plural*	men.
(13)	7	=	*positive*	happy.
(14)	$\hat{7}$	=	*comparative*	happier.
(15)	$\hat{\hat{7}}$	=	*superlative*	happiest.
	$\underline{7}$	=	as above, No. 6	happiness.
(16)	—7	=	*negation*	unhappy.

" From the above specimen, I should find no difficulty in comprehending the following sentence, though it were written in the language of the Hottentots:

$9, 8, .5, -\hat{7}, \overset{\frown}{6}.$ *I never saw a more unhappy woman.*

" Those languages which do not use the pronoun prefixed to the verb, as the Greek and Roman, may apply it in a small character, simply to denominate the person; thus, instead of 9, 8, .5, *I never saw*, they may write 8, ${}_9.5$, which will signify that the verb is in the first person, and will still have the same meaning."

Our author thinks, that according to this scheme of an universal character, about twenty signs, and less than 10,000 *chosen* words, synonyms being set aside, would answer all the ends proposed; and that foreigners, by referring to their numerical dictionary, would easily comprehend each other. He proceeds next to show how appropriate sounds may be given to his signs, and an universal *living language* formed from the universal *characters*.

With this view he proposes to distinguish the ten numerals by ten monosyllabic names of easy pronunciation, or such as may without difficulty run into one another. To illustrate his scheme, however, he calls them, for the present, by their common English names, but suggests that each number made use of should be pronounced by uttering separately its component parts, after the manner of accountants. Thus, let the number 6943 represent the word *horse*, he would not, in the universal language, call a horse *six thousand nine hundred and forty-three*, but *six, nine, four, three;* and so on for all the words of a sentence, making the proper stop at the end of each. In the same manner, a distinct appellation must be appropriated to each of the prefixed signs, to be pronounced immediately after the numeral of which it is an appendage. Therefore, if *plu* be the appellation or the sign of the plural number, *six, nine, four, three, plu*, will be *horses*.

" Thus," says our author, " I hope it is evident that about thirty or forty distinct syllables are sufficient for the above purpose; but I am much mistaken if *eleven* only will not answer the same end. This is to be done by substituting the first twenty or thirty numerals for the signs, and saying, as in algebra, that a term is in the power of such a number, which may be expressed by the simple word *under*. For example, let 6943 represent the word *horse*, and suppose 4 to be the sign of the plural number, I would write the word thus, $\frac{4}{6943}$, and pronounce it six, nine, four, three, in the power of or *under* four. By these means eleven distinct appellations would be sufficient, and time and use would much abbreviate the pronunciation."

3. Literal characters may again be divided, with reference to the nations among whom they have been invented, into Greek characters, Roman characters, Hebrew characters, and the like. The Latin character now used throughout all Europe was formed from the Greek, as the Greek was formed from the Phœnician; and the Phœnician, as well as the Chaldee, Syriac, and Arabic characters, were formed from the ancient Hebrew, which subsisted till the Babylonish captivity; for after that event the character of the Assyrians, which is the square Hebrew now in use, prevailed, the ancient being only found on some Hebrew medals, commonly called Samaritan medals. It was in 1091 that the Gothic characters, invented by Ulphilas, were abolished, and the Latin ones established in their room.

Medallists observe that the Greek character, consisting only of majuscule letters, has preserved its uniformity on all medals as low as the time of Gallienus, after which it appears somewhat weaker and rounder. From the time of Constantine to that of Michael we find only Latin characters; after the time of Michael the Greek characters recommence; but from that period they began to alter with the language, which was a mixture of Greek and Latin. The Latin medals preserved both their characters and language as late as the translation of the seat of the empire to Constantinople. Towards the time of Decius the character began to lose its roundness and beauty; but some time afterwards it retrieved, and subsisted tolerably till the time of Justin, when it degenerated gradually into the Gothic. The rounder, then, and better-formed a character is upon a medal, the fairer pretence it has to antiquity.

II. *Numeral* CHARACTERS, or characters used to express numbers, are either letters or figures.

The Arabic character, called also the common one, because it is used almost throughout Europe in all sorts of calculations, consists of the ten digits, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.

The Roman numeral character consists of seven majuscule letters of the Roman alphabet, viz. I, V, X, L, C, D, M. The I denotes one, V five, X ten, L fifty, C a hundred, D five hundred, and M a thousand. The I repeated twice makes two, II; thrice, three, III. Four is expressed thus, IV, as I before V or X takes an unit from the number expressed by these letters. To express six an I is added to a V, thus, VI; for seven, two, VII; and for eight, three, VIII. Nine is expressed by an I before X, thus, IX. The same remark may be made of the X before L or C, except that the diminution is by tens; thus, XL

denotes forty, XC ninety, and LX sixty. The C before D or M diminishes each by a hundred. The number five hundred is sometimes expressed by an I before a C inverted, thus, IↃ; and instead of M, which signifies a thousand, an I is sometimes used between two C's, the one direct and the other inverted, thus, CIↃ. The addition of C and Ↄ before or after raises CIↃ by tens; thus, CCIↃↃ expresses ten thousand, CCCIↃↃↃ a hundred thousand. The Romans also expressed any number of thousands by a line drawn over any numeral less than a thousand; thus, $\overline{V}$ denotes five thousand, $\overline{LX}$ sixty thousand; so likewise $\overline{M}$ is one million, $\overline{MM}$ is two millions, and so on.

The Greeks had three ways of expressing numbers: 1. Every letter, according to its place in the alphabet, denoted a number, from α, one, to ω, twenty-four. 2. The alphabet was divided into eight units, α one, β two, γ three, &c.; into eight tens, ι ten, κ twenty, λ thirty, &c.; and eight hundreds, ϱ one hundred, σ two hundred, τ three hundred, &c. 3. Ι stood for one, Π five, Δ ten, Η a hundred, Χ a thousand, Μ ten thousand; and when the latter Π inclosed any of these, except Ι, it showed the inclosed letter to be five times its value; as, |Δ| fifty, |Η| five hundred, |Χ| five thousand, |Μ| fifty thousand.

III. Characters of Abbreviations, &c. in several of the arts, are symbols contrived for the more concise and immediate conveyance of the knowledge of things.

Of the Aspects.

☌ or S Conjunction	△ Trine
SS Semisextile	Bq Biquintile
* Sextile	Vc Quincunx
Q Quintile	☍ Opposition
□ Quartile	☊ Dragon's head
Td Tredecile	☋ Dragon's tail

Of Time.

A. M. *ante meridiem*, before the sun comes upon the meridian.
O. or N. noon.
P. M. *post meridiem*, when the sun is past the meridian.

Characters in Commerce.

D° *ditto*, the same	S or *s*, shillings
N° *numero*, or number	*d*, pence or deniers
F° *folio*, or page	℔ pound weight
C or ⊕ hundredweight, or 112 pounds	R° *recto* } *folio* / V° *vero* } *folio*
qts quarters	Rx rixdollar
L. or *l.* pounds sterling	Dt ducat
pr *per* or by, pr *ann.* by the year, pr *cent.*	P. S. postscript, &c.

Characters in Geometry and Trigonometry.

‖ the character of parallelism	≚ equiangular or similar
△ triangle	≟ equilateral
□ square	∠ an angle
▭ rectangle	∟ right angle
⊙ circle	⊥ perpendicular

° denotes a degree; thus, 45° implies 45 degrees.
′ denotes a minute; thus, 50′ is 50 minutes. ″, ‴, ⁗, denote seconds, thirds, and fourths; and the same characters are used when the progressions are by tens, as it is here by sixties.

Characters in Grammar, Rhetoric, Poetry, &c.

( ) parenthesis	D. D. doctor in divinity
[ ] crotchet	V. D. M. minister of the word of God
- hyphen	LL. D. doctor of laws
' apostrophe	J. U. D. doctor of civil and canon law
` emphasis or accent	M. D. doctor of medicine
˘ breve	A. M. master of arts
¨ dialysis	A. B. bachelor of arts
^ caret and circumflex	F. R. S. fellow of the royal society
† ‡ and * references	(See Abbreviations.)
§ section or division	
¶ paragraph	
" quotation	

Characters among the ancient Lawyers, and in ancient Inscriptions.

§ paragraph	C. code
ff digests	C C. consules
Scto. senatus consulto	T. titulus
E. extra	P. P. D. D. propria pecunia dedicavit
S. P. Q. R. senatus populusque Romanus	D. D. M. dono dedit monumentum
P. P. pater patriæ	

Characters in Medicine and Pharmacy.

℞ recipe	coch. cochleare, a spoonful
ā, āā, or ana, of each alike	M. manipulus, a handful
℔ a pound, or pint	P. a pugil
℥ an ounce	P. Æ. equal weights
ʒ a drachm	S. A. according to art
℈ a scruple	q. s. a sufficient quantity
gr. grains	q. pl. as much as you please
ß or *f s* half of any thing	P. P. pulvis patrum, the Jesuits' bark
cong. congius, a gallon	

Characters upon Tomb-stones.

S. V. Siste viator, *i. e.* stop traveller
M. S. Memoriæ sacrum, *i. e.* sacred to the memory
D. M. Diis manibus
J. H. S. Jesus hominum salvator
X. P. a character found in the catacombs, about the meaning of which authors are not agreed.

Characters used in Music, and of Musical Notes with their proportions, are as follows:

character of a large......8	crotchet............... $\frac{1}{4}$
a long.....................4	quaver.................. $\frac{1}{8}$
a breve....................2	semiquaver........... $\frac{1}{16}$
a semibreve...............1	demisemiquaver...... $\frac{1}{32}$
a minim.................... $\frac{1}{2}$	

※ or ♯ character of a sharp note; this character at the beginning of a line or space denotes that all the notes in that line are to be taken a semitone higher than in the natural series; and the same affects all the octaves above and below, though not marked; but when prefixed to any particular note, it shows that note alone to be taken a semitone higher than it would be without such a character.

♭ or *b*, character of a flat note. This is the contrary to the other above; that is, a semitone lower.

♮ character of a natural note. When in a line or series of artificial notes marked at the beginning ♭ or ♯, the natural note happens to be required, it is denoted by this character.

𝄞 character of the treble clef
character of the mean clef
𝄢 bass clef

$\frac{2}{4}$ or $\frac{2}{8}$, characters of common duple ime, signifying the

measure of two crotchets to be equal to two notes, of which four make a semibreve.

C ₵ Ф characters that distinguish the movements of common time, the first implying slow, the second quick, and the third very quick.

$\frac{1}{2}$, $\frac{1}{3}$, $\frac{3}{4}$, $\frac{3}{8}$, $\frac{1}{16}$, characters of simple triple time, the measure of which is equal to three semibreves, or to three minims.

$\frac{4}{6}$, $\frac{6}{8}$, or $\frac{6}{16}$, characters of a mixed triple time, where the measure is equal to six crotchets or six quavers.

$\frac{9}{4}$, or $\frac{9}{8}$, or $\frac{9}{16}$, or $\frac{9}{1}$, or $\frac{9}{2}$, characters of compound triple time.

$\frac{4}{12}$, $\frac{8}{12}$, $\frac{12}{16}$, or $\frac{1}{12}$, or $\frac{2}{12}$, characters of that species of triple time called the measure of twelve times.

CHARACTER, in human life, that which is peculiar in the manners of any person, and distinguishes him from all others.

CHARACTER, in *Poetry*, particularly the epopee and drama, is the effect or result of the manners or peculiarities by which each person is distinguished from others.

The poetical character is not properly any particular virtue or quality, but a composition of several which are mixed together in different degrees, according to the necessity of the fable and the unity of the action; there must be one, however, to reign over all the rest, and this must be found, in some degree, in every part. The first quality in Achilles is wrath, in Ulysses dissimulation, and in Æneas mildness; but as these characters cannot stand alone, they must be accompanied with others to embellish them, as far as they are capable, either by hiding their defects, as in the anger of Achilles, which is palliated by extraordinary valour; or by making them centre in some solid virtue, as in Ulysses, whose dissimulation constitutes part of his prudence; and in Æneas, whose mildness is employed in submission to the will of the gods. In the making up of this union, it is to be observed, that the poets have joined together such qualities as are by nature the most compatible; valour with anger, piety with mildness, and prudence with dissimulation. The fable required prudence in Ulysses and piety in Æneas; in this, therefore, the poets were not left to their own choice. But Homer might have made Achilles a coward without abating any thing from the justness of his fable; and it was only the necessity of adorning his character that obliged him to make him valiant. The character, then, of a hero in the epic poem is compounded of three sorts of qualities; the first essential to the fable, the second embellishments of the first, while valour, which sustains the other two, constitutes the third.

Unity of character is as necessary as the unity of the fable. For this purpose a person should be the same from the beginning to the end; not that he is always to betray identical sentiments, or one passion; but that he should never speak nor act inconsistently with his fundamental character. For instance, the weak may sometimes burst into warmth, and the breast of the passionate may be calm; a change which often introduces into the drama a very affecting variety: but if the natural disposition of the former were to be represented as boisterous, and that of the latter as mild and soft, they would both act out of character, and contradict their personality.

True characters are such as we actually see in men, or as may exist without any contradiction to nature. No man questions but there have been men as generous and as good as Æneas, as passionate and as violent as Achilles, as prudent and as wise as Ulysses, as impious and atheistical as Mezentius, and as amorous and passionate as Dido. All these characters, therefore, are true, and nothing but just imitations of nature. On the contrary, a character is false when the author so feigns it that one can see nothing like it in the order of nature in which he designs it shall stand. Such characters should be wholly excluded from a poem, because, transgressing the bounds of probability and reason, they meet with no belief from the reader. They are fictions of the poet's brain, not imitations of nature; and yet all poetry consists of an imitation of nature.

CHARADE, the name of a fanciful species of composition or literary amusement. It owes its name to the idler who invented it. Its subject is usually a word of two syllables, each forming a distinct word; and these two syllables are to be concealed in an enigmatical description, first separately, and then together. The exercise of charades, if not greatly instructive, is at least innocent and amusing. Most of those which have appeared from time to time are not only destitute of all pleasantry, but are formed in general of words utterly unfit for the purpose. In trifles of this nature inaccuracy is without excuse. The following examples, therefore, are at least free from this blemish.

1. My *first*, however here abused,
Designs the sex alone;
In Cambria, such is custom's pow'r,
'Tis Jenkin, John, or Joan.
My *second* oft is loudly call'd,
When men prepare to fist it;
Its name delights the female ear;
Its force, may none resist it:
It binds the weak, it binds the strong,
The wealthy and the poor;
Still 'tis to joy a passport deem'd,
For sullied fame a cure.
It may insure an age of bliss,
Yet mis'ries oft attend it;
To fingers, ears, and noses too,
Its various lords commend it.
My *whole* may chance to make one drink,
Though vended in a fish shop;
'Tis now the monarch of the seas,
And has been an archbishop. *Her-ring.*

2. My *first*, when a Frenchman is learning English, serves him to swear by. My *second* is either hay or corn. My *whole* is the delight of the present age, and will be the admiration of posterity. *Gar-rick.*

3. My *first* is ploughed for various reasons, and grain is frequently buried in it to little purpose. My *second* is neither riches nor honours, yet the former would generally be given for it, and the latter is often tasteless without it. My *whole* applies equally to spring, summer, autumn, and winter; and both fish and flesh, praise and censure, mirth and melancholy, are the better for being in it. *Sea-son.*

4. My *first*, with the most rooted antipathy to a Frenchman, prides himself, whenever they meet, upon sticking close to his jacket. My *second* has many virtues, nor is it its least that it gives name to my first. My *whole* may I never catch! *Tar-tar.*

5. My *first* is one of England's prime boasts; it rejoices the ear of a horse, and anguishes the toe of a man. My *second*, when brick, is good; when stone, better; when *wooden*, best of all. My *whole* is famous alike for rottenness and tin. *Corn-wall.*

6. My *first* is called bad or good,
May pleasure or offend ye;
My *second*, in a thirsty mood,
May very much befriend ye.
My *whole*, though styled a "cruel word,"
May yet appear a kind one;
It often may with joy be heard,
With tears may often blind one. *Fare-well.*

7. My *first* is equally friendly to the thief and the lover, the toper and the student. My *second* is light's opposite, yet they are frequently seen hand in hand; and their

union, if judicious, gives much pleasure. My *whole* is tempting to the touch, grateful to the sight, but fatal to the taste. *Night-shade.*

CHARCOAL. When vegetable substances are subjected to a strong heat in the apparatus for distillation, the fixed residue is called charcoal. Charcoal is made in various ways. For general use it is obtained by building up pieces of wood in a pyramidal form, then covering the pile with earth or clay, leaving a few air-holes, which are closed when the mass is lighted, in order that combustion may proceed in a slow and imperfect manner. Charcoal of a very superior kind is made in the forest of Benon, near Rochelle, where great attention is paid to its manufacture. Black oak from ten to fifteen years old is cut into billets of about four feet in length, which are built up as above described, and, before being inclosed in the clay or earth, covered over to the depth of four inches with dry grass or fern. When the mass is charred, great care is taken to extinguish ignition, because if exposed too soon to the atmosphere, combustion goes on, and this is not put a stop to without difficulty. Accordingly, to obviate this, a barrel of water is thrown over the pile, and earth to the thickness of five or six inches is spread on it, after which it is left for twenty-four hours to cool. Charcoal is also made on a great scale in the following manner. A series of cast-iron cylinders, about four feet in diameter and six feet in length, are built horizontally into brickwork, so that the flame of one furnace may play round about two cylinders. The ends are made to project from the brickwork, and both are closed with discs of iron. From the centre of one of these an iron tube proceeds, and enters at a right angle the main tube of refrigeration. The vapour which is condensed in this vessel is a strong vinegar called pyroligneous acid. The tubes of course are filled with wood cut up into billets. Fire is applied during the day; all night they are allowed to cool, and next morning the charge is drawn. Care is taken to prevent the access of air, both while the wood is charring, and after it has begun to cool. When charcoal is wanted for the manufacture of gunpowder, it is necessary that the whole of the vinegar and tar should be allowed to escape, and that the reabsorption of the vapours should be prevented, by cutting off the communication between the interior of the cylinder and the apparatus for condensing the pyroligneous acid after the fire has been withdrawn from the furnace. Unless this precaution be taken, the gunpowder manufactured with the charcoal will be of inferior quality. Mr Mushet has made a number of valuable experiments respecting charcoal. The following is his table of results, reduced to 100 parts, from experiments on one pound avoirdupois of various kinds of wood.

	Volatile Matter.	Charcoal.	Ashes.
Oak	76·895	22·682	0·423
Ash	81·260	17·972	0·768
Birch	80·717	17·491	1·792
Norway Pine	80·441	19·204	0·355
Mahogany	73·528	25·492	0·980
Sycamore	79·20	19·734	1·066
Holly	78·92	19·918	1·162
Scotch Pine	83·095	16·456	0·449
Beech	79·104	19·941	0·955
Elm	79·655	19·574	0·761
Walnut	78·521	20·663	0·816
American Maple	79·331	19·901	0·768
American Black Beech	77·512	21·445	1·033
Laburnum	74·234	24·586	1·180
Lignum Vitæ	72·643	26·857	0·500
Sallow	80·371	18·497	1·132
Chestnut	76·304	23·280	0·416

By a long continued moderate heat Rumford obtained a much larger quantity of charcoal from wood; but Berzelius states, that wood in general yields from 22 to 27 per cent. of charcoal, according to the kind of wood, and the process employed. The best wood charcoal for gunpowder is obtained from spongy trees, such as the alder, the white willow, and the poplar. We are informed by M. Proust that good pit-coals afford 70, 75, or 80 per cent. of charcoal, which leaves of ashes after combustion only two or three parts in the hundred. This species is much used in Great Britain under the name of coke. Turf or peat has been lately charred in France by a peculiar process. It is considered as superior to that obtained from wood. It kindles more slowly, but emits more flame, and burns longer than the other. Gold fused by it retains its malleability; and this property is increased in iron heated red hot by it in a forge.

Charcoal is black, sonorous, and brittle, and generally retains the figure of the vegetable from which it was obtained. The charcoal produced from oily or bituminous substances is of a light pulverulent form, and rises in the form of soot. This charcoal of oils is well known in the arts under the name of lamp-black. What is called *animal charcoal* is obtained from the carbonaceous portion of bones. For an account of the chemical and other properties of charcoal, see CHEMISTRY, where it will be found treated of under the scientific appellation CARBON. (Ure's *Dictionary of Chemistry;* Tilloch's *Magazine*, vols. iii. and viii., On the Economical Application of Charcoal to Sanitary purposes, by John Stenhouse, LL.D., and J. Forbes Watson, M.A. London, 1855.)

CHARD, a municipal borough and market-town of England, Somersetshire, hundred of East Kingsbury, 18 miles S. of Bridgewater, and 139 miles from London. It was made a parliamentary borough, returning 2 members to parliament, by Edward I., but deprived of that privilege in the reign of Edward III. The town stands upon an eminence on the S. border of the county, is well built, and has manufactures of lace and woollen goods. Pop. (1851) 2291.

CHARDIN, SIR JOHN, a celebrated traveller, was born at Paris in 1643. His father, who was a jeweller, educated him for his own profession; and partly on business and partly to gratify his own inclination he set out on his travels to Persia and India. He visited these countries twice; and settling at last in London as jeweller to the court, he died there in 1713. He wrote an account of his travels in these regions which furnished to Montesquieu, Rousseau, Gibbon, and Helvetius, an accurate knowledge of the political system of Persia. His monument in Westminster Abbey bears the following inscription—*Nomen sibi fecit eundo.*

CHARENTE, an inland department in the S.W. of France, comprehending the ancient division of Angoumois, with inconsiderable portions of Saintonge, Poitou, and Limousin. It is bounded N. by the departments of Deux-Sèvres and Haute-Vienne; E. by those of Vienne and Dordogne; S. and W. by those of Dordogne and Charente-Inférieure. Area 2670 square miles. The great part of it consists of the valley of the river Charente, which rises in Haute-Vienne, and after a circuitous course passes into Charente-Inférieure, where it falls into the sea opposite Isle-Madame. Principal tributaries—the Tardoire, Touvres, Né Seugne, Antoine, and Boutonne. The Charente, though rapid, has been rendered navigable artificially; and steamers ply between Angoulême and Saintes, although the tide ascends no higher than the latter. The surface is comparatively level, and subject to frequent inundations. In the arrondissement of Confolens are upwards of 60 small lakes. The hills are generally uniform in height, and abound in marine deposits; while some of them are covered with chestnut forests. Climate temperate; prevailing winds W. and S.W. Principal productions, wine, corn, hemp, flax, and potatoes. The wine is largely distilled into brandy, for which Cognac is famous. The value of truffles annually brought to market is estimated at 300,000 francs. Pigs, sheep, and poultry are extensively reared for the Paris market. Its mineral productions consist chiefly of iron, lead, antimony, and

gypsum, of which iron and gypsum only are worked to any extent. Among its manufactures paper occupies the foremost place; but canvas, linen cloth, hats, cordage, hoops, and pottery are also made. Charente is divided into five arrondissements, deriving their names from the five principal towns. Their divisions and populations are as follows, viz.:—

Arrondissements.	Cantons.	Communes.	Pop. (1851.)
Angoulême	9	144	137,696
Cognac	4	70	57,959
Ruffec	4	82	59,260
Barbézieux	6	88	56,557
Confolens	6	70	71,440
Total	29	454	382,912

CHARENTE-INFERIEURE, or *Lower Charente*, a maritime department of France, comprehending the old provinces of Saintonge and Aunis, and including the islands of Ré, Oleron, Aix, and Madame. It is bounded N. by Vendée and Deux-Sèvres; E. by Charente; S. by Gironde, and W. by the Bay of Biscay. Area 2757 square miles. The surface is exceedingly flat throughout the whole department, and along the coast-line it is so far depressed as to require in many places the erection of sea-dikes and extensive artificial draining. Its facilities for internal communication are greatly increased by the number of navigable streams, and the formation of two canals, one from La-Rochelle to the Sèvre Niortaise, the other from Brouage to Rochefort. The productions very nearly coincide with those of Charente, with this difference—that its wines and brandy are greatly inferior, but its fruits and vegetables greatly superior to those of the upper province. It has also more extensive pasturage, and considerable revenue accruing from the pilchard and oyster fisheries on the coast, but its mineral wealth and manufactures are neither so various nor so productive. The former is confined to the salt supplied by marshes along the coast; the latter includes coarse woollen stuffs, leather, soap, earthenware, staves, and timber. It has several sheltered bays on the coast, and several good harbours, at which a brisk coasting trade is carried on. It has considerable trade in colonial produce; and shipbuilding is prosecuted to some extent. The climate is salubrious, except along the coast, where fevers and ague prevail. It is divided into six arrondissements, cognominal with the principal towns, which are subdivided and peopled as follows:—

Arrondissements.	Cantons.	Communes.	Pop. (1851.)
La-Rochelle	7	55	82,293
Rochefort	4	47	61,760
Marennes	6	34	51,689
Saintes..............	8	99	107,513
Jouzac	7	120	83,706
St Jean d'Angely	7	126	83,031
Total	39	481	469,992

CHARENTON-LE-PONT, a town of France, department of Seine, pleasantly situated on the right bank of the Marne, near its confluence with the Seine, 5 miles E.S.E. of Paris. Pop. 3000. The Marne is here crossed by a bridge of 10 arches, which has frequently been the scene of sanguinary conflicts, and has always been regarded as of great importance in the defence of the capital. This bridge unites the town with the village of Charenton St Maurice, where there is a large national lunatic asylum.

CHARES, of Lindus in Rhodes, a celebrated statuary, the sculptor of the famous statue of the Sun generally known as the "Colossus of Rhodes," which was regarded as one of the seven wonders of the world. See COLOSSUS. He was the favourite pupil of Lysippus, and flourished about B.C. 290.

CHARGE, in *Heraldry*, the figures represented on the escutcheon, by which the bearers are distinguished from one another.

CHARIOT, a half coach or carriage with four wheels and one seat, used for convenience and pleasure.

The chariots of the ancients had two wheels, and were supported by a pole (or sometimes by two, or even three, as among the Lydians). They were used in war and in the public games, and were called by the several names of *bigæ*, *trigæ*, or *quadrigæ*, according to the number of horses used to draw them. A chariot carried two men, the warrior and the charioteer; and we read of several men of note and valour employed in driving the chariot. When the warriors came to encounter in close fight, they alighted and fought on foot; and when weary, they retired to their chariots, and thence annoyed the enemy with darts and missile weapons. These chariots were so strongly built that they lasted for several generations.

We also find frequent mention of the *currus falcati*, or chariots armed with hooks or scythes, with which whole ranks of soldiers were sometimes cut down. These were used by the Persians, Syrians, Egyptians, and other eastern nations, and also among the ancient Britons. By the Greek and Roman historians these chariots are described by the various names of *benna*, *petoritum*, *currus* or *carrus*, *covinus*, *essĕdum*, and *rheda*. The *benna* seems to have been a chariot designed rather for travelling than for war. It contained two persons, who were thence called *combennones*. The *petoritum* seems to have been a larger kind of chariot than the *benna*, and is thought to have derived its name from the British word *pedwar*, signifying *four*, as this kind of carriage had four wheels. The *carrus* or *currus* was the common cart or waggon. This kind of chariot was used by the ancient Britons, in time of peace, for the purposes of agriculture and merchandise; and, in time of war, for carrying their baggage, and wives and children, who commonly followed the armies of all the Celtic nations. The *covinus* was a war-chariot, and a very terrible instrument of destruction, being armed with sharp scythes and hooks for cutting and tearing all who happened to come within its reach. This kind of chariot was made very light, being designed to drive with great force and rapidity, and to do execution chiefly with its hooks and scythes. The *essedum* and *rheda* were also war-chariots, probably of a larger size and stronger make than the *covinus*, being designed for containing a charioteer to conduct it, and one or two warriors to fight. The greater number of the British war-chariots seem to have been of this kind. These chariots were found in great numbers among the Britons; insomuch that, according to Cæsar, Cassivelaunus, after dismissing all his other forces, retained no fewer than four thousand war-chariots about his person. The same author relates, that by continual practice they had arrived at such perfection in the management of their chariots, that in the most steep and difficult places they could stop their horses when at full speed, turn them which way they pleased, run along the pole, rest on the harness, and throw themselves back into their chariots with incredible dexterity.

CHARIOTS were sometimes consecrated to the sun; and it is related in Scripture that Josiah burnt those which had been offered to the sun by the kings, his predecessors. This superstitious custom was an imitation of the heathens, and principally of the Persians, who had horses and chariots consecrated in honour of the sun. Herodotus, Xenophon, and Quintus Curtius, speak of white chariots crowned, which, among the Persians, were consecrated to the sun, and drawn by white horses.

Triumphal CHARIOT, was one of the principal ornaments of the Roman celebration of a victory.

The Roman triumphal chariot was generally made of ivory, and round like a tower, or rather of a cylindrical figure. It was sometimes gilded at the top, and ornamented with crowns; and in short the utmost skill was employed to render it as splendid as possible. It was commonly drawn

by four white horses; but also frequently by lions, elephants, tigers, bears, leopards, &c.

CHARISIUS, a surname of Zeus (Jupiter), derived from χάρις, *gratia*, grace or favour. It was customary among the Greeks at their meals to make a libation to Jupiter Charisius.

CHARISTIA, an annual festival of the Romans, celebrated on the 19th of February, in which the relations and members of the same family met, in order that any difference among them might the more easily be accommodated by the good humour and mirth of the entertainment. (Ovid, *Fast.* ii.)

CHARISTICARIES, in ecclesiastical history, among the Greeks, were a kind of donatories or commendatories, who enjoyed uncontrolled power over the revenues of hospitals and monasteries. The origin of this abuse is referred to the iconoclasts in the eighth century, and particularly to the emperor Constantine Copronymus, the avowed enemy of the monks, whose monasteries he gave away to strangers. In after-times the emperors and patriarchs gave many to persons of rank, not to enable the donatories to reap any temporal advantage from the grants, but to repair, beautify, and patronize them. But avarice prevailed over these good intentions, so that at length they were all given away, rich and poor, monasteries and nunneries, and that even to laymen and to married men.

CHARITE, La, a town of France, department of Nievre, on the right bank of the Loire, here crossed by a handsome bridge. It is an ancient town, formerly of greater importance, and is still partly surrounded by ramparts flanked by towers of the fourteenth century. It has an active trade, and considerable manufactures of hardware, jewellery, glass, earthenware, &c. Pop. 4500.

CHARITES, the three graces, Euphrosyne, Aglaia, and Thalia; called *Gratiæ* by the Romans. See Graces.

CHARITON, of Aphrodisias in Caria, a Greek writer, who probably lived about the fifth century of the Christian era. He was the author of the *Loves of Chæreas and Callirrhöe*, a romance of small invention, which has been translated into German and French. The best edition is that by D'Orville, reprinted by Beck, Lips. 1783.

CHARITY, one of the three grand Scriptural virtues, consisting in the love of God and of our neighbour, or the habit and disposition of loving God with all our heart, and our neighbour as ourselves.

Charity also denotes the effect of moral virtue, which consists in supplying the necessities of others, whether with money, counsel, assistance, or the like.

Brothers of Charity, a sort of religious hospitallers founded about the year 1297, since denominated *Billetins*. They took the third order of St Francis, and the scapulary, making the three usual vows, but without begging.

Brothers of Charity also denotes an order of hospitallers still subsisting in Catholic countries, whose business is to attend the sick poor, and minister to them both spiritual and temporal succour. They are all laymen, except a few priests for administering the sacraments to the sick in their hospitals. The brothers of charity usually cultivate botany, pharmacy, surgery, and chemistry, which they practise with success. They were first founded at Granada by St John de Dieu; and a second establishment was made at Madrid in 1553. The order was confirmed by Gregory XIII. in 1572. Gregory XIV. forbade them to take holy orders; but by leave of Paul V. in 1609, a few of the brothers might be admitted to orders. In 1619 they were exempted from the jurisdiction of the bishop. Those of Spain are separated from the rest; and they, as well as the brothers of France, Germany, Poland, and Italy, have their distinct generals, who reside at Rome. They were first introduced into France by Mary of Medicis in 1601, and have a fine hospital in the fauxbourg St Germain

Sisters of Charity (*Sœurs de la Charité*), an order of female hospitallers, revived in France since the commencement of the present century, and consisting chiefly of professed nuns who devote themselves to the duties of attending the poor and sick in the hospitals, ministering to their wants, dressing their sores, and affording them religious consolation. This order includes females belonging to some of the first families in France.

CHARKOV. See Kharkov.

CHARLATAN, one who prates much in commendation of himself, and makes unwarrantable pretensions to skill; originally an empiric or quack, a retailer of medicines on a public stage, who attracted notice by his buffooneries, feats of activity, and the like. The word, according to Calepine, comes from the Italian *ceretano*, from Cæretum, a town near Spoleto, where these impostors are said to have first appeared. Ménage, however, derives it from *ciarlatano*, and that from *circulatorius* or *circulator*, a mountebank.

CHARLEMAGNE, or Charles I. king of France, and emperor of the West by conquest, was born at the castle of Salzburg in Upper Bavaria in 742. The events in the life of this great monarch belong properly to the history of France. Equally illustrious in the cabinet and in the field, a wise legislator and a great warrior, the patron of men of letters and the restorer of learning, Charlemagne has united in his favour the suffrages of statesmen and soldiers, of ecclesiastics, lawyers, and men of letters, who have all vied with one another in bestowing the homage of their praise on the celebrated founder of the western empire. Politicians indeed have blamed him for having regulated every thing in his states except the succession to the throne, which he left at the mercy of faction; and for having multiplied those assemblies where the royal power is necessarily weakened by being divided, a policy unsuitable to the extent and condition of his empire. Nor is this censure without foundation. By his genius, his courage, his activity, and the skill with which he distributed rewards, he unquestionably surmounted all obstacles; but he unfortunately consolidated nothing; and hence, to succeed him, we do not say with glory, but with safety to the throne and to France, it would have been necessary to resemble him in many of his great qualities. But such a successor was nowhere to be found. Charlemagne was the last hero of his race; and as he took no effectual measures to consolidate the empire which he had established, it went to pieces not long after that disastrous day when his nephew Roland, "with all his peerage, fell by Fontarabia." His death happened on the 28th January 814, in the seventy-second year of his age, and the forty-seventh of his reign; and he was buried in the cathedral of Aix-la-Chapelle. In the latter part of last century his tomb was opened, and his body, clothed in the imperial robes, was found seated on a throne of state. The whole crumbled into dust on being touched; but the diamond clasp that fastened his mantle is still preserved at Vienna.

The works of Charlemagne are, 1. His *Capitularies*, first collected by Ansegise, abbot of St Wandrille, the best edition of which is that of Etienne Baluze, Paris, 1677, 2 vols. folio; 2. *Letters*, contained in the collection of D. Bouquet; 3. A *Grammar*, of which fragments are to be found in the *Polygraphia* of Trithemius; 4. His *Testament*, contained in Bouchel's *Bibliothèque du Droit Français*, tom. iii., printed at Paris, 1667, folio, 5. Some Latin poems, such as the *Epitaph of Pope Adrian*, and the *Song of Roland*; 6. The *Caroline Books*.

Of the more early historians of Charlemagne the principal is Eginhard. The details of his reign will be found under France and Italy.

CHARLEROI or Charleroy, a town on the Sambre, province Hainault, Belgium, 33 miles S. from Brussels. It was originally founded by Charles II. of Spain; was destroyed in 1795; attacked by Napoleon in 1815; and restored

and strengthened in the following year by the Duke of Wellington. It contains extensive manufactories of woollen stuffs, leather, ropes, and glass, besides several distilleries and sugar refineries. There are about 90 coal pits, 50 iron foundries, and 70 high furnaces in the vicinity. About 6000 of the inhabitants are employed in nail-making, and 8345 at the coal-mines of the district. The railways, which run to most of the important towns, and the Brussels and Charleroi canal, afford abundant means of transit. Pop. of the town 8080; of the arrondissement 141,107.

CHARLES MARTEL (i.e. *the Hammer*), a renowned conqueror in the early annals of France. He deposed and restored Chilperic, king of France; and had the entire government of the kingdom, first with the title of *Mayor of the Palace*, and afterwards as *Duke of France.* He was the first to check the victorious career of the Saracens, who had overrun Spain and France. He defeated them with great slaughter near Tours, A.D. 732. He died in 741. See FRANCE.

CHARLES *le Gros*, emperor of the west in 881, king of Italy and Suabia, is memorable for his reverse of fortune. He was dethroned at a diet held near Mentz, by the French, the Italians, and the Germans, in 887; after which he was obliged to subsist on the bounty of the archbishop of Mentz. He died in 888.

CHARLES V., emperor of Germany and king of Spain, was son of Philip archduke of Austria, and of Jane queen of Castile. He was born at Ghent on the 24th February 1500, and succeeded to the crown of Spain in 1517. Two years afterwards he was chosen emperor at Frankfort, upon the death of his grandfather Maximilian. He was a great warrior and politician; and his ambition prompted him to aspire to universal empire. He fought sixty battles, in most of which he was victorious. He took Francis I., the king of France, prisoner at the battle of Pavia, and afterwards sold him his liberty on very hard terms; yet when the people of Ghent subsequently revolted, he asked leave to pass through the dominions of Francis; and the generous king, so far from avenging the ill treatment he had experienced, received and attended Charles with the utmost pomp and magnificence. He sacked Rome, took the pope prisoner, and perpetrated cruelties which are said to have exceeded those committed by the northern barbarians; yet the pious emperor went into mourning on account of this conquest, forbade the ringing of bells, commanded processions to be made, and prayers to be offered up for the deliverance of the pope his prisoner; and at the same time forbore to inflict the slightest punishment on those who had treated the holy father and the holy see with such inhumanity. He is accused by some Catholic writers of favouring the Lutherans, whom he might easily have extirpated. But the truth is, he found his account in the divisions which that sect occasioned; and he never failed to take advantage of them, sometimes against the pope, sometimes against France, and at other times against the empire itself. He was a great traveller, and made fifty different journeys into Germany, Spain, Italy, Flanders, France, England, and Africa. Though he had been successful in many unjust enterprises, yet his last attempt on Metz, which he besieged with an army of 100,000 men, and which deserved to have succeeded, proved a total failure.

Vexed at the reverse of fortune which seemed to attend his latter days, and oppressed by sickness, which unfitted him any longer for holding the reins of government with steadiness, or guiding them with address, he resigned his dominions to his brother Ferdinand and his son Philip, and retired to the monastery of St Justus, near Placentia, in Estremadura.

About six months before his death, the gout, to which he had long been subject, after a longer intermission than usual, returned with a proportional increase of violence. His shattered constitution had not strength enough remaining to withstand such a shock. It enfeebled his mind as well as his body; and from this period we hardly discern any traces of that sound and masculine understanding which distinguished Charles among his contemporaries. An illiberal and timid superstition depressed his spirit. He had no relish for amusements of any kind; and endeavoured to conform, in his manner of living, to all the rigour of monastic austerity. He desired no other society than that of monks, and was almost continually employed in chanting with them the hymns of the missal. As an expiation for his sins, he gave himself the discipline in secret, with such severity, that the whip of cords which he employed as the instrument of his punishment was found, after his decease, tinged with his blood. Nor was he satisfied with these acts of mortification, which, however severe, were not unexampled. The timorous and distrustful solicitude which always accompanies superstition still continued to disquiet him, and, depreciating all that he had done, prompted him to aim at something extraordinary, some new and singular act of piety which would display his zeal, and merit the favour of Heaven. The act on which he fixed was as wild and uncommon as any that superstition ever suggested to a disordered fancy. He resolved to celebrate his own obsequies before his death. He ordered his tomb to be erected in the chapel of the monastery. His domestics marched thither in funeral procession, with black tapers in their hands; and he himself followed in his shroud. He was laid in his coffin with much solemnity. The service for the dead was chanted; and Charles joined in the prayers which were offered up for the rest of his soul, mingling his tears with those which his attendants shed, as if they had been celebrating a real funeral. The ceremony closed with sprinkling holy water on the coffin in the usual form, and, all the assistants retiring, the doors of the chapel were shut. Then Charles rose out of the coffin, and withdrew to his apartment, full of those awful sentiments which such a singular solemnity was calculated to inspire. But either the fatiguing length of the ceremony, or the impression which this image of death left on his mind, affected him so much that next day he was seized with a fever. His feeble frame could not long resist its violence; and he expired on the 21st of September, after a life of fifty-eight years, six months, and twenty-one days. (Robertson's *History of Charles V.*) See SPAIN.

CHARLES I. } kings of Britain. See BRITAIN.
CHARLES II. }

CHARLES XII., king of Sweden, born in 1682, and killed at Frederickshall in Norway in 1718. His military achievements, which astonished all Europe, and his character as a sovereign, form parts of the history of Sweden, and are given in the account of that country. In person he was tall and of a noble mien, had a fine open forehead, large blue eyes, flaxen hair, fair complexion, a handsome nose, but little beard, and an agreeable smile. His manners were harsh and austere, not to say savage; and with respect to religion, he was indifferent towards all, though exteriorly a Lutheran, and a strong believer in predestination. A few anecdotes will illustrate his character. No dangers, however great, made the least impression upon him. When a horse or two were killed under him at the battle of Narva in 1700, he leapt nimbly upon fresh ones, saying, "These people find me exercise." One day when he was dictating letters to a secretary, a bomb fell through the roof into the next room of the house where they were sitting. The secretary, terrified lest the house should come down upon them, let the pen drop out of his hand. "What is the matter?" said the king calmly. The secretary could only reply, "Ah, Sire, the bomb!" "The bomb!" said the king, "what has the bomb to do with what I am dictating to you? Go on."

He preserved more humanity than is usually found among conquerors. Once in the middle of an action, finding a young Swedish officer wounded and unable to march, he obliged the officer to take his horse, and continued to command his infantry on foot. One day, near Leipsic, a peasant threw himself at his feet, with a complaint against a grenadier, that he had robbed him of certain eatables provided for himself and his family. "Is it true," said Charles sternly, "that you have robbed this man?" The soldier replied, "Sir, I have not done near so much to this man as your majesty has done to his master; for you have taken from Augustus a kingdom, whereas I have only taken from this poor scoundrel a dinner." Charles made the peasant amends, and pardoned the soldier for his firmness: "However, my friend," said he to the grenadier, "you will do well to recollect, that if I took a kingdom from Augustus, I did not take it for myself."

CHARLES'S WAIN, in *Astronomy*, seven stars in the constellation called *Ursa Major* or the Great Bear.

CHARLESTON, a city and seaport, capital of a district of the same name in the state of South Carolina, North America, stands on a tongue of land formed by the junction of the Ashley and Cooper rivers. N. Lat. 32. 46. 33., W. Long. 79. 57. 27. The bay is a large estuary formed by the junction of the two rivers, and extends about 7 miles S.E. from Charleston to the ocean, having an average width of 2 miles. A sand-bar extends across its mouth, but there are several channel entrances, the deepest of which, passing close to Sullivan's Island, admits at high tide vessels drawing 16 feet of water. Cooper and Ashley rivers are both deep and capable of accommodating the largest class of vessels, the former being 1400, and the latter 2100 yards wide opposite the city. The harbour is open to easterly winds, and vessels are much exposed during storms from that quarter. The city is protected by Fort Moultrie on Sullivan's Island, and by Castle Pinchney and Fort Johnson, the former 2 miles and the latter 4 below the city.

Charleston, one of the oldest cities in the Union, was founded as early as 1672, and was first called Oyster-Point Town. It soon became a place of considerable trade, and was chartered as a city in 1783. The ground on which it is built is low, being only 8 or 9 feet above high tide, which rises here about 6 feet; and the city has several times suffered from inundations by the water of the harbour being driven up by violent winds. The city is divided into four wards, and is governed by a mayor and 12 aldermen. It is regularly laid out in parallel streets running E. and W. from the Cooper to the Ashley, and intersected by others at nearly right angles. The streets vary in width from 35 to 70 feet, the houses are neat and elegant, and mostly built of brick. The streets are lined with a tree termed the "Pride of India;" while elegant villas adorned with verandahs, and surrounded with orange trees, magnolias, and palmettoes, add much to the elegance and beauty of the city. Among the public buildings are the city hall, exchange, court-house, jail, two arsenals, custom-house, theatre, college buildings, and orphan asylum. The college, one of the most flourishing institutions of the southern states, was founded in 1785, and has a president and 6 professors, with (in 1850) 70 students. The medical college was founded in 1833, and in 1850 had 8 professors and 158 students. The literary and philosophical society has a fine collection of objects in natural history, &c.; and the academy of fine arts possesses some valuable paintings. The city library contains about 2400 volumes. Four daily, 4 weekly, 1 bi-monthly, and 3 monthly newspapers and periodicals are published in Charleston. The floating dry dock is considered one of the best in the Union. The South Carolina railway extends from Charleston to Augusta, 136 miles, and has numerous branches going off in different directions. A canal 22 miles long connects the harbour with the Santee river; and by means of the railways now in the course of construction it will communicate with the Mississippi and Ohio rivers. The staple exports of Charleston are rice and cotton. Of cotton the receipts from the interior in 1850 were 400,714 bales, and of sea-island 17,994 bales; the exports were 365,327 bales upland, and 16,437 sea-island; the receipts of rice amounted to 147,690 barrels, the exports to 134,417 barrels. In 1852, 6,587,764 lb. sea-island, and 122,785,275 lb. upland cotton, 33,185 tierces of rice, and 329,279 bushels rough rice were exported. Charleston carries on very little foreign traffic. Its principal trade is coastwise with New York, whence the commodities are shipped to other countries. For the year ending June 1850 only 351 vessels of 121,367 tons cleared, and 303 vessels of 96,619 tons entered from foreign ports. The registered shipping of the port at this period consisted of 15,377 tons, and the shipping employed in the coasting trade of 17,916. The population of Charleston in 1790 was 16,359; in 1800, 18,711; 1810, 24,711; 1820, 24,780; 1830, 30,289; 1840, 29,261; and in 1850, 42,985. This is exclusive of the suburb St Philip, which contains about 16,000 inhabitants.

CHARLESTOWN, a town of North America, state of Massachusetts, and county of Middlesex, situated on a peninsula formed by the Charles and Mystic rivers, one mile N. of Boston, with which, as also with Chelsea, Malden, &c. it is connected by bridges. It contains the Massachusetts state prison, lunatic asylum, town-hall, and United States navy-yard covering 60 acres of land, and which has a marine hospital, extensive warehouse, arsenal, and powder magazine. Breed's or Bunker's Hill stands close to the town, and has a granite obelisk commemorating the battle fought there June 17, 1775. Charlestown may be considered as a suburb of Boston. It is a place of considerable trade, and had in 1850 17,216 inhabitants.

CHARLETON, Walter (1619–1707), a learned English physician, and physician in ordinary to Charles I. and Charles II., was one of the first members of the Royal Society, and president of the College of Physicians. Having fallen into straitened circumstances he was obliged to retire to Jersey, where he died. He wrote several dissertations on medical and antiquarian subjects.

CHARLEVILLE, a remarkably handsome and well built town of France, on the left bank of the Meuse, department of Ardennes, arrondissement and one mile N. of the town of Mézières, with which it is connected by an avenue and suspension bridge. Since the end of the seventeenth century, when its fortifications were destroyed, it has become a thriving place, and has manufactures of nails, hardware, firearms, &c., and an active export trade in wine, spirits, coal, iron, and slates. It has tribunals of primary instance and commerce, a commodious port, theatre, public library of 24,000 volumes, and cabinet of natural history. The royal manufactory of arms, formerly established here, has been transferred to Tulle and Chatellerault. Pop. 9000.

Charleville, a town of Ireland, county of Cork, 34 miles N.N.W. of Cork, and 129½ from Dublin by the Great Southern and Western railway, on which it has a station. It is pleasantly situated, tolerably well built, and has a handsome Roman Catholic chapel, court-house, classical school, bridewell, dispensary, fever hospital, corn-mills, and some manufactures of blankets and leather. Previous to the Union it returned 2 members to the Irish parliament. Pop. (1851) 2685.

CHARLEVOIX, Pierre François Xavier de, a French Jesuit missionary, who has left laborious and minute accounts of his proceedings in North America. He was born in 1682, went to Quebec in 1720, explored Canada and St Domingo, and returned to France in 1722. His *Histoire de la Nouvelle France* contains good details regarding the French settlements in the new world. He also compiled an account of Japan, principally taken from Kœmp-

fer; and a history of St Domingo from the MSS. of another Jesuit, Bers; besides an account of Paraguay from similar materials. He died in 1761.

CHARLOTTENBURG, a town in the Prussian province of Brandenburg, government of Potsdam, and circle of Teltow, on the left bank of the Spree, 4 miles W. of Berlin. The town is handsome and well built, the streets are straight, and ornamented with rows of trees. There is a magnificent palace built by Frederick I. with finely laid out gardens, always open to the public, and much resorted to by parties from the capital. In a secluded part of the gardens there is an exquisite statue of the beautiful and unfortunate queen Louisa of Mecklenburg. Pop. (1849), including the military, 9213.

CHARLOTTESVILLE, a village in the state of Virginia, North America, capital of the county of Albemarle, on Moore's Creek, 2 miles from its entrance into the Rivanna river, 63 miles N.W. of Richmond. It is chiefly important as being the seat of the university of Virginia, founded in 1819, and which has a fine observatory, museums, library of 18,000 volumes, and about 400 students. Pop. about 1400.

CHARLOTTE-TOWN, the capital of Prince Edwards Island, stands on a gentle eminence on the N. bank of the Hillsborough river, near the south coast. The harbour is good and capacious. The town is well built, and has a court-house, barrack, fort, two churches, national school, &c. Pop. 4000.

CHARM (Latin *carmen*, a verse), is used to denote a magical power or spell, by which sorcerers and witches were supposed, with the assistance of the devil, to do wonderful things.

CHARNEL, or CHARNEL-HOUSE, a place under or near churches, where the bones of the dead are reposited. Anciently, a kind of portico or gallery, in or near a church-yard, over which the bones of the dead were laid after the flesh had been consumed.

CHAROLLES, a town of France, capital of an arrondissement of the same name, in the department of Saône-et-Loire, 30 miles W.N.W. of Mâcon. It has tribunals of primary instance and commerce, agricultural society, communal college, public library, manufactories of pottery ware, iron forges, and a considerable trade in corn, wine, cattle, and timber. It was the capital of Charolais, an old division of France which gave the title of Count to the eldest son of the Duke of Burgundy. The ruins of the count's castle occupy the summit of a hill in the immediate vicinity. Pop. (1851) 3427.

CHARON, in Grecian mythology, the son of Erebus and Nox, whose office it was to ferry the souls of the deceased over the waters of Acheron. For this service each soul was required to pay an obolus or danace; which coin was accordingly placed in the mouth of every corpse previous to burial.

CHARONDAS, a celebrated lawgiver, who legislated not only for his native Catana, but likewise for various cities of Magna Græcia. By some he is said to have been a disciple of Pythagoras, who flourished B.C. 540–510; and according to the common account (as given by Diodorus, xii.), he also drew up a code for the use of the Thurians; but this statement is scarcely admissible, since Thurii was not founded till the year 443, and it is known that the laws of Charondas were in use among the Rhegians till they were abolished by Anaxilaus, who reigned from B.C. 494 to 476. It is traditionally related that Charondas fell a sacrifice to one of his own laws, by which it was made a capital offence to appear armed in a public assembly. Hastening to quell a tumult on his return from a military expedition, his sword still hanging by his side, a citizen reminded him of his violation of the law; upon which Charondas exclaimed—"Then will I seal it with my blood," and immediately plunged the weapon into his breast. Fragments of his laws are given in Heyne's *Opuscula*, vol. ii.

CHARPENTIER, FRANÇOIS (1620–1702), dean of the French academy, was educated for the bar; but preferred the study of languages and antiquity to that of law. He was employed by Colbert in establishing his new Academy of Medals and Inscriptions; and was a principal contributor to the series of medals struck on occasion of the principal events which distinguished the reign of Louis XIV. His principal works are a *Life of Socrates*, a *Translation of the Cyropædia*, and a good collection of Ana.

CHARR. See ICHTHYOLOGY.

CHARRON, PIERRE, the author of a book on *Wisdom*, and *Les Trois Vérités*, was born at Paris in 1541. After having been advocate in the parliament of Paris for five or six years, he applied himself to divinity, and became so popular a preacher, that the bishops of several dioceses offered him the highest dignities in their gift. He died suddenly in the street at Paris, on the 16th of November 1603.

CHART, or SEA-CHART, an hydrographical map, or a projection of some part of the earth's superficies *in plano*, for the use of navigators. Charts differ very considerably from geographical or land-maps, which are of no use in navigation. Nor are sea-charts all of the same kind; some being what are called plane charts, others Mercator charts, and others globular charts.

Plane CHART is a representation of some part of the superficies of the terraqueous globe, in which the meridians are supposed parallel to each other, the parallels of latitude at equal distances, and consequently the degrees of latitude and longitude everywhere equal to each other.

Mercator's CHART is that where the meridians are straight lines, parallel to each other, and equidistant; the parallels also straight lines, and parallel to each other; but the distance between them increasing from the equinoctial towards either pole, in the ratio of the secant of the latitude to the radius.

Globular CHART, a meridional projection, in which the distance of the eye from the plane of the meridian, upon which the projection is made, is supposed to be equal to the sine of the angle 45°. This projection comes the nearest of all to the nature of the globe, because the meridians are placed at equal distances; the parallels also are nearly equidistant, and consequently the several parts of the earth have their proper proportion of magnitude, distance, and situation, nearly the same indeed as on the globe itself.

Hydrographic CHARTS, sheets of large paper on which several parts of the land and sea are described, with their respective coasts, harbours, sounds, flats, rocks, shelves, sands, and so forth, together with the longitude and latitude of each place, and the points of the compass.

Selenographic CHARTS, represent the spots, appearances, and maculæ of the moon.

Topographic CHARTS, draughts of small parts of the earth, or of particular places.

CHARTA, primarily signifies a sort of paper made of the plant *papyrus* or *biblus*.

CHARTER, MAGNA CHARTA. The word charter, from χάρτης, thick paper or parchment, came to be applied, from the substance on which it was written, to a document granted by a prince conferring or acknowledging privileges to be enjoyed by either the whole, or a portion of the people under his rule. In England, from the Conquest downwards, there was a struggle between those who sought to enforce the feudal exactions which the Normans had learned in France, and those who attempted to resist the innovation and hold to the old Saxon customs. If at first it was a contest between the monarch with his Norman followers on the one side, and the Saxon population on the other, the conditions had changed during the lapse of nearly a century and

a half preceding the reign of John, and the barons were so frequently incensed by the oppressions and exactions of the ambitious kings, to whose power they had contributed so much, that they joined in the general demand for "the good old laws of Edward the Confessor." Even so early as the reign of the Conqueror himself, there was a royal acknowledgment of franchises or liberties, and the charters, renewals, or confirmations granted by subsequent kings are inextricably numerous. Coke, without exhausting them, counts thirty-two. The Great Charter of King John has so conspicuous a place in history, not only from its comparative completeness, but because it was exacted by men with arms in their hands from a resisting king, and was thus an enforced stipulation likely to be rigidly interpreted, instead of a concession carelessly conceded and readily forgotten. A great many of the stipulations of the great charter refer to feudal exactions now so long obsolete that the restraints on them cease to be intelligible; and those who have looked at the "palladium of our liberties" expecting to find in it high-sounding definitions of freedom like those in modern continental declarations of right have been much disappointed. Even in the comparatively popular language of Blackstone, there is not much to convey a distinct expression to unprofessional modern readers.

"It fixed," he says, "the forfeiture of lands for felony in the same manner as it still remains; and prohibited for the future the grants of exclusive fisheries, and the erection of new bridges so as to oppress the neighbourhood. With respect to private rights, it established the testamentary power of the subject over part of his personal estate, the rest being distributed among his wife and children; it laid down the law of dower as it has continued ever since; and it prohibited the appeals of women, unless for the death of their husbands. In matters of public police and national concern, it enjoined an uniformity of weights and measures; gave new encouragements to commerce, by the protection of merchant strangers; and forbade the alienation of lands in mortmain. With regard to the administration of justice, besides prohibiting all denials or delays of it, it fixed the court of common pleas at Westminster, that the suitors might no longer be harassed with following the king's person in all his progresses; and at the same time brought the trial of issues home to the very doors of the freeholders, by directing assizes to be taken in the proper counties, and establishing annual circuits. It also corrected some abuses then incident to the trials by wager of law and of battle; directed the regular awarding of inquests for life or member; prohibited the king's inferior ministers from holding pleas of the crown, or trying any criminal charge, whereby many forfeitures might otherwise have unjustly accrued to the exchequer; and regulated the time and place of holding the inferior tribunals of justice, the county-court, sheriff's turn and court-leet. It confirmed and established the liberties of the city of London, and all other cities, boroughs, towns, and ports of the kingdom. And, lastly, it protected every individual of the nation in the free enjoyment of his life, his liberty, and his property, unless declared to be forfeited by the judgment of his peers, or the law of the land."

The material feature of the document is that so slightly referred to in the above extract, which says, "No freeman shall be taken or imprisoned, or be disseised of his freehold or liberties, or free customs, or be outlawed or exiled, or any otherwise damaged, nor will we pass upon him, nor send upon him, but by lawful judgment of his peers, or by the law of the land." In this stipulation there is inferred that supremacy of the fixed principles of the law over the will and power of the monarch, which has rendered the fanatical devotion of the English lawyers to their common law so justifiable; and as a farther security, the right of trial by peers or jurymen appointed a perpetual popular tribunal to check the official judges, should they be tempted to sell the liberties and privileges of the subject. Hallam, a very competent judge, says, "The institutions of positive law, the far more important changes which time has wrought in the order of society during 600 years subsequent to the Great Charter, have undoubtedly lessened its direct application to our present circumstances. But it is still the keystone of English liberty. All that has since been obtained is little more than a confirmation or commentary; and if every subsequent law were to be swept away, there would still remain the bold features that distinguish a free from a despotic monarchy."—(*Mid. Ages*, tit. ii. chap. viii.)

Exemplars of the Great Charter were preserved among the muniments of cathedrals, and in other places calculated to preserve public archives. The late record commission, when they published their edition of the statutes of the realm, were desirous to print the best authenticated version of the charter of King John; and they state, that "In Lincoln Cathedral, an original of the Great Charter of Liberties, granted by King John in the seventh year of his reign, is preserved in a perfect state. This charter appears to be of superior authority to either of the two charters of the same date preserved in the British Museum. From the contemporary indorsement of the word *Lincolina* on two folds of the charter, this may be presumed to be the charter transmitted by the hands of Hugh, the then bishop of Lincoln, who is one of the bishops named in the introductory clause."—(*Introduction*, xxix.)

Among the other concessions of a less comprehensive nature, the Charter of the Forest was deemed next in importance to Magna Charta. In nothing was the selfish rapacity of the Norman monarchs more conspicuous than in their relentless clearings of great districts of country for the establishment of forests or chases, where the sanctity of their field sports was protected with a strict legal severity not conceded to the protection of ordinary property and personal freedom. The Charter of the Forest imposed wholesome limits on such inroads, and hence, along with the Great Charter, it has been printed at the commencement of the English statutes. The position of these documents in a series of acts of parliament is not so anomalous as it might seem; for it would be very difficult to distinguish the charters from the earliest statutes, which were concessions or admissions granted by the monarch, on the requisition of the principal persons of the realm assembled together. Our statutes, indeed, still bear in their phraseology a testimony to this origin.

The early use of the word "charter," as a foundation of constitutional liberties, led to its being applied on various occasions to fundamental constitutional codes or rules of government adopted by various nations. The most memorable instance is the French *Charte*, containing the constitution of the French government, as adjusted at the restoration in 1815, and amended at the revolution of 1830, which was caused by an attempt of Charles X. to stretch one of its dubious clauses. See France.

From such public acts as Magna Charta, the concession of privileges by charter from the crown descended through various grades. Both in England and Scotland the privileges of municipal corporations were either conferred of old by charter, or presumed to have been so. (Municipal Corporations.) The power of the crown has in this form long virtually departed, but it is still competent to incorporate collective bodies with certain limited powers by royal charter; though, in general, it is deemed necessary when the powers might affect personal or public interests to secure them by act of parliament. (See Corporation.) Insidious privileges were sometimes granted by charter, and were among the objects of the attacks on the crown's power to grant monopolies in the seventeenth century.

By the practice of mimicking the usages of the sovereign through all grades of feudality, it became the custom for

every feudal lord or superior, high or low, when conceding any privilege as to his fief or landed property to do so by a charter. Thus, throughout the British empire, and in Scotland especially, one of the most ordinary deeds connected with the commerce in land, assumes to this day the shape of a concession of privileges by a sovereign or other high feudal lord to his vassal. One of the essential features which the student of Scottish law has to master in the practice of conveyancing, is the constitution of the charter. Although modern practice has ingrafted on it other classes of deeds, to suit the exigencies of the commerce in land, such as the disposition, the assignation, &c., yet "the charter" is the original source from which the spirit and tenor of the whole system of conveyancing are to be acquired. (J. H. B.)

Charter-Party, a written, or partly written and partly printed contract, by which a ship is let or hired for the conveyance of goods on a specified voyage, or for a definite term in some particular trade. By the terms of this contract the owners declare the ship to be "tight, staunch, strong, and every way fitted for the voyage;" and they are accordingly liable in damages to the merchant or charterer, if the ship be unseaworthy, or if they fail to provide her either with any necessary equipment, or with the clearances or other documents legally required for the voyage. The shipowners are further bound to have the vessel ready to receive her cargo at the stipulated time; and they are responsible for the proper stowage of the goods received on board. On the loading being completed, the vessel must proceed without delay to her appointed destination; and should she unnecessarily deviate from the regular course of the voyage (a proceeding which might vitiate the merchant's insurances), the owners are legally liable for whatever damages the merchant may prove that he has thereby sustained. On arrival at the port of destination the goods are to be delivered "agreeably to bills of lading," the responsibility of the shipowners in this particular being limited by the usual exception against loss or damage by "the act of God, the queen's enemies, fire, and all and every other dangers and accidents of the seas, rivers, and navigation of whatever nature and kind soever." The freight payable to the shipowners is the amount specified in the charter-party, which may in certain cases be either more or less than the rates mentioned in the bills of lading; the charterer having usually the right of sub-letting the ship in part or in whole to other shippers, on terms agreed upon between themselves, and which it is customary to specify in their separate bills of lading, without prejudice to the original agreement. In such cases, however, the shipowners' lien on the goods for freight extends only to the amount specified in the bills of lading; and they must look to the charterer personally for any further sum which may be due to them.

The charterer, on his part, is bound to furnish the cargo at the port of loading, and to take delivery of the same at the port of discharge within specified periods, which are usually called "laydays." He may detain the vessel for a certain fixed time beyond the stipulated laydays on payment of a specified sum as "demurrage" for each day the ship is so detained. The laydays commence on the ship being ready to load or to discharge, even although it may happen from the port being crowded, or from similar causes, that she cannot at the time be placed in a berth where it would be convenient or even practicable for the merchant to begin these operations.

The vessel is not bound to proceed nearer to her port of loading and discharging than "she may safely get;" and this is held to mean that she is not bound to go nearer to a loading port than to the point from which she can safely get away again *with her cargo on board.* The charterer, therefore, must pay the expense of necessary lighterage in loading or discharging, unless there be a specific agreement to the contrary.

It is usual to insert in charter-parties a clause by which the parties bind themselves to fulfil their contract under a specified sum as penalty for non-performance; but the amount of this penalty is not the absolute limit of the damages which either party may be entitled to recover under any of the other conditions which may have been violated. See Carrier. (J. W—K.)

CHARTISTS, the name of a party of political agitators in Great Britain, who sprung up about the year 1838, and whose views are developed in a document called the "People's Charter." As their leading principles they advocate universal suffrage, vote by ballot, annual parliaments, no property qualification, division of the kingdom into electoral districts so as to give uniform constituencies, and the payment of members. See Britain, vol. iv., p. 671.

CHARTOPHYLAX. See Chartulary.

CHARTRES, the capital of the department Eure-et-Loire, 55 miles S.W. from Paris, and connected with it by railway, stands on a slope skirted by the river Eure, which flows partly within and partly without the ramparts. The houses are antique and straggling; but there are four fine squares, in one of which, used as the herb-market, is an obelisk in memory of General Marceau. It is the seat of tribunals of the first instance and commerce; of a communal college and diocesan seminary; and has a weekly corn-market, which is well managed by a corporation of women. Its chief manufactures are woollens and leather. Its cathedral of Nôtre Dame, founded by Bishop Fulbert in 1269, is a vast Gothic edifice, and is reckoned one of the finest cathedrals in France. The churches of St Pierre and St André may also be noticed. Pop. (1851) 16,680.

Chartres was one of the principal towns of the Carmites, and by the Romans was called Autricum from the river Audura (Eure). From the Romans it passed into the hands of the Frankish kings, and was successively taken by Thierry II., king of Orleans and Bourgogne, and by the Normans, who burnt it in 852 and 872. It afterwards fell into the hands of the English, from whom it was again recovered in 1432. It was attacked unsuccessfully by the Protestants in 1568, and taken in 1591 by Henry IV., who was consecrated there three years afterwards. Since the time of Louis XIII. the title of Duke de Chartres has been hereditary in the family of Orleans.

CHARTREUSE, La Grande, a famous Carthusian monastery of France, department of Isère, 14 miles N. of Grenoble, occupying the summit of a steep rock in a wildly picturesque district, 4268 feet above the level of the sea. It was founded in 1084, but the present buildings have been erected since 1676. During the revolution the monks were driven out and their property confiscated and sold; but in 1826 it was restored to its original destination, and is still the capital of the Carthusian convents. See Carthusians.

From this mother convent all others of the same order took their name, among which was the Chartreuse of London, corruptly called the *Charterhouse.* This old monastery in 1611 was converted into a hospital for a master, preacher, second master, 40 boys, and 80 pensioners not under 50 years of age, and endowed with lands then worth about L.5000 a year. The boys receive instruction in the classics; and those sent to the university have an exhibition of L.20 a year for 8 years, and an immediate title to 9 church livings in the gift of the governors of the hospital, who are sixteen in number. The pensioners have provisions, fire, lodging, a gown of black cloth, and an allowance of money. They are presented by the governors in rotation.

CHARTULARY, Chartularius, an officer in the ancient Latin Church, who had the care of charters and papers relating to public affairs. He also presided in ecclesiastical judgments, in place of the pope. In the Greek Church the chartulary was called *chartophylax;* but his

office was there even more considerable. The word *chartulary* is also used for a record or register, as of a monastery.

CHARYBDIS. See SCYLLA.

CHASE, or CHACE, is a place of retreat for deer and wild beasts, of a middle kind between a forest and a park, being usually less than a forest and not possessed of so many privileges. The following history of the English chase is given by Mr Pennant (*British Zool.* i. 42): "At first the beasts of chase had this whole island for their range; they knew no other limits than the ocean, nor confessed any particular master. When the Saxons had established themselves in the heptarchy, they were reserved by each sovereign for his own particular diversion. Hunting and war in those uncivilized ages were the only employ of the great; their active but uncultivated minds being susceptible of no pleasures but those of a violent kind, such as gave exercise to their bodies, and prevented the pain of thinking.

"But as the Saxon kings only appropriated those lands to the use of forests which were unoccupied, so no individuals received any injury; but when the Conquest had settled the Norman line on the throne, this passion for the chase was carried to an excess which involved every civil right in a general ruin: it superseded the consideration of religion even in a superstitious age; the village communities, nay, even the most sacred edifices, were turned into one vast waste, to make room for animals, the objects of a lawless tyrant's pleasure. The New Forest in Hampshire is too trite an instance to be dwelt on; sanguinary laws were enacted to preserve the game; and in the reigns of William Rufus and Henry I. it was less criminal to destroy one of the human species than a beast of chase. Thus it continued while the Norman line filled the throne; but when the Saxon line was restored under Henry II. the rigour of the forest laws was immediately softened.

"When our barons began to form a power, they claimed a vast but more limited tract for a diversion that the English were always fond of. They were very jealous of any encroachments on their respective bounds, which were often the cause of deadly feuds. Such a one gave cause to the fatal battle of *Chevy-chase*, a fact which, though recorded only in a ballad, may, from what we know of the manners of the times, be founded on truth; not that it was attended with all the circumstances which the author of that natural but heroic composition has given it; for on that day neither a *Percy* nor a *Douglas* fell. Here the poet seems to have claimed his privilege, and mixed with this fray some of the events of the battle of *Otterbourne*.

"When property became happily more divided by the relaxation of the feudal tenures, those extensive hunting grounds became more limited; and as tillage and husbandry increased, the beasts of chase were obliged to give way to others more useful to the community. The vast tracts of land before dedicated to hunting were then contracted, and, in proportion as the useful arts gained ground, either lost their original destination, or gave rise to the invention of *parks*. Liberty and the arts seem coeval; for when once the latter got footing, the former protected the labours of the industrious from being ruined by the licentious sportsman, or being devoured by the objects of his diversion. For this reason the subjects of a despotic government still experience the inconveniences of vast wastes and forests, the terrors of the neighbouring husbandmen, while in our well-regulated monarchy very few chases remain. The English still indulge themselves in the pleasures of hunting, but confine the deer kind to parks, of which England boasts of more than any other kingdom in Europe. The laws allow every man his pleasure, but confine them in such bounds as to prevent them from being injurious to the meanest of the community. Before the Reformation the prelates seem to have guarded sufficiently against this want of amusement, the see of Norwich in particular being possessed about that time of thirteen parks."

CHASTELLET, MADAME DU, whose full name was *Gabrielle Emilie Le Tonnellier de Breteuil, Marquise du Chastellet*, has obtained celebrity by her translation of the *Principia* of Newton, as well as by being *l'Amie de Voltaire*. This accomplished lady was mistress of Latin, Italian, and English, and appears to have made great proficiency in mathematics. Her translation was considered worthy of the revision of Clairaut. She was also the author of *Institutions de Physique*, published in 1740, and so popular as to appear in a second edition at Amsterdam in 1742. The translation of Newton was a posthumous publication, and the labour bestowed on it is said to have caused her death, which took place at Luneville in 1749.

CHASTITY (*castitas*), a state of purity or freedom from unlawful sexual intercourse. By the Roman law homicide is justifiable in defence of a person's own chastity, or that of one's relations; and so also, according to Selden, stood the law in the Jewish republic.

CHATEAUBRIAND, FRANÇOIS AUGUSTE, VICOMTE DE, was born at St Malo, Brittany, in 1769. After studying at Dol and Rennes, he entered the army as a sub-lieutenant in 1786, and on the establishment of the Reign of Terror emigrated to America, where he remained till 1792. He returned to serve in the army of Condé; but having been wounded at the siege of Thionville, retired to England, where he published his *Essay on Revolutions.* A visit to the United States at this period made him acquainted with the phases of Indian life which are delineated in some of his tales. After the 18th Brumaire 1799 he returned to France, and became a contributor to the *Mercure.* His reputation as a writer was established in 1802 by the publication of the *Génie du Christianisme;* and in the following year he entered the diplomatic service of the First Consul, by whom he was sent as secretary to the French embassy at Rome. From Rome he went in an official capacity to Switzerland; but on the execution of the Duke d'Enghien he resigned his appointments and lived in retirement till the restoration. A part of the interval, however, was spent abroad in visiting the Holy Land. At Ghent he officiated as foreign minister to Louis XVIII., and in 1815 was elected a member of the Chamber of Peers. Under the Villèle administration he was sent as ambassador to London, and afterwards to the Congress of Verona, where he organized the French invasion of Spain, a measure which, when minister of foreign affairs, he had afterwards the principal responsibility of executing. In 1824 he was dismissed from office, and employed his pen in vigorously denouncing his former colleagues. Four years later, when his friends were for a short time restored to power, Chateaubriand was sent as ambassador to Rome, but again resigned on the formation of the Polignac ministry. On the outbreak of the revolution in 1830 he went to Paris, and delivered an oration in favour of the Duke of Bourdeaux. This was his last appearance personally in public. The rest of his life was spent in strict seclusion; but the keen political pamphlets which occasionally issued from his retreat wielded so great an influence over the minds of his countrymen that the government of Louis Philippe found it necessary to lay him under a brief arrest. He died in July 1848, after witnessing the second revolution of that year which ushered in the republic. His *Mémoires* were published after his death, and contain much curious information illustrative of the eventful times in which he lived, but are greatly marred by the tone of supercilious vanity which prevails throughout the whole. His collected works were published at Paris in 1826.

CHATEAUBRIANT, a town of France, capital of an arrondissement of the same name, in the department of Loire Inférieure, on the left bank of the Chere, 35 miles N.N.E. of Nantes. It takes its name from a castle, founded

in 1015, of which remains still exist. It has manufactures of woollen stuffs and confectionary, and some trade in iron, coal, wood, and corn. Pop. (1851) 4010.

CHATEAUDUN, a town of France, capital of an arrondissement of the same name in the department of Eure-et-Loire, 28 miles S.S.W. of Chartres. It stands on an eminence near the left bank of the Loire, and has remains of an old castle, a town-hall, communal college, public library, and manufactures of woollens and leather. It was almost entirely destroyed by fire in 1723. Pop. 6441.

CHATEAU-GONTIER, the capital of an arrondissement of the same name, in the department of Mayenne, France, on the right bank of the Mayenne, here crossed by a stone bridge, 17 miles S.S.E. of Laval. It has a fine Gothic church, communal college, three hospitals, agricultural society, public baths, extensive bleachfields, and manufactures of linen and woollen stuffs. It is the entrepot of a great part of the wine, slate, coal, &c. of the department. Pop. 6443.

CHATEAUROUX, the capital of the department of Indre, France, is situated in a fine plain on the left bank of the Indre, 63 miles S.E. of Tours. It is the seat of a court of assize, tribunals of primary instance and commerce, and has a castle, now used as the town-hall, a society of arts and agriculture, communal college, theatre, and public library. It is ill-built, with narrow filthy streets. The principal manufacture is woollens, in which a great part of its inhabitants are employed; and it has an active trade in woollen yarn, leather, iron, grain, cattle, &c. Pop. 14,276.

CHATEAU-THIERRY, a town of France, capital of an arrondissement of the same name in the department of Aisne, pleasantly situated on the right bank of the Marne, and connected with an extensive suburb on the opposite bank by a fine stone bridge of three arches. It is the seat of a tribunal of primary instance, and has a communal college, public library, and manufactures of linen, leather, and earthenware. It contains a marble statue erected to the memory of La Fontaine, who was born here, and whose house is still preserved. Pop. 5380.

CHATELLERAULT, a town of France, capital of an arrondissement of the same name, in the department of Vienne, on the right bank of the Vienne, here crossed by a handsome stone bridge, which connects it with a suburb on the opposite side of the river, 24 miles N.N.E. of Poitiers. Pop. (1851) 11,959. It stands in a fertile valley, and has several fine promenades, but is ill-built and dirty. It has tribunals of primary instance and commerce, a fine Gothic church, public fountain, communal college, exchange, hospital, society of agriculture, and a theatre. It is one of the chief seats of the manufacture of cutlery in France; and has a royal manufactory of swords and bayonets, established in 1820. It has a large trade in wines, dried fruits, slates, iron, corn, hemp, timber, &c. James Hamilton, second Earl of Arran, was created Duke of Chatellerault in 1548 by Henri II.; and the title is still in the family.

CHATHAM, a fortified town and royal dockyard on the Medway (which at Rochester bridge is a considerable tidal river), Kent, 30 miles from London. It includes the village of Brompton, between which and Rochester it forms a continuous, narrow, and irregular street. The houses are ill-built, many of them being only of wood. It contains two Established and seven Dissenting churches, five schools (including a ragged school), and a mechanics' institute. Its charities included several ancient hospitals, which have now been superseded; but there is still maintained a military lunatic asylum and several smaller establishments. The "Chest," for disabled seamen, established by Queen Elizabeth, who also founded the dockyard, has been removed to Greenwich. An account of the dock will be found under the article DOCKYARD. Chatham returns one member to the imperial parliament. Pop. (1851) 28,424.

CHATHAM ISLANDS, a group in the South Pacific, E. of New Zealand, lying between S. Lat. 43. 40. and 45. 20., and W. Long. 176. 10. and 177. 20. It consists of three islands, a large one called Ware-Kauri, or Chatham Island, a smaller one, Rangi-Haute, or Pitt's Island, and a third, Rangatira, or South-east Island. Chatham Island, according to Dieffenbach, contains an area of 305,280 acres; of which, however, 57,600 acres are lakes and lagoons. In the centre is a large lake called Tewanga, about 25 miles long, and 6 or 7 broad, and surrounded on all sides by hills either wooded or boggy. Its water is slightly brackish, probably from infiltration. Occasionally it bursts its barriers and empties itself into the sea. The southern part of the island has an undulating surface, and is either covered with an open forest or with high ferns. In general the soil is extremely fertile, and where naturally drained, a rich vegetation of fern and flax (*Phormium tenax*) has sprung up, giving firmness to the soil and yielding a rich harvest to the planter. On the N.W. are a number of conical hills of basalt, which are surrounded by oases of fertile soil. On the western side is a large bay called Waitang Bay, well sheltered by projecting creeks, and affording excellent anchorage. Into this bay the river Mangatu falls, and is navigable for 3 miles from its mouth. The climate is very mild, in winter varying only from 45° to 60°. The changes of temperature are less sudden than in New Zealand. The natives cultivate potatoes, turnips, cabbages, taro (esculent *arum*), tobacco, and pumpkins. Wheat, sown by the sealers, grows wild on Pitt's Island. The trees and shrubs resemble those of New Zealand. The rat is the only quadruped; but ducks, snipes, plovers, curlews, red bills, sand larks, and parroquets, abound. Fish are abundant on the coast. Both spermaceti and black whales have been seen. Pitt's Island is about 12 miles long and 8 broad, has no harbour, and is inhabited only by a few aborigines.

These islands were discovered in 1791 by Lieut. Broughton, who gave them the name of Chatham, from the brig which he commanded. The aborigines who then inhabited them have been since enslaved by two tribes of New Zealanders, and their numbers reduced from 1200 to 90, by the oppressive labour exacted from them. Geologically speaking, the islands seem to belong to New Zealand; and it is said that soundings can be obtained between the two groups.

CHATILLON-SUR-SEINE, the capital of the arrondissement of Chatillon, in the department of Côte d'Or, France, on both sides of the Seine, 46 miles N.N.W. of Dijon. It is a neat well-built town, and has a magnificent castle, hospital, communal college, public library, and some fine promenades. In February 1814 a conference was held here between Napoleon and the allies. Pop. 4866.

CHATRE, LA, a pleasantly situated and well-built town of France, capital of an arrondissement of the same name, in the department of Indre, 22 miles S.E. of Chateauroux. It has an old castle, a fine church, communal college, manufactures of woollens and leather, and some trade in cattle, wool, hides, and chestnuts. Pop. 4889.

CHATSWORTH, the seat of the Duke of Devonshire, one of the most splendid private residences in England, is in the county of Derby, on the Derwent, 3½ miles N.E. of Bakewell. The present mansion was erected by the first duke of Devonshire in 1706, on the site of a former mansion built by Sir William Cavendish about the middle of the sixteenth century, and in which Mary Queen of Scotland was imprisoned for 13 years. The building is in the Ionic style, composed of four nearly equal sides, surrounding an open quadrangular court with a fountain in the centre. A wing and other additions have been made to it since 1820. Chatsworth contains some beautiful wood carvings by Gibbons and Watson, and several exquisite

pieces of sculpture by Canova, Thorwaldsen, Chantrey, Wyatt, &c. The park is about 9 miles in circuit, and the gardens are among the most celebrated in the kingdom. The conservatory, 300 feet long, 145 feet broad, and 67 feet high, is unequalled by any in Europe, and the water-works are only surpassed by those of Versailles.

CHATTAOOCHEE, a river of North America, United States, rises in the Appalachian Mountains, forming for a great part of its course the boundary between Georgia and Alabama, and after a course of nearly 400 miles unites with the Flint river to form the Appalachicola. It is navigable for steam-boats to Columbus.

CHATTELS, a Norman term, under which were anciently comprehended all moveable goods, those immoveable being termed *fief* or *fee*. In modern usage it includes all goods, moveable or immoveable, except such as are in the nature of freehold.

CHATTERTON, Thomas, a highly-gifted but ill-starred poet, was born at Bristol, November 20, 1752. His father, who had been originally an usher in a classical academy, and ultimately became master of the free school of Bristol, died three months before his son was born. At the early age of five the future poet was sent to the school in which his father had latterly taught; but so far was he from giving any indication of talent, that he was regarded alike by his teachers and his fellow pupils as an incorrigible dunce. At the end of a year and a half he was withdrawn from school, without having mastered the letters of the alphabet. Upon his mother now devolved the care of educating him. She happened to have in her possession an old black-letter manuscript, from which she proceeded to teach him the alphabet. His progress now became as rapid as it had formerly been slow. He very soon learned to read, and he had hardly mastered this accomplishment when he was visited by dreams of future distinction. When asked by a manufacturer, who had given him a small present of china-ware, what device he would like to have painted on it, he replied, "Paint me an angel with wings, and a trumpet to trumpet my name over the world." In 1760, before he had quite attained his eighth year, he became a pupil of Colston's charity school, at which he remained till 1767. During this period he made rapid progress in the branches taught at that institution, and distinguished himself besides by his poetical attempts, which were generally of a satiric tendency. By far the most remarkable of these youthful productions is the *Hymn for Christmas Day*. If we contrast the harmony and ease of expression displayed in this poem with the boyhood and inexperience of the author, we must pronounce it astonishing. During these seven years of his life, he was for the most part thoughtful and reserved, took no interest or share in boyish sports, was subject to fits of melancholy, and spent all his spare time in miscellaneous reading.

On leaving Colston's school, he was apprenticed to a scrivener in his native city. Though he was now compelled to perform the most menial offices, and was kept hard at work for twelve hours of the day, he nevertheless found time to amass great stores of knowledge in his favourite pursuits of heraldry and antiquities. The results of these studies he next year turned to account, by beginning a series of literary impositions, unparalleled in the history of letters. In 1768, a new bridge was opened at Bristol. Chatterton sent to the editor of a local newspaper a minute account of the ceremonies which had inaugurated the opening of the old bridge, as described in an ancient manuscript, which he said he had found in an old coffer in the church of St Mary Redcliffe. To a pewterer of the town, by name Burgum, who was ambitious of heraldic honours, he gave a long pedigree, tracing his genealogy from the times of the Norman Conquest, and his connexion with the noble family of De Bergham. To a theologian of Bristol he gave a fragment of a sermon on the divinity of the Holy Spirit, written by Thomas Rowley a monk of the 15th century; and to the historian of the city he supplied an account of all the churches of Bristol as they existed three hundred years before, with a minute description and plans of the castle, likewise purporting to be the work of Rowley. To Horace Walpole, who was at that time writing the history of British painters, he sent an account of the eminent "carvellers and peyncters who once flourished in Bristol." The skill with which all these forgeries were conducted was such, that not one of the Bristol literati entertained a suspicion of their genuineness, and Walpole himself was for a time deceived. To this must be attributed the coldness with which he regarded Chatterton during his life, and the bitterness with which he treated his memory after he was dead. Walpole's own forgeries, ingenious as they were, had been far too easily detected and too bitterly exposed for him not to view with distrust the similar attempts of any one else. Accordingly, when he received from the scrivener's apprentice of Bristol a roll of manuscript purporting to have been found in "Canynge's cofre" in the tower of St Mary Redcliffe, his suspicions were awakened; but, finding himself unable to pronounce a verdict on the matter, he called in the assistance of the poets Gray and Mason. After a careful scrutiny, Gray decided that the Rowley poems were forgeries, and in this decision he was completely borne out by Mason. Walpole had given a promise to assist the unknown and unbefriended antiquarian of Bristol; but his vanity had been wounded, and from this time he turned a deaf ear to all Chatterton's solicitations. He even refused to return the young poet his manuscripts, and it was only after the threat of an action at law that he restored them without a word of comment or encouragement. This silence provoked Chatterton, who avenged himself by a bitterly satirical attack on the cowardice and unworthiness of Walpole's conduct. The controversy soon began to attract considerable attention in London; and many persons, strongly convinced of the genuineness of the Rowley poems, undertook their defence, though with more zeal than success. Evidence, however, stronger than any of the moral evidence adduced on either side, was brought forward some years after Chatterton's death by Warton, Tyrwhit, Malone, and others of the more acute antiquarians of the day, which ought to have set the question at rest for ever. As late as 1834, however, a "Vindication" of Chatterton appeared, which the most partial of critics were obliged to pronounce completely unsuccessful. Meanwhile, without entering at all into the question of the moral guilt which has been imputed to Chatterton, we can only regret that he so sadly misdirected a genius that might have made his name respected as a benefactor of the human race, and earned for him a high place among the poets of England.

In the meantime the poet was working busily at his Rowley manuscripts. He slept little and wrote much during the night, especially if the moon were up; for he believed that the influence of that planet inspired him for his work. His eccentricities, combined with his sceptical views on religious matters, induced his master to break his indentures; and in 1770, Chatterton, without friends or introductions, set off to seek his fortune in London. His prospects at first were sufficiently bright, and he used laughingly to observe, that if all other means of subsistence failed, he would become a Methodist preacher. He began his literary career in the metropolis by contributing to various magazines and reviews. He likewise wrote political letters which gained for him both money and repute, besides sermons for dull clergymen, and burlettas for Vauxhall. By these and such means he was enabled for a while not only to maintain himself, but to re-

Chaucer. mit small sums to his mother and sister in his native town. But persecution followed him wherever he went, and his unconquerable pride would never allow him to vindicate himself in the manner that his better judgment might have suggested. For five months he maintained the desperate struggle, confiding to no one the history of his wrongs and sufferings. At the end of that period, finding himself utterly destitute, and without the prospect either of present relief or future success, he tore into shreds all his manuscripts, and after spending three days without food, bought with his last penny a little arsenic. On the following morning he was found dead in his miserable garret, and that same night was interred in the pauper burying-ground of Shoe-Lane.

Though Chatterton was below the middle height, his bearing was proud and manly. His eyes, like Lord Byron's, were gray; and, as was also the case with that poet, one of them was more brilliant than the other. Posterity has granted to him the meed of honour which his own generation withheld from him. Byron has praised him; Shelley has acknowledged his "solemn agency;" Wordsworth has thought of him as "the marvellous boy, the sleepless soul that perished in his pride;" Coleridge has apostrophized him in a pathetic monody; Keats has dedicated Endymion to his memory; and Alfred de Vigny has made his history and character the subject of one of his most interesting dramas. (J.C—L.)

CHAUCER, Geoffrey, who has been styled the Father of English poetry, has had many biographers, but much of his history is involved in considerable obscurity. The year 1328 has been usually assigned as the date of his birth, upon the authority of an inscription on his tombstone, in which he is said to have died in 1400, aged seventy-two. This inscription, however, was not placed on his tomb till the middle of the sixteenth century; and some doubt of its correctness has been expressed in consequence of Chaucer's deposition as a witness in October 1386, in which he states himself then to have been "forty years and upwards," and which, if strictly correct, would place his birth about 1345. We are certain, however, from his own words, that he was born in London; but with regard to his descent and parentage there is absolutely nothing known. Leland says he was *nobili loco natus;* but Speght, in 1598, informs us, that "in the opinion of some heralds, hee descended not of any great house, which they gather by his armes." This, as an old writer observes, "is a slender conjecture," yet not more so than Speght's supposition that his father was Richard Chaucer, a vintner, who died in 1348; while Pitts says that he was the son of a knight. It may also be noticed that there was a Robert Chaucer connected with the royal household of Edward II. who perhaps may have stood in that relationship. (*Rot. Scot.*) Leland, who lived in the reign of Henry VIII., asserts that he studied at Oxford; while his signature "Philogenet of Cambridge, Clerk," affixed to one of his early pieces, has been brought forward as more direct proof that he received his education at the latter university. Some of his biographers very gravely assure us that he was first at Cambridge, and then completed his studies at Oxford; after which they say he went on his travels through France and the Netherlands. The next statement is, that he was a member of the Inner Temple, and that whilst there he was fined "two shillings for beating a Franciscane frier in Fleet Street."

Without stopping to consider the probability of these several points, we may observe, that frequent mention of Chaucer, during the more advanced period of his life, occurs in various public instruments; most of which are printed in the Appendix to Mr Godwin's life of the poet. The first direct information we possess regarding his history is, that, in the autumn of 1359, he was in the army with which Edward III. invaded France. This fact we learn from his own deposition, which further states that he was made prisoner by the French near the town of Retters during that expedition; but we are not informed at what time he was ransomed and returned to England, although we may conclude that he never resumed the profession of arms. The next notice that has been discovered shows that he had attracted the regard of the English monarch, and that he was an attendant on the king's person. It is a patent in 1367, by which Edward the Third grants Chaucer an annuity of twenty marks, by the title of 'dilectus vallettus noster,' our valet or yeoman, in consideration of his former and expected services. According to Tyrwhitt, this designation was the intermediate rank between *squier* and *grome;* and this annuity may be reckoned in our present money at two hundred pounds. In his poem of the Dream, or the Complaint of the Black Knight, written before this time, the poet is supposed to allude to the nuptials of his munificent patron John of Gaunt, with Blanche, heiress of Lancaster. The same poem contains an allusion to the lady whom Chaucer himself afterwards married, although the time of his marriage is somewhat uncertain; but it is admitted that by this alliance he became eventually related to his illustrious patron.

In June 1370, it appears that Chaucer was abroad in the king's service; and on the 12th November 1372, being at that time one of the king's esquires, "scutifer noster," he was joined in a commission with two citizens of Genoa, to treat with the Duke and Duchess of Genoa, for the purpose of fixing upon some place on the coast of England where the Genoese might form a commercial establishment. It was at this time he enjoyed the opportunity of visiting Petrarch, if his visit to that illustrious poet ever took place, which, however pleasing to the imagination, is somewhat doubtful; as the passage in his Canterbury Tales, upon which his supposed conference with the "worthy clerk of Padua" is founded, is susceptible of a different interpretation. The next notice of Chaucer is, that on the 23d of April 1374, he obtained a grant for life of a pitcher of wine daily, to be received from the hands of the king's butler in the port of London. On the 8th June 1374 he was appointed comptroller of the customs, and subsidy of wools, &c. in the port of London, during the king's pleasure; but the patent contains the following injunction, "so that the said Geoffrey write with his own hand his rolls touching the said office, and continually reside there, and do and execute all things pertaining to the said office in his own person, and not by substitute." The reason of such an express injunction is not known, and it is possible that his majesty may have been insensible of his poetical talents, although this attendance on his official duties seems to have had no prejudicial effect on his genius, as the composition of his House of Fame is assigned to the same period. In November 1375, the wardship of Edmond, son and heir of Edmond Staplegate of Kent, was granted to Chaucer, for which he received L. 104; and in the following year, another grant, to the value of L. 71. 4s. 6d. connected with his office of comptroller of the customs. In February 1377 Chaucer was joined with Sir Guichard d'Angle, afterwards Earl of Huntingdon, and Sir Richard Sturry, to negotiate a secret treaty respecting the marriage of Richard, prince of Wales, with Mary, daughter of the king of France. His employment in foreign missions shows that Chaucer had established a personal and political character of some importance; and the emoluments which he received enabled him to live in a state of dignity and hospitality that was in accordance with his natural sociality of disposition.

The reign of his successor was, on the whole, not so propitious to the poet. On the accession of Richard the

Second, the annuity of twenty marks was indeed confirmed to him, and his grant of wine was replaced by an equivalent annuity of other twenty marks. He also retained the situation of comptroller of the customs and subsidies, which Edward the Third bestowed on him; but he was doomed to experience a reverse of fortune, in some measure connected with the decline of John of Gaunt's influence at court. The immediate cause of this reverse is said to have been his connection with a political party, in some disputes between the court and the city of London, in the year 1384. This party was headed by John of Northampton, an opulent merchant, who had been mayor, and was attached to the religious tenets of Wykliffe, and to the political interests of John of Gaunt. The result was, that Chaucer was compelled to fly the kingdom; and he retired first to Hainault, then to France, and finally to Zealand. How long he remained abroad is uncertain; but we find that Chaucer was elected a knight of the shire for the county of Kent in the parliament which met on the 1st October 1386. Whilst attending his parliamentary duties, he was examined at Westminster, on the 15th of October, as a witness "in the court of chivalry," in the great cause between Sir Richard Scrope and Sir Robert Grosvenor, when he made the deposition to which we have already alluded, the substance of which, in as far as relates to himself, is as follows; "Geoffrey Chaucer, Esquire, of the age of forty and upwards, armed twenty-seven years, being asked whether the arms, *azure*, a bend *or*, belonged to Sir Richard Scrope, said Yes; for he saw him so armed in France before the town of Retters, and Sir Henry Scrope armed in the same arms with a white label, and with banner; and the said Richard armed in the entire arms, and so during the whole expedition, untill the said Geoffrey was taken."

Whatever may be the date of Chaucer's return to England, we have his own testimony that he fled to avoid being examined in relation to certain disturbances; and that after his return he was arrested and confined to the Tower of London. That he was deprived of his comptrollership is also evident, as other persons are named as holding them in December 1386. During his imprisonment he commenced his Testament of Love, an allegorical prose composition, in imitation of Boethius' *De Consolatione Philosophiæ*, in which he feelingly laments his own situation, "berafte out of dignitie of office, in which he had made a gatheringe of worldly goodes;" and "enduring penance in this dark prison, caitifned from frendship and acquaintance, and forsaken of al that any word dare speak." As the price of his release, it is said, he was obliged to make a confession respecting the conspiracy in which he had been implicated. In May 1388 he found it necessary to apply for permission to surrender his two grants of twenty marks each in favour of one John Scalby. After this he is said to have retired to Woodstock, and employed himself in revising and correcting his writings, and enjoying the calm pleasures of rural contemplation, amidst the scenes which inspired his youthful genius. The composition of his Canterbury Tales is usually assigned to this period; when, though long past the prime of life, his mental powers must have been in their fullest vigour.

In 1389 the Duke of Lancaster having returned from Spain, and resumed his influence at court, it was probably through his influence that, on the 12th July 1390, Chaucer was appointed to the office of clerk of the king's works, the duties of which he was permitted to execute by deputy, with a salary of two shillings per diem. In this office, however, he seems to have been superseded in the course of the following year; but, on the 28th of February 1394, he obtained a grant of twenty pounds yearly for life. On the 4th May 1398, letters of protection were granted him for the space of two years. On the 13th October in the same year he obtained another grant of wine, being one tun yearly during his life.

Henry the Fourth, the son of his great patron the Duke of Lancaster, ascended the throne in 1399; and from him Chaucer had his annuity of twenty pounds confirmed, with the additional sum of forty marks yearly. The last record of Chaucer that has been discovered is a lease of a tenement in the garden of the chapel of the Blessed Mary of Westminster, dated on Christmas eve 1399. But the poet was not privileged to benefit long by these grants, as his death is said to have occurred at London on the 25th October 1400, at the age of seventy-two. The chief evidence on which the date of his decease rests is the inscription on his tomb, which was erected in the year 1556, by Nicholas Brigham, a gentleman of Oxford, an ardent admirer of the great English poet, and who no doubt had sufficient grounds, either from a previous inscription, or other information, for fixing the date. Chaucer lies interred in the south cross aisle of Westminster Abbey, in a place consecrated to the poetical genius of England.

Such is a brief abstract of nearly every fact relating to Chaucer that has been discovered; and upon which, aided by ample conjectural inferences, Mr Godwin constructed a life of the poet, which extends to two large volumes in 4to, and was reprinted in four vols. 8vo. Besides the Memoir by Sir Harris Nicolas, contained in his valuable historical and genealogical notes to the Scrope and Grosvenor Roll, recently printed, the curious reader is referred to the Reverend Mr Todd's "Illustrations of the Lives and Writings of Gower and Chaucer." Lond. 1810, 8vo.

Chaucer's works have been preserved in a variety of early manuscripts, which attest their continued popularity, and have been very frequently printed. One of the earlier productions of Caxton's press is an edition of the Canterbury Tales, without date, but printed about 1475. He also published a second edition, six years after the first, on being informed of the imperfections of that edition. It may be worthy of mention, in proof of Chaucer's popularity in Scotland, that one of the earliest specimens of the Scottish press was an edition of his Complaynt of the Black Knight, which was printed at Edinburgh, by Chepman and Myllar, in 1508, under the title of "The Maying or Disport of Chaucer." The first collected edition of his works was edited by William Thynne, and printed by Godfrey in 1532. They passed through several subsequent editions during the sixteenth and seventeenth centuries, besides later republications. The edition of the Canterbury Tales edited by Thomas Tyrwhitt, one of the most learned and accomplished of scholars whose attention had been directed to old English literature during the last century, is worthy of the highest commendation for accuracy and critical acumen. It was printed at London 1775, in 5 vols. 8vo, and reprinted at Oxford 1798, in 2 vols. 4to, and also more recently in London in its original form. A complete edition of Chaucer's works, from a collation of the earlier MSS. would be a most important addition to old English literature.

Chaucer's merits as a poet are of no ordinary kind; but in considering his poetical character, it is necessary to attend to the age in which he lived, in order to ascertain to what extent he may be said to have improved our language and versification. Chaucer himself, while he exposes the absurdity of his countrymen, like Gower, writing in a foreign language, seems to have entertained no very exalted idea of the vernacular tongue. During the thirteenth and fourteenth centuries there had been several English poets whose remains are interesting chiefly for their antiquity; but it remained as a distinction for the reign of Edward the Third to produce works which tend-

ed to exalt and fix the standard of our present language. In our veneration for Chaucer, however, too much influence in this respect has been attributed exclusively to his writings. It was the policy of the English monarch, rather than the poetical genius of Chaucer, which gave importance and dignity to the language, by causing it to be spoken at court, and to be substituted in all public and judicial proceedings, instead of the Norman-French, which had been introduced at the Conquest in 1066, and which had continued to be employed for nearly three centuries. Among the eminent men who adorned the reign of Edward the Third, the first in priority of date is Langland, the reputed author of the Visions of Piers Plowman. In his Visions, which are written in very obscure alliterative language, the author's object was to expose the abuses which then prevailed, and to bring about a reform in the morals both of the clergy and aristocracy. To accomplish this, with striking originality in his character as a moral satirist he depicts the various orders of society, and inveighs with great boldness against the depraved conduct of the clergy, and the corruptions of the papal government. The composition of this work has been fixed to the year 1362; and although the satire is considerably affected by the general personification in which the author indulged, there can be little doubt that the Visions contributed to improve the moral feelings of his contemporaries; and if his work had no beneficial effect upon the literature of the time, it at least remains as a monument of true poetical genius.

Another poet of distinction, contemporary with Chaucer, was John Gower. He is generally allowed to have been a man of extensive learning, but not of much natural genius. In fact his claims as an English poet are considerably lessened, as his French ballads are among his best productions; and one of his great works, the *Vox Clamantis,* is in Latin. Neither is Laurence Minot, who wrote various narrative ballads on the subject of the Wars of Edward the Third, entitled to any very marked distinction as an original writer.

Chaucer may have been known as a poet at the time Langland's Visions were written; but his greatest work is at least twenty years later in date. His chief merit in regard to versification consisted in rendering it more natural, regular, and comprehensive, by discarding alliteration, and by reducing the irregular Alexandrine metre to the heroic measure in an uniform and equal number of syllables. This adoption of the decasyllabic couplet has been used by nearly every great English poet from Spenser to Byron, who declared it to be " the best adapted measure to our language." In the structure of his verse generally, when compared with some previous writers, or with the numerous class of English metrical romances, there will not be found any essential distinction. But in contributing to the improvement of the English language, perhaps no author ought to be put into competition with the illustrious reformer Wykliffe. In addressing the different classes of society, he was obliged to use the vernacular dialect; and he inveighed against the corruptions of the time, not under the veil of cold allegorical personification, but in a bold and open manner, which must have been productive of important consequences in exciting the intellectual energies of the people. The extent and variety of knowledge he displayed far exceeded that of most of his contemporaries; and, being persuaded that the surest mode of enlightening the people would be the perusal of the Scriptures in their own tongue (although at the time it was affirmed by illiterate ecclesiastics to be heresy to speak of the Holy Scriptures in English), he accomplished a translation, which of itself, in a literary point of view, is sufficient to have immortalized his name.

Chaucer's writings partake much of his own personal character and spirit, as influenced by his intercourse with the world and his employment in public affairs. If his writings had not much influence upon the moral feelings of his contemporaries, they had at least a most important influence upon the literature of his country. But while his more immediate followers imitated the peculiarities of his " ornate" style and manner, they suffered his spirit and grace to evaporate; their chief object being an accumulation of ornament and an exuberance of diction to which every thing else was subservient. It is sufficiently remarkable, that during the greater part of Chaucer's poetical career, he contented himself with transferring into our language the most popular works of contemporary French and Italian writers, but in a manner which gives them the character of original productions rather than that of translations. In these earlier works there is elegance of fancy and picturesqueness of description; but all the grace and beauty of his allegorical compositions fall infinitely short of his power of delineating living character, as displayed in his immortal work the Canterbury Tales.

In this work, the idea of which was no doubt derived from Boccaccio, he brings together a motley crew of " syndry folke," who " in felowshyp" are travelling together on a pilgrimage to the shrine of St Thomas of Becket, to Canterbury; and, as the means of affording instruction and amusement, they agree, each of them in their turn, to relate a story, the details of which, with the incidents that happen, and, above all, the description of the character and manners of the persons themselves who are thus assembled, form a picture of life and manners altogether unrivalled. Nothing can exceed the skill shown in the general prologue, in which the habits of life and peculiarities of disposition of the different pilgrims are so singularly and so strikingly contrasted, with a rich vein of humour, and great discrimination of human nature.

We cannot do better than conclude with an extract from the work of an eminent contemporary, who has shown himself to be in every respect a master in the art of poetical criticism.

" Chaucer's forte," says Mr Campbell, " is description; much of his moral reflection is superfluous; none of his characteristic painting. His men and women are not mere ladies and gentlemen, like those who furnish apologies for Boccaccio's stories. They rise before us minutely traced, profusely varied, and strongly discriminated. Their features and casual manners seem to have an amusing congruity with their moral characters. He notices minute circumstances as if by chance; but every touch has its effect to our conception so distinctly that we seem to live and travel with his personages throughout the journey.

" What an intimate scene of English life in the fourteenth century do we enjoy in those tales, beyond what history displays by glimpses, through the stormy atmosphere of her scenes, or the antiquarian can discover by the cold light of his researches! Our ancestors are restored to us, not as phantoms from the field of battle, or the scaffold, but in the full enjoyment of their social existence. After four hundred years have closed over the mirthful features which formed the living originals of the poet's descriptions, his pages impress the fancy with the momentary credence that they are still alive; as if Time had rebuilt his ruins, and were re-acting the lost scenes of existence." *Specimens of the British Poets*, vol. ii. p. 21. (D. L.)

CHAUD MELLE, a term in the ancient law of Scotland, applied to a homicide committed in heat of blood or passion.

CHAUDES AIGUES, an old rustic-looking town of France, with about 1500 inhabitants, in the department of Cantal, arrondissement and 17 miles S.S.W. of St Flour. It is celebrated for hot mineral springs, varying in tempera-

ture from 135° to 177° Fahr.; and extensively used for baths, washing wool, and warming the houses of the town.

CHAUMONT, a town of France, capital of an arrondissement of the same name, and of the department of Haute Marne, on an eminence between the Marne and the Suize, 19 miles N.N.W. of Langres. It is the seat of tribunals of primary instance and commerce, is tolerably well built, and has an elegant town-hall, a palace of justice, communal college, theatre, public library, and museum. It has manufactures of coarse woollens, druggets, hosiery, gloves, and a considerable trade in iron and iron wares. Pop. (1851) 6088. In 1814 a treaty was concluded here by the allies against Napoleon.

CHAUNY, a town of France, department of Aisne, arrondissement and 20 miles W.N.W. of Laon, situated partly on the right bank of, and partly on an island in the Oise, at the commencement of the canal of St Quentin. It has some trade in cider, linen cloths, and hosiery, and is a depôt for coals from Flanders and glass mirrors from St Gobain. Pop. 5200.

CHAUVIN, Stephen, a celebrated minister of the Reformed religion, born at Nismes, who retired to Rotterdam at the revocation of the edict of Nantes, where he began a new *Journal des Sçavans*. He was afterwards made professor of philosophy at Berlin, and discharged that office with much honour and reputation. His principal work is a *Lexicon Philosophicum*, which he published at Rotterdam in 1692. A new and enlarged edition was printed at Lewarden in 1703. Chauvin died in 1725.

CHAUX-de-Fond, La, a town of Switzerland, canton and 10 miles N.W. of Neufchâtel, in the rugged and narrow valley of the Jura, 3100 feet above the level of the sea. It is celebrated for the manufacture of gold and silver watches, which employs about 500 of its inhabitants. Pop. 8500.

CHAVES, a fortified town of Portugal, province of Tras-os-Montes, on a plain near the right bank of the Tamega, which is here crossed by a fine old Roman bridge of eighteen arches. It has hot saline springs. Pop. about 6000.

CHAZELLES, Jean Mathieu de, a French mathematician and engineer, was born at Lyons in 1657. He was employed for some time by M. Cassini in measuring the meridian, and afterwards taught mathematics to the Duke of Mortemar, who procured him the preferment of hydrographic professor for the galleys of Marseilles. In 1686 Chazelles went on board the galleys in their campaigns, and kept his school at sea. He was sent to the west coasts in July 1689 to examine the practicability of so contriving galleys that they might live upon the ocean, and be employed to tug the men-of-war when becalmed; and having set sail with fifteen galleys from Rochefort, cruised as far as Torbay, in England, and proved serviceable at the descent upon Tynemouth. On his return he published his observations, and drew maps of the coasts he had visited, with a description of all the harbours, &c. discovered. These maps were inserted in the *Neptune Français*, published in 1692, in which year Chazelles acted as engineer at the descent on Oneille. In 1693, Monsieur de Pontchartrain, secretary of state for the marine, engaged Chazelles to publish a second volume of the *Neptune Français*, which was to include the hydrography of the Mediterranean. For this purpose he passed through Greece, Egypt, and other parts of Turkey. When in Egypt he measured the pyramids; and finding that the angles formed by the sides of the largest were in the direction of the four cardinal points, he concluded that this position must have been intended, and also that the poles of the earth and meridians had not deviated since the erection of these colossal structures. Chazelles likewise made a report of his voyage in the Levant, and concerning the position of Alexandria. He was made a member of the academy in 1695, and died in 1710.

CHEADLE, an ancient and irregularly-built market-town of Staffordshire, 14 miles N.N.E. from Stafford. Chief manufactures—copper, brass, tin, cotton, and tape; besides some trade in coal. It contains seven places of worship (including a fine Roman Catholic chapel, built chiefly by the Earl of Shrewsbury), and four principal schools. Pop. (1851) 2728.

CHECKY, or Chequy, in *Heraldry*, is used of a shield or bordure divided into chequers or squares, in the manner of a chess-board, which is supposed to represent a field of battle.

CHEDUBA, an island in the bay of Bengal, situate 10 miles from the coast of Arracan, between Long. 18. 40., 18. 56.; Lat. 93. 31., 93. 50. It extends about 20 miles in length from north to south, and 17 miles from east to west, and has an area of 250 square miles. The channel between the island and the mainland is navigable for boats, but not for large vessels. The geology of Cheduba affords various indications of a volcanic nature. Along the coast are earthy cones covered with a greensward, from which issue springs of muddy water emitting bubbles of gas. Among the mineral productions, copper, iron, and silver ore have been discovered. The island is also noted for its petroleum wells, the oil derived from which is of excellent quality: it possesses a strong pungent smell, and is extensively used in the composition of paint, as it possesses the property of preserving wood from the ravages of insects, especially the white ant. Timber is not abundant. The gamboge tree, prized for the valuable properties of its gum, is found of a good size; as is also the wood-oil tree. Tobacco, cotton, sugar-cane, hemp, and indigo are among the productions of Cheduba; but the staple article is rice, which is of superior quality, and the chief article of export. The inhabitants are of the Mugh persuasion. Cheduba fell to the Burmese in the latter part of the last century. From them it was captured in 1824 by the British, to whom it was confirmed in 1826 by the treaty concluded with the Burmese at Yandaboo.

CHEESE (Saxon, *cese*, or *cyse;* Lat. *caseus*), the curd of milk, coagulated by rennet or some acid, separated from the whey, and pressed. See Dairy. The quantity of cheese imported in the year ending 1853 into the United Kingdom from Europe was 278,179 cwts., and from the United States 11,275 cwts.; while during the same period the exports amounted to 5694 cwts.

CHEKE, Sir John, a celebrated statesman, philologer, and divine, descended of an ancient family in the Isle of Wight, was born at Cambridge in 1514, and educated at St John's College. After taking his degrees in arts, he was first chosen Greek lecturer; and then, in 1540, professor of that language, with a salary of L.40 a-year. In this station he was principally instrumental in reforming the pronunciation of the Greek language, which had been much neglected, and was imperfectly understood. About 1544 he went to court, and was appointed Latin tutor to Prince Edward. About this time he was made canon of the college newly founded at Oxford, so that he must then have been in orders. On the accession of his royal pupil to the crown, Mr Cheke was first rewarded with a pension of a hundred merks, and afterwards obtained several considerable grants from the crown. In 1550 he was made chief gentleman of the privy chamber, and was knighted the following year; in 1552, chamberlain of the exchequer for life; in 1553, clerk of the council; and soon afterwards secretary of state and privy-counsellor. But these honours were of short duration. Having concurred in the measures of the Duke of Northumberland for settling the crown on the unfortunate Lady Jane Grey, and acted as her secretary during the nine days of her reign, on the accession of Queen Mary he was sent to the Tower, and stripped of the greater part of his possessions. In September 1554 he obtained his

liberty, and a license to travel abroad. He went first to Basle, thence to Italy, and afterwards returned to Strasburg, where he was reduced to the necessity of reading Greek lectures for subsistence. In 1556 he set out to meet his wife at Brussels; but before he reached that city he was seized by order of Philip II., thrown into a waggon, and thus ignominiously conducted to a ship, which brought him to the Tower of London. He soon found that religion was the cause of his imprisonment; for he was immediately visited by two Catholic priests, who endeavoured to convert him, but without success. He was at last visited by Fleckenham, who told him from the queen that he must either comply or be burned. This powerful argument had the desired effect; Sir John Cheke formally complied, and his lands, upon certain conditions, were restored; but his remorse soon put an end to his life. He died in September 1557, at the house of his friend Mr Peter Osborne, in Wood Street, London, and was buried in St Alban's church. He left three sons, the eldest of whom, Henry, was knighted by Queen Elizabeth.

He wrote, 1. *A Latin translation of two of St Chrysostom's homilies*, Lond. 1543, 4to; 2 *A Latin translation of six homilies of the same Father*, Lond. 1547; 3. *The Hurt of Sedition*, Lond. 1549, 1576, 1641; 4. *A Latin translation of the English Communion Service*, printed among Bucer's *Opuscula*; 5. *De Obitu doctissimi et sanctissimi theologi Domini Martini Buceri*, &c., Lond. 1551; 6. *Carmen Heroicum, in Antonium Deneium*, Lond. 4to; 7. *De Pronunciatione Græcæ Linguæ*, Basle, 1555, 8vo; 8. *De Superstitione*; 9. *Several Letters* published in his life by Strype; 10 *A Latin translation of Archbishop Cranmer's book on the Lord's Supper*, 1553; 11. *Translation of Leo de Apparatu Bellico*, Basle, 1554. He left also a great many unpublished writings, which are most probably lost.

CHEIROTHERIUM. In the sandstone of Hildburghausen in Saxony, and in the second-sandstone of Stourton in Cheshire, are foot-prints of an extinct animal, to which Kauss assigned this name. The prints are large, and strongly resemble the human hand in form. Kauss supposes that they belong to a mammifer, while others with less probability refer them to some reptile. The animal appears to have frequented a muddy shore; for ripple-marks and rain-drops occur on the Cheshire sandstone, along with the foot-prints of the Cheirotherium.

CHE-KIANG, a maritime province of China, between N. Lat. 27. and 31., and E. Long. 118. and 121; bounded on the N. by Kiang-see; E. by the Eastern Sea; S. by Fokien, and W. by Kiangsi and Nganhwui. Area 39,150 square miles; population, according to the last official census of 1825, 26,256,784. This is one of the most fertile and most commercial of the provinces of China. It is well watered, and produces abundance of cotton, silk, tea, rice, and other grains. Its manufactures include silk, cotton, and linen goods, gold and silver stuffs, paper, &c. The capital is Hangchau-Fu.

CHELIDONIAS, another name for Favonius, the spring wind, so called because it brings the swallows. (Pliny.)

CHELMSFORD, the county-town of Essex, 29 miles N.N.E. from London; situated in a valley on the Chelmer, near its confluence with the Cann. The Cann is crossed by two bridges, one of stone and the other of cast-iron, and there are also two bridges over the Chelmer, which divides into two branches and incloses an island called Mesopotamia, famous to the townspeople as the scene of mock-elections. The parish church of St Mary is an ancient Gothic edifice, and has been twice rebuilt. Besides it there are six churches belonging to different religious bodies. It has a grammar-school founded by Edward VI., national, Lancasterian, and infant schools, a mechanics' institute, museum, library, &c. It is the seat of the county assizes and quarter-sessions, and has an elegant shire hall. Most of the inhabitants are engaged in agriculture, and the trades connected with it. Chelmsford communicates with Maldon by means of a canal, and with London by the Eastern Counties railway. Pop. 6033.

CHELSEA, a town of Middlesex, on the Thames, in the hundred of Ossulston; which, by the rapid extension of London towards the west, has now become one of the suburbs of the metropolis. In the seventeenth and eighteenth centuries it was much frequented by pleasure parties from the city, and was a favourite retreat of the nobility and gentry, many of whom had residences in the village and its environs. It has now altogether lost its rural character, and since the beginning of the present century has been rapidly extending in all directions. The most interesting feature of the town is the Royal Hospital for invalid soldiers; the plans and design of which were furnished by Sir Christopher Wren, and the foundation-stone laid by Charles II. with great ceremony in 1682. The building—which is of brick, with stone quoins, pillars, and cornices—was completed in 1690, at an expense of about L.150,000. It consists of three quadrangles, one of which is open on the side looking towards the river. The hospital affords accommodation to upwards of 500 invalid soldiers, who in addition to their food and clothing receive pensions varying according to the rank and service of the recipients from 8d. to 3s. 6d. a-day. The out-door pensioners are about 70,000 in number, and receive pensions varying from 4d. to 2s. 6d a-day. The establishment is managed by a governor, lieutenant-governor, and subordinate officers. Besides the hospital, Chelsea possesses a Royal Military Asylum (founded by the Duke of York in 1801, and completed in 1805) for the education of the children of soldiers and non-commissioned officers. In this establishment nearly 1000 children receive an excellent education on Bell's plan. Immediately adjoining the hospital are the botanical gardens of the London Apothecaries' Company, granted by Sir Hans Sloane, and occupying four acres of ground. A statue of the donor, by Rysbrach, is to be seen in the centre of the gardens. There is a considerable number of churches in Chelsea, the most noteworthy of which are the old parish church, containing some interesting monuments; Christ's church, St Jude's, Upper Chelsea church, and St Saviour's. Besides these, there are many Methodist, Independent, Presbyterian, and Catholic chapels. There are four National, two British and Foreign, and many Sunday and infant schools. St Mark's Training College for schoolmasters is attended by about 75 students. There is a similar institution for schoolmistresses, attended by a still larger number of pupils. Pop. of district (1851) 56,538.

CHELTENHAM, a parliamentary borough in a valley watered by the Chelt, and sheltered by the Cotswold Hills, Gloucestershire, 88 miles N.W. from London. Although an ancient town and existing under the Romans it was a place of no importance till the discovery of its saline springs, containing muriate of soda, sulphate of soda, and sulphate of magnesia, in the beginning of the eighteenth century. From its comparatively modern origin, the streets and buildings of Cheltenham are spacious and elegant, and its promenades are reckoned among the finest in England. St Mary's church is a cruciform edifice with a lofty octagonal spire, and contains a curious font and ancient stone cross. Trinity church and Christ church are modern, and are much admired. Besides these there are several other established and numerous Dissenting churches. It contains a proprietary college (capable of containing 300), a Church of England training college, and numerous schools and charities. Cheltenham contains no manufacturing establishments of any importance. It is the seat of a county court, and returns one member to the imperial parliament. Pop. (1851) 35,051.

CHEMISE, in *Fortification*, the wall with which a bastion or any other bulwark of earth is lined, for its greater support and strength.

CHEMISTRY.

CHEMISTRY, as a regular branch of natural science, is of comparatively recent origin, and can hardly be said to date from an earlier period than the latter third of the past century. It is true that, before that time, many men of high talent and wonderful ingenuity had devoted themselves to chemical studies; and the very name of the science, which, with the prefixed article, forms the well-known word Alchemy, is of Arabian origin. The early Greek philosophers had some vague yet profound ideas on the subject, but their acquaintance with it was limited chiefly to speculation *a priori*, founded on a general and often inaccurate observation of natural phenomena. Yet their acuteness was such, that some of their speculations as to the constitution of matter coincide in a most wonderful manner, as will be hereafter shown, with those which are now beginning to prevail among the most profound modern philosophers.

In these early ages, and long afterwards, those who turned their attention to the experimental part of the subject, which the Greeks hardly attempted, did so with some other object in view than the mere cultivation of chemistry as a science for its own sake. They either laboured to discover and produce new remedies, and in this manner were led to the search after the panacea or universal remedy, the elixir vitæ, and similar desiderata, which indeed formed the chief occupation of alchemists, as chemists were then called, for many centuries; and these transcendental researches, while they failed in their professed objects, yet led to the discovery of many of the best known and most important compounds of chemistry, as well as of many most valuable medicines. Or else, on the other hand, led by speculations as to the nature of the material elements, which are much less absurd, or at least were then much less absurd, than we are apt to suppose, they attempted to effect the transmutation of one element into another, and especially of the baser metals into gold and silver. In this way arose the search after the philosopher's stone, supposed to be capable of effecting this transmutation, and after the universal menstruum or solvent, which was expected to have similar effects, or at least to facilitate the necessary processes. In this pursuit, as in the other, the alchemists failed; but their indefatigable industry and their wonderful ingenuity led them to numerous discoveries neglected at the time in many instances, but which have had a most marked and important influence on the development of the modern science.

It has already been said, that the alchemists did not study chemistry as a science, but only practised it as a means of attaining their objects. They proceeded on certain speculative notions, adopted *a priori*, and supposed to be established truths. But at last the time came, when the materials they had collected with so much industry and zeal were made the foundation, on the Baconian or inductive system, of a new science. This could not take place until after the development of physics, or mechanical philosophy, which treats of those properties which are common to all material substances, and which development immediately followed or accompanied that of astronomy.

From the very nature of chemistry, it was impossible that it should take a truly scientific form, until the balance was applied to it. Up to that time, speculations *a priori*, and erroneous interpretations of observed phenomena, retarded its progress, although new and important discoveries were daily made. But Lavoisier, who first employed the balance in the study of some of the most important phenomena, such as those of combustion, on a certain theory of which the then existing science was founded, effected a complete revolution in chemistry; and from that time, 1760–1770, the science of chemistry has made rapid and continuous progress.

Our limited space will not permit us to enter more minutely into the history of chemistry, and we shall therefore at once proceed to give some account of the science as it now stands.

It is not easy, and fortunately it is not necessary, to define chemistry in a few words. We may describe it as the science which treats of the properties of the different kinds of matter, or elementary bodies, which exist in our universe, the laws which regulate their mutual actions, and the proportions in which they combine together to form the compounds which, for the most part, constitute the animal, vegetable, and mineral kingdoms, as well as the properties of these compounds. But it is necessary here to explain the term elementary body or element.

ELEMENTARY BODIES.

The ancients, as is well known, admitted four elements, earth, water, air, and fire, of which all things were composed. But it is a mistake to suppose that they used the term element in the same sense as we do. That which they understood by it was rather the forms under which matter is presented to us, than the nature or essence of material substances. Thus, by earth they understood solid matter; by water, liquid matter; and by air, matter in the state of gas or vapour. Fire was their name for what we call heat or caloric, which causes solid bodies to become liquid, liquids to become gaseous. And in this sense the four elements of the ancients do indeed include all material substances.

The meaning now attached to the word element is very different from this. We observe that there are different kinds of matter, whether solid, liquid, or gaseous; and on investigation we find that some of these may be resolved into two or more different substances, some of which again may in like manner be resolved into others, but at last we come to substances in which we are unable, with all our appliances, to detect more than one kind of substance or matter. Some such substances occur in nature, although most natural substances contain more than one kind of matter. To take a few examples. Common salt can easily be shown to consist of two different kinds of matter; of a metal, sodium, and of a non-metallic body, chlorine. Water can be resolved into two gaseous non-metallic substances, oxygen and hydrogen. Cinnabar consists of mercury and sulphur; marble of three bodies, the metal calcium, the non-metallic body carbon, and oxygen. But it is out of our power, by any means yet known to us, to detect any other substance in sodium, chlorine, oxygen, hydrogen, mercury, sulphur, calcium, and carbon; sodium yields only sodium, sulphur only sulphur, and so on. And when this is the case—when a body cannot be proved to contain more than one kind of matter—it is called an element or elementary body, because such bodies are, in fact, the elements of which the material world around us is made up. Some elementary bodies are found in nature as such—for example, mercury, sulphur, carbon, gold, silver, iron, copper, and a few others; but in general two or more are found united, as in air, water, rocks, earths, plants, and animals.

It must be observed, that when we call a substance, such as carbon or chlorine, elementary or simple, we do not assert that it is absolutely and certainly simple, or may not be found hereafter to contain more than one kind of matter; we only mean that, to us, or so far as our knowledge extends, it is so. Thus, at the beginning of the present century potash and soda were considered elementary, be-

cause no one could prove them to be compounded; yet soon afterwards, by the aid of a new power, that of galvanism, Davy succeeded in showing that they contained each a metal, potassium and sodium, united to oxygen. It may happen that some future chemist should find the means of proving that these metals themselves contain more than one kind of matter, in which case they would no longer be called elementary. Nay, it is even considered probable, that all the metals may ultimately prove to be compounds, not elements; and the same opinion is entertained regarding such elements as chlorine, bromine, and iodine. But so long as this is not demonstrated, these bodies, and all others in the same position, must be retained on the list of elements.

The researches of chemists have, up to this time, detected about 60 elementary substances; of which 12 are non-metallic, and the rest all metals. The non-metallic bodies are also called *metalloids.*

Of these elements, the whole of our earth, including the waters and the atmosphere belonging to it, and likewise all the living organisms, whether animal or vegetable, are made up. But it is only a small number of the elements which occur in any great abundance; for the majority, especially of the metals, are only found in a few rare and scattered minerals.

The following table exhibits the elements arranged alphabetically. The second column contains the symbols or abbreviations used to represent them in chemical notation, and the third contains the numbers which represent their respective combining proportions, as ascertained by experiment, that of hydrogen being made the standard of comparison = 1. The meaning and value of these numbers will be presently explained.

Elements.	Symbols.	Hydrogen = 1
ALUMINUM	Al	13 7
Antimony (Stibium)	Sb	129
Arsenic	As	75
Barium	Ba	68 5
Bismuth	Bi	71
Boron	B	10·9
Bromine	Br	80
Cadmium	Cd	56
CALCIUM	Ca	20
CARBON	C	6
Cerium	Ce	47
CHLORINE	Cl	35·5
Chromium	Cr	26 7
Cobalt	Co	29 5
Columbium (Tantalum)	Ta	92
COPPER (Cuprum)	Cu	31·7
Didymium	D	49 6 ?
Erbium	E	?
Fluorine	F	18 9
Glucinium	G	26 5
Gold (Aurum)	Au	99 6
HYDROGEN	H	1
Iodine	I	127·1
Iridium	Ir	99
IRON (Ferrum)	Fe	28
Lanthanium	La	47 ?
LEAD (Plumbum)	Pb	103·7
Lithium	Li	6·5
Magnesium	Mg	12·2
Manganese	Mn	27·6
Mercury (Hydrargyrum)	Hg	200
Molybdenum	Mo	46
Nickel	Ni	29·6
Niobium	Nb	?
NITROGEN	N	14
Norium	No	?
Osmium	Os	99·6
OXYGEN	O	8
Palladium	Pd	53 3
Pelopium	Pe	?
PHOSPHORUS	P	32
Platinum	Pt	98 7
POTASSIUM (Kalium)	K	39·2
Rhodium	R	52·2
Ruthenium	Ru	52·2
Selenium	Se	39·5
Silicon	Si	21 3
Silver (Argentum)	Ag	108
SODIUM (Natrium)	Na	23
Strontium	Sr	43 8
SULPHUR	S	16
Tellurium	Te	64 2
Terbium	Tb	?
Thorium	Th	59 6
Tin (Stannum)	Sn	59
Titanium	Ti	25
Tungsten (Wolfram)	W	95
Uranium	U	217·2
Vanadium	V	68 6
Yttrium	Y	32 2 ?
Zinc	Zn	32 6
Zirconium	Zr	22 4 ?

Those elements, the names of which are printed in small capitals, are the most abundant and the most important; for of them, practically, the mass of the globe and all its inhabitants, the sea and the air, are composed.

Thus, the air consists for the most part of only two elements, oxygen and nitrogen; water of two, oxygen and hydrogen; sea salt of two, sodium and chlorine; calcareous matter, such as marble, limestone, chalk, and Iceland spar, as well as the earthy part of shells, of three elements, carbon, calcium, and oxygen. Silica, quartz, or sandstone, contains silicon and oxygen; gypsum consists of sulphur, calcium, and oxygen; bone earth of phosphorus, calcium, and oxygen; woody fibre of carbon, hydrogen, and oxygen; muscular fibre of carbon, hydrogen, nitrogen, sulphur, and oxygen; pure clay of aluminum and oxygen; iron ore of iron and oxygen, or of carbon, iron, and oxygen; lead ore of lead and sulphur; copper ore of copper and sulphur. The ashes of land plants contain much carbonate of potash, that is carbon, potassium, and oxygen; those of sea plants, carbonate of soda, or carbon, sodium, and oxygen. Many, indeed most, rocks and soils are more complex, being mixtures of several of the substances just enumerated. Thus, granite, gneiss, and mica slate, all contain quartz, felspar, and mica; and the two latter minerals are compounds of silica with clay or alumina, potash, lime, &c. Clay slate grauwacke, and other rocks, consist chiefly of felspar; and the beds of coal contain much carbon, with less hydrogen nitrogen, and oxygen, than the vegetables from which they are derived. Soils are rocks, more or less disintegrated; but contain the same substances, namely, quartz or silica, clay or alumina, limestone, felspar, gypsum, &c., which are found in the rocks which yield them, generally mixed with decaying vegetable matter or mould.

The preceding statements will show how small is the number of the more important elements; that is, of those which constitute an important part of the earth's crust. And even among the substances named there are one or two, such as the ores of lead and copper, which occur only in veins and in comparatively small quantity. But these metals, and a good many others, such as gold, silver, mercury, zinc, antimony, chromium, arsenic, cobalt, nickel, platinum, magnesium, &c., although, in comparison with the more abundant elements their quantity is small, yet occur in sufficient abundance to be applied to innumerable useful purposes. Iron, although its ores are scarce, compared with the common rocks, is yet, in small proportion, so universally diffused that it may be reckoned among those elements which make up the chief part of the earth's crust.

It will be seen that of all the elements oxygen is the most universally present, forming a constituent part, indeed, of all rocks and soils, excepting only rock salt, which is hardly to be called a true rock; of all plants and animals, of water, and of the air. It cannot, therefore, be doubted that oxygen is of all the elements the most important.

Next to it, in the mineral kingdom, come silicon, aluminum, calcium, carbon (in limestone), sodium, chlorine

(these two in salt), hydrogen (in water), nitrogen (in air), magnesium, iron, potassium, and sulphur, and in smaller proportion, phosphorus, iodine, bromine, and fluorine, besides the ores of metals.

But in the animal and vegetable kingdoms, while nearly the same elements form their mass, the proportions vary much. Carbon is the predominant and characteristic element of all organized structures; after it come hydrogen, nitrogen, oxygen, phosphorus, and calcium (in bones), sulphur, potassium, chlorine, sodium, and in smaller proportion iodine and fluorine. Aluminum hardly occurs in the organized world.

It is thus obvious, that there is no essential distinction, so far as concerns the mere nature of the elements, between the mineral and the organized kingdoms of nature. The principal elements of both are the same; and the difference lies, first, in the predominance of oxygen in the former, and of carbon in the latter; and, secondly, in the more complex nature, as we shall hereafter see, of the chief compounds which enter into the formation of organized tissues.

It is hardly necessary to point out, that by the very definition we have given of the term element, it is implied that we cannot transmute one element into another. We do not mean to assert that it is absolutely or physically impossible to transmute one of our so-called elements into another, but only that we cannot do this up to the present time. And there is every reason to believe that if we should ever succeed in transmuting one of our elements into another, it would be in consequence of our discovering, which is quite conceivable, that one or both of the transmutable bodies was in reality a compound, and not a true element. There are certain groups which have so many characters in common to all the members of them, that the simplest explanation would seem to be, that all these members contain one common ingredient or element, to which the common properties are to be ascribed, and which, in each case, is combined with a different element, to which the differences are due.

Thus all the metals agree in having the metallic lustre, and in conducting heat and electricity, besides having a general resemblance in their chemical characters; and it is conjectured that all metals contain one common ingredient. But if this be so, the metals cease to be simple elementary bodies, and must be compound. Again, there is a wonderful and accurately graduated analogy between chlorine, bromine, and iodine, in all their characters; and the opinion is pretty generally held, that they also will ultimately prove to be compound bodies, and to possess a common ingredient. But this, in the meantime, is but conjecture.

When we shall have explained the views now held as to the atomic constitution of matter, we shall mention another conjecture as to the possibility of the transmutation of bodies truly elementary. For the present it may suffice to point out that if such transmutation be supposed possible, it must be under circumstances very different from those which commonly exist. For if it were possible, under existing circumstances, that one element should become converted into another, the whole foundation, not only of chemistry, but of nature, would be destroyed. If, for example, carbon, the predominating and essential element of organized beings, could, under ordinary circumstances, be converted, as has been alleged, into silicon, one of the chief elements of mineral nature, how could plants or animals, to which carbon, as such, is essential, possess any stability? As soon as the carbon of any vegetable or animal tissue became silicon, that tissue must cease to exist. Again, if such transformation were possible, under the usual conditions of experiment, chemical analysis would be utterly impracticable, since it would be impossible to determine with accuracy the amount or weight of an element, liable at any time to become a different one. It is easy to see that an indispensable condition of the very existence of the material world we inhabit is the *stability* of the elements of which it is made up. An unstable element is almost a contradiction in terms; and, therefore, practically, the transmutation of elements, under the usual conditions of experiment, must be regarded as necessarily unattainable, although it may be conceivable under widely different circumstances. And when we speak of the indispensable stability of elementary bodies, it is altogether independently of the question whether these be really elementary, or, as is perhaps more probable in many cases, compounds which we are unable to decompose, or prove to be compounds. Thus, whether carbon be really elementary or not, it must be a stable element *to us*, otherwise the compounds it forms could have no stability.

Having explained what is understood by elements or elementary bodies, we shall next proceed, before describing the elements individually, to mention briefly the important laws which regulate chemical action between different elements, and especially those which have reference to the proportions, by weight as well as by volume, in which they combine together. It will also be necessary to explain the atomic hypothesis, which is adopted to furnish an explanation of the facts alluded to.

CHEMICAL COMBINATION.

Chemical combination, or chemical action, is to be distinguished from such actions of matter on matter as are physical or mechanical. Thus, all bodies are acted on by the force of gravitation, and, as we say, *attracted* towards the earth, and towards each other. A rod of sealing wax briskly rubbed on cloth or silk attracts light bodies; a magnet attracts iron filings. In all these cases, one mass or portion of matter acts on or attracts another, and motion is the result. These actions, or attractions, of gravitation, electricity, and magnetism are exerted between different portions of matter, but not necessarily between different *kinds* of matter; and they are also exerted at sensible distances, which in the case of gravity or of magnetism may be very great distances.

In all these respects chemical action is different. It is exerted invariably between different kinds of matter. It operates at insensible distances, and the result is, not sensible motion, but the formation of one or more new substances, by the combination of those which act on each other. The evidence of this is found in changes of properties, both physical and chemical. Of course the simplest case is that in which two elements act on each other, or combine to form a new body, which is said to be a compound of the two. Two portions of sulphur or two of iron cannot act chemically on each other, but can only exhibit mechanical attractions, such as those of gravitation, cohesion, and the like. But if a portion of sulphur and a portion of iron be placed in contact, at a certain temperature, chemical action ensues; the sulphur and iron combine together, and a new substance is the result. This new substance contains these two elements, and is called the sulphuret of iron. It is neither yellow and easily fusible like sulphur, nor metallic, malleable, and tenacious, like iron. It is of a brassy colour, with some degree of metallic lustre, and very brittle. Here the new body or compound formed has properties quite distinct from those of its elements. Now this is universally the case where chemical combination takes place. The change of properties is usually complete. Thus oxygen and hydrogen, two permanent gases, combine and produce water, a liquid at ordinary temperature. Iodine, which is a black solid, forms with mercury, which is white and metallic as well as liquid, a fine scarlet crystalline compound; and with lead, a compound which forms hexagonal plates of the colour and lustre of gold. Sulphur with mercury forms vermilion. Nitrogen and hydrogen, two inodorous and taste-

less gases, combine to form the caustic and pungent ammonia. The same law holds in regard to compound bodies, which act on each other. Thus sulphuric acid, which is highly corrosive, and caustic potash, a substance used as an escharotic, unite to form sulphate of potash, a mild neutral salt; and there are hundreds of similar cases.

In every case of a chemical compound, we can show that it contains two or more elements, and we thus distinguish compound bodies from such as are simple or elementary.

In every case of chemical action between two substances, whether simple or compound, combination takes place. But in a great many instances decomposition also occurs; that is, substances previously combined are separated. In the greater number of cases both these changes happen; some of the substances present enter into combination, while others are separated; or the same substance separates from that with which it had been united, and combines with another. Hence the almost infinite variety of the results which the chemist can produce.

When zinc is introduced into a solution of chloride of tin, a compound of tin and chlorine, the zinc combines with the chlorine, forming chloride of zinc, and the tin is separated in bright metallic crystals. Here we have both combination and decomposition. When iodide of potassium is added to chloride of mercury, what is called double decomposition, which, however, implies double combination, takes place. The potassium leaves the iodine to unite with the chlorine, while the mercury leaves the chlorine to unite with the iodine, and thus, while the two original compounds are destroyed, two new ones, the chloride of potassium and the iodide of mercury, are formed.

There are certain conditions which favour and promote, others which impede or oppose, chemical action. Thus, two substances, both solid, rarely act on each other, because the force of cohesion among the particles of each prevents them from coming into sufficiently close proximity to those of the other. In some few instances, as when iodine and phosphorus act on each other, their mutual attraction overcomes the obstacle offered by cohesion.

In general, the best plan is to liquefy one of the substances, or both, either by the aid of heat, or by the use of some solvent, such as water. If this be done, and if the attraction or tendency to combine be powerful, combination will generally follow.

The liquid form is the most favourable to chemical action, because it permits the particles to come into close proximity. Hence most substances are employed in a state of solution.

The gaseous form is unfavourable to chemical action, because the particles of elastic fluids or gases are at a great distance from each other compared to that which separates them in the liquid state. Yet, where the attraction is powerful, gases do act on each other. Thus oxygen and deutoxide of nitrogen gases instantly combine. But in general gases do not act on each other, unless under the influence of the sun's rays, or of a high temperature. Chlorine and hydrogen do not unite in the dark, but combine with explosion if placed in the sunshine, or if a flame be applied to the mixture. Oxygen and hydrogen do not combine till either a flame is applied or an electric spark passed through the mixture; in both cases they combine with explosion.

Chemical action frequently takes place between a solid and a gas, as when potassium absorbs oxygen; or between a liquid and a gas, as when water absorbs ammonia.

Heat favours chemical action, although at the same time, by increasing elasticity, it tends to separate bodies already combined. But it appears to exalt the energy of chemical attraction in a still higher degree. Hence heat is constantly employed by the chemist, both to liquefy solid bodies, and thus indirectly assist chemical action, and to increase directly the force of chemical attraction.

When several substances are present in a solution, various circumstances contribute to determine the result. If two of the substances present can form a compound which is very insoluble in the menstruum employed, that is, in which the force of cohesion is very great, that substance will be formed, and this will decide the other changes. Thus, when sulphate of soda is mixed with nitrate of baryta, since sulphuric acid and baryta form a compound absolutely insoluble in water, they combine, and the sulphate of baryta being thus formed, the nitric acid must combine with the soda and form nitrate of soda.

In like manner, if any of the substances present have a great tendency to assume the form of gas, that is, if its elasticity be great, it will escape as gas, and thus determine the result. If carbonate of lime be mixed with nitric acid, the carbonic acid, which has a far greater elasticity than nitric acid, escapes as gas, and the lime of course combines with the nitric acid. It is often said that carbonic acid is a weak acid, and is expelled by a stronger, such as nitric acid; but it is the elasticity of carbonic acid which causes it to appear weak.

At ordinary temperatures, sulphuric acid expels silicic acid from its combinations. But at a red heat, silicic acid expels sulphuric acid, because at that high temperature the elasticity of sulphuric acid is very great.

When a number of different substances are present in a solution, and when these are capable of combining two and two,—as, for example, several acids with several bases, each acid being capable of combining with each base,—the result is determined by all the above circumstances; by the temperature; by the relation of the solvent to the compounds that may be formed; by the force of cohesion in these possible compounds, and by the force of elasticity in such of the bodies present as tend to assume the elastic form.

It was formerly the custom to give tables of affinity or of decomposition, showing the supposed comparative force of chemical attraction between two or more acids, for example, and any given base; or between two or more bases and a given acid. That body which expelled another and took its place was called the stronger, and was said to exert a more powerful affinity, or chemical attraction, than the substance it expelled for the third body. Thus, sulphuric acid, which expels nitric acid from nitrate of potash, was said to have a stronger affinity for potash than nitric acid. But in this case, the change, which only takes place fully with the aid of heat, is determined by the tendency of the nitric acid to assume the gaseous form, that is, by its elasticity; and it affords no proof that nitric acid is weaker than sulphuric. Nay, as we have seen, an acid, apparently very feeble at ordinary temperatures, may become, at a red heat, capable of expelling sulphuric acid, by which it is itself expelled in the cold. In consequence of these and similar considerations, tables of affinity are no longer used, since they convey no information but the bare fact, that at a given temperature, and under certain circumstances, certain changes occur, and cannot tell us the real comparative force of affinity or attraction between any two or more substances of the same class, and a third with which both can unite.

When one body leaves another with which it had been combined to unite with a third, the result used to be called an example of elective affinity; as if the body B, in the compound AB, chose or preferred the body C, and thus formed the compound BC, A being set free. But it is now considered, that when a body C is placed in contact with a compound AB, the compound BC is only formed when it has a greater cohesive force than AB; or when A has a greater elasticity or cohesion than C, or when both causes are combined. And we have no means of ascertaining whether the attraction between B and C be greater than that between A and B, considered apart from the influencing circumstances.

There is another case, namely, where two bodies refuse

to act on each other till a third is added, which tends to combine with the new compound that may be formed. Thus, zinc does not decompose water till sulphuric acid be added, and then hydrogen is set free, while the oxygen of the decomposed water is found to be combined with zinc and sulphuric acid, forming sulphate of oxide of zinc. This was formerly called a case of predisposing affinity, and the acid was said to promote the action in virtue of its attraction for the oxide of zinc about to be formed. It is obvious, however, that it is absurd to speak of the attraction of sulphuric acid for a body not yet in existence, and still more so to ascribe to this attraction the formation of that body. The truth is, that when zinc is in contact with water, no change occurs; the forces tending to preserve the existing state of things being superior to those which tend to disturb it. But when the acid is added, an additional disturbing force is brought into play, the existing arrangement is overturned, and the zinc, oxygen, and sulphuric acid unite to form the sulphate of oxide of zinc, while the hydrogen, from its elasticity, is disengaged as gas.

There are, besides, some remarkable instances, in which certain substances appear, by their mere presence, to promote chemical action without taking a share in the change, as the sulphuric acid does in the case last mentioned. Thus, oxygen and hydrogen, which, when mixed, may be kept for any length of time without combining, rapidly combine if allowed to come in contact with platinum, whether in a compact, dense, polished plate, in a porous spongy form, or in the form of powder. And yet the platinum does not in any way enter into the change, but remains, as before, uncombined. It must be admitted that we cannot satisfactorily explain this striking fact. The proposed explanations will be mentioned under Hydrogen.

In like manner, yeast or ferment induces the fermentation or decomposition of sugar, if placed in contact with it, yet neither gives anything material to the sugar, nor receives anything from it. It is supposed to act by the communication of a mechanical impulse or motion to the particles of the sugar, which motion or impulse destroys the existing equilibrium, and a new equilibrium is established, which is permanent under the existing circumstances.

Some have included these two last-named modes of action under one head, under the name of catalysis or catalytic action. But independently of the circumstance that this is merely giving a name to the phenomenon which we cannot explain, and not explaining it, it would seem that we can hardly conceive that the same cause which produces the *combination* of oxygen and hydrogen by mere contact, should also by mere contact cause the *decomposition* of sugar, or the separation of bodies already combined.

Such is a brief account of the circumstances which promote or oppose chemical action. Let us now consider the subject in reference to the quantity of the substances which combine, and we shall find it to be a matter of the highest importance; the study of which, in fact, has created the existing science of chemistry.

COMBINATION IN DEFINITE PROPORTIONS.

The researches of chemists have established a most important law; which is, that when two or more substances unite to form a new compound, they do so in definite, fixed, invariable proportions.

Thus, hydrogen and oxygen unite to form water. Now, when 1 grain (ounce, pound, &c.) of hydrogen is thus converted into water, the water produced weighs, invariably, exactly 9 grains (ounces, &c.) Consequently hydrogen and oxygen unite, *to form water*, always in the proportion of 1 part of hydrogen to 8 parts by weight of oxygen. If we analyze (after purifying it) the water of a river, of a lake, of the sea, of rain, or of snow and ice, whether newly formed, or produced ages ago, we shall always find that 9 grains of water contain 1 grain of hydrogen and 8 grains of oxygen. If we mix these elements in any other proportion, such as 1 to 10, or 2 to 8, and cause combination to take place, we shall find, in the former case, 2 parts of oxygen, and in the latter 1 part of hydrogen, remaining uncombined. In short, we cannot form water which shall have a composition different from that just stated. If we should be able, and this is possible, to cause these two elements to combine in any other proportion, the resulting compound, as will be seen hereafter, would be, not water, but a totally different compound; and this compound, in its turn, would be found, whenever formed, to be as invariable in the proportion of its elements as water itself.

If we analyze the oldest marble, geologically speaking, we shall find it to consist of carbon, calcium, and oxygen, in the proportions of 6 parts, by weight, of carbon, 20 of calcium, and 24 of oxygen, which make up 50 parts of carbonate of lime. If we analyze the newest chalk, or if we prepare, artificially, carbonate of lime, and analyze it, the results will be precisely the same. These three elements, *to form this compound*, unite in the above proportions invariably.

This law admits of no exceptions; and it is of the very essence of any compound, and a point on which its properties as well as its existence depend, to contain always the same relative amount of its component elements.

It is easy to see that, unless this were so, chemistry as a science could have no existence, for analysis would be impossible. If the proportion of any of the elements of a compound were variable, it would be impossible to attach any value to such a compound. If, for example, iron ore, lead ore, or silver ore, being pure compounds, contained at one time 50 per cent. of the metal, at another 5 per cent., how could such ores be valued? This, in fact, constitutes the difference between a true compound and a mixture, in which the proportions are never twice the same. But all true compounds, if pure and free from admixture of foreign matter, are uniform in their composition. This is the first great law, in regard to quantities, which regulates chemical combination.

The second law is, that if two bodies are capable of combining in more proportions than one, that is, of producing more compounds than one, then a very simple ratio exists between the quantities of the same element in these compounds, when referred to the same amount of the other element. This ratio is usually that of a multiple by a small whole number.

Thus, hydrogen forms with oxygen two compounds with properties totally dissimilar; namely, water or protoxide of hydrogen, and the deutoxide, binoxide, or peroxide of hydrogen. In water, as we have seen, the proportion is 1 of hydrogen to 8 of oxygen. In the peroxide, the hydrogen being made 1 as before, the oxygen is not 8, but 16, that is, 8 multiplied by 2. Again, lead forms with oxygen two compounds, or oxides, which contain—

	Lead.	Oxygen.
Protoxide of Lead,..................	104 parts	8 parts
Deutoxide of Lead,..................	104 ...	16 ...

In some cases there are three or more compounds of the same elements, but the law holds invariably. Thus, nitrogen forms with oxygen the following five compounds:—

	Nitrogen.	Oxygen.
Protoxide of Nitrogen,..............	14 parts	8 parts
Deutoxide of Nitrogen,..............	14 ...	16 ...
Hyponitrous Acid,....................	14 ...	24 ...
Nitrous Acid,..........................	14 ...	32 ...
Nitric Acid,.............................	14 ...	40 ...

Here the oxygen in the first compound is multiplied successively by 2, 3, 4, and 5. Such cases, however, are rare. There are few instances in which two elements combine in more proportions than two or three.

In the cases just cited, the ratio is the simplest possible;

but there occur ratios somewhat different. Thus iron forms with oxygen several compounds. We find, in the

	Iron.	Oxygen.
Protoxide of Iron,	28 parts	8 parts
Sesquioxide of Iron,	28 ...	12 ...
Ferric Acid,	28 ...	24 ...

Here the ratio in the second compound, if we consider the first as in the ratio of 1 : 1, is that of 1 : 1·5, and in the third, it is 1 : 3. Compounds in which the ratio of 1 : 1·5 is observed are called sesqui-compounds. In some rare cases we find the ratio of 1 : 2·5, and of 1 : 3·5. In all other instances, and these constitute the vast majority, the quantity of the element which varies, the other being supposed stationary, is multiplied by a whole number, such as 2, 3, 4, 5, and very rarely 7.

This law is called the law of multiple proportions, and in reference to it compounds may be arranged in two categories. In the first we have the amount of one element, the other being supposed to be fixed, increasing by the simple multiples 2, 3, 4, &c., so that we have a simple arithmetical series.

In the other, we have the following series of numbers for the quantities of the variable element, or some of them, namely—1, 1·5, 2, 2·5, 3, 3·5.

The next law of combination is, that the numbers representing the weights in which bodies combine together are mutually proportional. That is to say, if a certain weight of A combine with a certain weight of B, and if the same weight of A combine with a certain weight of C, then the numbers which represent the weights of B and of C which combine with the same weight of A, will also represent the weights of B and C which will combine together, if they can combine. Or if not, then the combining weight of either B or C will be a multiple or submultiple of the number referred to.

Thus, 8 parts of oxygen unite with 1 of hydrogen to form water, and 1 part of hydrogen combines with 16 of sulphur to form hydrosulphuric acid. Now, when oxygen and sulphur combine, they do so either in the proportion of 8 parts of the former to 16 of the latter, as in hyposulphurous acid; or in those of 16 of oxygen to 16 of sulphur, as in sulphurous acid; or 24 of oxygen to 16 of sulphur, as in sulphuric acid.

Again, 8 parts of oxygen unite with 40 of potassium, and 40 of potassium unite with 16 of sulphur; the quantity which, or a multiple of it, we have just seen to combine with 8 of oxygen.

Lastly, 1 part of hydrogen, which, as we have seen, unites with 8 of oxygen and 16 of sulphur, unites also with 36 parts of chlorine. And 36 parts of chlorine unite with 8 of oxygen, and also with 40 of potassium, the quantity of that metal which combines with 8 of oxygen and 16 of sulphur. Chlorine, however, combines with oxygen in more proportions than one; and here, as with sulphur, the law of multiples holds, for 36 of chlorine combine with 8, with 24, with 32, with 40, and with 56 of oxygen.

It will now be obvious to the reader, that if we ascertain by experiment the proportions by weight in which all the other elements combine with one, such as oxygen (which can combine with all the others except only fluorine), these numbers will at once tell us in what proportions these other elements which combine with oxygen will combine among themselves. Or, if the numbers thus obtained should in any case be found not to represent the combining proportion of one element with another, it will only be because in that instance one of the elements combines according to a multiple or submultiple of the number representing the weight of it, which combines with 8 of oxygen.

It is precisely in this way that the numbers in the third column of the table, p. 438, have been obtained. They represent the proportions by weight, in which, or in some instances in multiples or submultiples of which, they combine, not only severally with 8 parts of oxygen, but with each other, according to the third law, which declares that these numbers are mutually proportional.

It will be observed that in this table hydrogen is made the standard of combining proportions, its number being = 1. And it is for this reason that oxygen is represented by 8, being, as we have seen, the quantity which in water is combined with 1 of hydrogen. Hydrogen has been chosen in this country as the standard of comparison, because, being the lightest of all bodies, it has the smallest combining number, and if that be made = 1, the numbers of the other elements will generally be whole numbers, and thus we get rid of fractions as far as possible. If we were to make hydrogen = 10 or 100, the other numbers would have to be increased in proportion.

On the Continent, oxygen is made the standard, and is made = 100. Hydrogen then becomes 12·5; sulphur 200, chlorine about 450, and so on. The smaller numbers of the English scale are more easily retained, and, as already mentioned, there are fewer fractions. But any one who wishes to do so, can easily convert the numbers of the hydrogen scale into those of the oxygen scale. For this purpose, he has only to multiply the former by 12·5; and conversely, to reduce numbers of the oxygen scale to those of the hydrogen scale, we divide them by 12·5.

It is a very remarkable fact, and one no doubt connected with the intimate constitution of matter, that when hydrogen is made unity, nearly all the other elements are represented by whole numbers. In other words, their combining proportions are multiples of that of hydrogen by whole numbers. Dr Prout first advanced this as a law, which was much contested, and for a time it was supposed to be overthrown by the results of experiment. But as our methods of analysis have improved, it has been found that every year more elements are brought under Prout's law; and it seems probable that, as this improvement advances, that law will be ultimately found to apply universally. For the present, some important elements, such as chlorine and potassium, cannot be brought exactly under it, although we have used whole numbers in speaking of these elements, in order to avoid fractions. The true numbers of these elements, according to the best and most recent authorities, are given in the table.

It must be carefully remembered that these numbers are in no respect whatever theoretical, but represent the actual results of the best analyses. They are quite independent of all hypothesis, and it must be received as a simple observed fact, that the elements combine according to these numbers, or multiples or submultiples of them, whether we can explain it or not. It will be at once perceived that this important fact constitutes the only true foundation for chemistry as an exact science.

It cannot be doubted that this essential fact depends on some cause connected with the constitution of matter. But as we know nothing certain concerning the constitution of matter, nay, nothing whatever of matter, except its properties, that is to say, the various ways in which it affects our senses; so we are as little able to explain why the elements combine in fixed and invariable proportions, as we are to explain why or how the earth and the sun gravitate towards each other.

In all departments of natural science, we find ultimate facts, like this of definite proportions, or like gravitation, of which we know only that they exist; and those who imagine that, for example, they *explain* gravitation by saying that there exists an attraction between the gravitating bodies, which they call gravity, or the attraction of gravitation, delude themselves with words. To say this is merely to repeat the simple fact, that the bodies in question somehow tend towards each other, in different terms; and it furnishes not

even the shadow of an explanation of the phenomenon. Newton's celebrated law of gravitation was never intended, as some imagine, to explain gravitation, which no man can explain, but only tells us that all masses or portions of matter tend towards each other with a force which varies directly as the mass, and inversely as the square of the distance. This law enables us to measure and calculate the *force* of gravitation, but throws no gleam of light, nor does it pretend to do so, on the nature and mode of action of that force. *Why* do two bodies tend towards each other, and *how* is it effected? These are questions which Newton never attempted to answer, well knowing that they are beyond the reach of our faculties.

In like manner, the questions, Why do two elements combine chemically? How is their union effected? Why do they unite in fixed and definite proportions? have never been answered, and probably will never be answered, so long as our faculties remain the same. We can only say that they do unite, and that they unite according to certain laws which we can investigate and ascertain.

It is not wonderful that we should be utterly unable to answer such questions as we have stated, when it is considered that we cannot even define matter, or say what matter is. Of matter we know only the properties, not the essence.

But philosophers, in their eager anxiety to explain everything, have formed certain hypotheses as to the constitution of matter; and although none of these has been demonstrated to be true, and the knowledge of the true nature or essence of matter is, in all probability, beyond the reach of our faculties, yet some practical advantage may be derived from assuming as true a certain hypothesis concerning matter, from which we can deduce, in a simple and logical manner, the facts of combination in definite proportions, of combination in multiple proportions, and of proportional or equivalent numbers. This hypothesis is that which is known as the Atomic Theory. We shall now proceed to explain it in its application to chemistry; but the reader must carefully bear in mind, that although the Atomic Theory is only an hypothesis, assumed in order to furnish some explanation of the above-named facts, yet, whatever the ultimate fate of that hypothesis, and it is next to impossible that it should ever be demonstrated, the facts which it is intended to explain are observed and ascertained truths, which must remain, even were the atomic hypothesis proved to be false.

ATOMIC THEORY.

From the very earliest periods philosophers speculated on the nature and constitution of matter; and among the Greeks two opinions were held, both of which have ever since had supporters among those who studied natural science.

According to one opinion, matter is divisible *ad infinitum*, so that the smallest conceivable portion of matter may yet be divided into two or more smaller portions, and these again into others still smaller. Those who argue in favour of the infinite divisibility of matter appeal to experiment, which shows that matter is really divisible to an extent far beyond that of which our senses, aided by the microscope, can take cognisance. And they add, that we cannot conceive a mass of matter so small, that we are not able to imagine it to be divided into two halves, and these again each into two halves, and so on *ad infinitum*.

Now, all this is quite true. The actual divisibility of matter is amazingly great. One grain weight of gold can be beat out so thin as to cover with a perfect metallic surface 54 square inches; and gold is present, therefore, on every visible point of this large surface, even when examined by a high magnifying power. The one grain of gold, therefore, has been divided into at least as many minute parts as there are visible points in 54 square inches, viewed, let us say, under a magnifying power of 1000 linear. Platinum can be drawn out to a wire so fine as to be with difficulty seen. And these facts are as nothing compared to the division effected by chemical means. If one grain of iron or of copper be dissolved in an acid, and diluted with a gallon of water, the presence of the metal may be detected in every drop of the liquid. Now an ordinary drop weighs one grain, and in a gallon of water there are 70,000 grains. But each drop may be divided without difficulty into 1000 parts, since we can easily weigh $\frac{1}{1000}$th of a grain on our balances. And in every one of these parts we can detect the metal, even with the naked eye, by the use of proper tests. Again, under the microscope, each of these $\frac{1}{1000}$th parts of a grain of the liquid may be so magnified as to appear equal to the original drop, and of course may be again subdivided into 1000th parts, in which it cannot be doubted that we should still be able to detect the metal. Now, the gallon of liquid will yield 70 millions of minute drops, each weighing $\frac{1}{1000}$th of a grain; and 70,000 millions of the microscopic drops we have supposed to be derived from these under a high magnifying power. So that, if, as there is every reason to believe, the iron or copper can be shown to exist in each of these last particles, we shall have divided the one grain of metal, by chemical means, into 70,000,000,000 parts. And there is no reason to think that, even then, we should have reached the limit of actual divisibility, if there be a limit to it.

But all this does not prove that matter is *infinitely divisible*, for there may be a limit, though beyond the reach of our senses.

Now, the other opinion, which was held by some of the early Greek philosophers, is this: that matter is indeed divisible to a prodigious degree, but not infinitely; that there is a limit to divisibility, and that this limit depends on the constitution of matter. Matter is believed, by those who hold this opinion, to be formed of very minute particles which are called atoms, from two Greek words, signifying "that which cannot be cut or divided;" and when division reaches these, it can go no further, and must stop.

It is no doubt true, that however minute the supposed atoms may be, we can conceive of them as halved, and of the halves again as again divided. But while there is no limit to our *conception* of the smallness of atoms, this by no means proves that there may not be a limit to the actual divisibility of matter. To see this, let us consider what division really is; and we shall see that the knife, the hammer, the pestle, and the solvent, all agree in separating one part of a mass of matter from another, or in causing the parts to assume a new arrangement. The knife, which is perhaps the simplest agent of division, is a form of the wedge, and, being forced into the vacant space between two portions of a mass of matter, separates these. But that this may be done, there must be empty spaces between the parts of which the mass of matter is made up. And this is the case. Every mass of matter has multitudes of such empty spaces or pores, into which the dividing instrument penetrates. Matter itself is impenetrable; and when we penetrate a mass of it, we force the instrument into its pores, the matter being displaced or yielding on all sides, but not being itself penetrated. Consequently, if we suppose a mass of matter devoid of pores, it would not be possible for us to divide it, since matter is impenetrable, and there is no space for the instrument to enter. All natural matter, however, is porous, and consequently divisible; and the same is true of the smallest particles which our senses can appreciate.

But the very nature of the atoms, supposed by the second hypothesis to exist, is to be destitute of pores; to be in fact units of matter, entirely filling the space within their periphery, which the minutest fragment of ordinary matter does not. And when we have conceived a mass without pores, we have conceived an atom, that is, a particle which

cannot be divided, although we can conceive a particle of half its size, and so on.

According to this theory then, matter is made up of such atoms, or entirely solid, indivisible particles, which are not in absolute contact, but probably touch each other at one point only; and of the pores, or vacant spaces between them. When heat expands matter, it forces the atoms farther apart; when cold contracts it, they come nearer together. When cut or bruised, they are more or less completely separated from their original cohesion; when dissolved, the atoms are separated by the solvent. When beaten out thin, or drawn into fine wire, they are made to assume a new arrangement, either in many parallel lines or in one or a few such lines. In short, these atoms may be separated, or newly arranged, but they cannot possibly be divided; and therefore when, in the process of division, we come to the atoms, we must stop. They are, however, so very minute, that our means of division fail us before we reach them; so that the limit to divisibility in practice is short of that fixed by the nature of matter, according to this view.

For this reason we cannot demonstrate the actual existence of atoms, but the hypothesis which assumes their existence agrees perfectly with all the known phenomena exhibited by matter, whether physical or chemical, and more particularly with the laws of combination in fixed and multiple proportions; whereas the theory of the infinite divisibility of matter leaves these phenomena entirely unaccounted for.

It was Dalton who, reflecting on the facts of combination in definite proportion, first thought of applying to explain these the atomic hypothesis of the constitution of matter. In order to do this, however, we must assume, not only the atomic constitution of matter, but also three other hypotheses, namely, first, that the atoms of each element possess a weight which is invariable; secondly, that the weight of the atom of each element is different from that of all others; and, thirdly, that the elements combine atom to atom, and so forth.

If, for example, we assume that an atom of oxygen weighs 8 times as much as an atom of hydrogen; and if we further assume that 1 atom of oxygen unites with 1 of hydrogen to form water; it is easy to see that, in that case, water must contain oxygen and hydrogen in the proportions ascertained by experiment, namely, that of 8 parts by weight of oxygen to 1 part of hydrogen. And if we suppose 2 atoms of oxygen to combine with 1 atom of hydrogen, the compound thus formed must contain 16 parts, by weight, of oxygen to 1 of hydrogen, which, as we have seen, is the case in the deutoxide of hydrogen.

It must never be forgotten, that in applying the atomic theory to explain the facts of combination, we begin by a series of assumptions. We assume, first, that matter is formed of atoms; secondly, that these have fixed weights; thirdly, that these weights are different in different elements; and, fourthly, that when elements combine, they do so either atom to atom, or 1 atom to 2, 2 to 3, 1 to 3, &c. &c. All these are pure assumptions, which we cannot demonstrate; but these being made, and admitted, the whole facts of combination in fixed and multiple proportions may be naturally deduced from them, and indeed may even be predicted. This is the strongest argument in favour of the truth of these hypotheses, but yet they are not demonstrated truth; while the facts are facts, even if our hypotheses should be abandoned.

This, then, is what is called the Atomic Theory of chemistry. It supposes matter to be formed of exceedingly minute but indivisible particles or atoms, which possess weight, and which have different weights in different elements, but invariably the same weight in the same element. It is, however, impossible for us to know the absolute weight of these atoms in any case; all that we can do is to ascertain their comparative weights, on the further supposition that elements unite atom to atom, or in some very simple ratio. Thus, if we suppose that one atom of hydrogen and one atom of oxygen unite to form one (compound) atom or molecule of water; then, since we know as a fact that the proportions, by weight, in water, are 1 part of hydrogen to 8 of oxygen, we see that, admitting the suppositions we have stated, whatever be the absolute weight of an atom of hydrogen, an atom of oxygen must weigh 8 times as much. The smallest portion of water we can weigh may possibly contain a million of atoms of each element; but the number signifies nothing, so long as they are supposed to unite one atom with one atom; the relative weights of a million of atoms of each being the same as those of one atom of each element. If, then, we make hydrogen, as being the element whose atoms are the lightest in the standard, and express the relative weight of its atom by 1, the weight of the atom of oxygen will be 8.

In this way the relative weights of all the elements are ascertained, being referred to hydrogen as a standard; and the reader will at once see that these weights—atomic weights, as they are called—coincide with the combining proportions given in the table at p. 438. These numbers, therefore, are called indifferently atomic weights, combining proportions, or equivalent numbers, and, for shortness' sake, equivalents. They are mutually equivalent, because, as has been shown, when a body B leaves another A, to unite with a third C, the weight of B, at first united with a given weight of A, combines with or is equivalent to a weight of C, which is equivalent to or combines with the same weight of A. In other words, when one element is substituted for or replaces another, it is always in the proportion indicated by these numbers, or occasionally in a multiple of these. The terms, combining proportion and equivalent number or equivalent, are preferable to that of atomic weight, inasmuch as they simply express a fact, and do not involve any hypothesis. We shall therefore use, in general, the term equivalent, contracted, when desirable, into eq., as being unobjectionable.

The facts of multiple proportion follow naturally from the atomic theory. Thus, in the compounds of nitrogen and oxygen, the equivalents of these bodies being ascertained to be 14 and 8 (hydrogen = 1), we have only to suppose that,

In the first, 1	atom of nitrogen unites with	1 of oxygen.
In the second, 1		2 ...
In the third, 1		3 ...
In the fourth, 1		4 ...
In the fifth, 1		5 ...

and the resulting numbers will be as formerly stated.

In the case of such compounds as exhibit the ratio, in their composition, of 1 : 1·5, or 1 : 2·5, we cannot, without contradiction, speak of such compounds as formed of 1 atom of one element and $1\frac{1}{2}$ or $2\frac{1}{2}$ atoms of another. The half of an atom, of that which is indivisible, *ex hypothesi*, is a contradiction in terms. To avoid this, while using the terms of the atomic theory, we double the numbers and say that these compounds are formed by the union of 2 atoms of one element with 3 or with 5 of another. The two oxides of iron consist of

	Iron.	Oxygen.
Protoxide of iron	1 atom	1 atom
Sesquioxide or peroxide of iron	2 atoms	3 atoms

Alumina or sesquioxide of aluminum, sesquioxide of manganese, and sesquioxide of chromium, all likewise consist of 2 atoms or eqs. of metal and 3 of oxygen; and this analogy in composition is attended with remarkable analogy in properties.

It only remains to mention, that the compounds formed by elementary bodies combine together among themselves

precisely as the elements do. It rarely, if ever, happens, at least in inorganic or mineral chemistry, that elementary bodies and compounds combine together, unless in the case of such compounds as play the part of elements, and are hence called compound radicals. Few of these, however, are known, save in combination; and in general, we find that compounds unite with compounds, elements with elements. Thus, oxygen and sulphur unite with hydrogen and metals; but sulphuric acid, a compound of sulphur and oxygen, combines, not with hydrogen or metals, but with water and the oxides of the metals.

The combining proportion, atomic weight, or equivalent of a compound, is the sum of those of its elements. Thus water, formed of 8 parts of oxygen, and 1 of hydrogen, enters into combination in a proportion expressed by 9, the sum of these. Sulphuric acid, a compound of 1 eq. of sulphur and 3 eqs. of oxygen—that is, of 16 parts of sulphur, and 24 of oxygen, by weight—has the number $40 = 16 + 24$ for its equivalent or combining proportion. Potash, a compound of 1 eq. potassium, and 1 eq. oxygen, or (in round numbers) 40 parts of potassium and 8 of oxygen, has the equivalent $48 = 40 + 8$. And when potash and sulphuric acid combine, so as mutually to neutralize each other, they do so in the proportion of 48 parts of potash to 40 of sulphuric acid, forming neutral sulphate of potash, a compound of 1 eq. of each compound. There is another sulphate of potash, which is composed of 1 eq. of potash, 2 eqs. of sulphuric acid, and 1 eq. of water, and is termed the bi-sulphate of potash. So that the law of multiple proportions holds in regard to compounds as well as to elementary bodies.

We have no means of ascertaining the absolute size or volume of the atoms of any substance, and consequently we cannot directly find the relative volumes. But there are facts which indicate that the atoms of some elements are of the same size as those of certain others. For in compounds which crystallize, some of the elements may be removed and replaced by others, without affecting the form or angles of the crystal; which could hardly happen if the atoms of the replacing element differed much in size from those of the element which it replaces. This leads us to consider the subject of crystallization, and that of isomorphism, or the substitution of one element for another, without affecting the crystalline form of the compound.

This treatise is not the place for a full discussion of the subject of crystallization, which is one of great extent and importance, both in regard to chemistry and to mineralogy. Crystallography is now, in fact, a distinct branch of science.

It is sufficient for our purpose to state, that when substances are so placed as to assume the solid form, whether from the liquid state, or that of gas or vapour; and when this takes place slowly, and so that the particles or molecules can arrange themselves according to their natural tendencies,—they assume regular geometrical forms, which are termed crystals. Each substance which is capable of crystallizing, whether simple or compound, exhibits always the same form, except in a very few cases to be presently mentioned. This is so uniformly the case, that many substances may be recognised by this crystalline form alone.

Two circumstances require notice; first, that although the same substance always takes the same form (with the exceptions above alluded to), yet, within certain limits, the outward form may vary; that is, provided all the forms which occur are geometrically derivable from one, which is the fundamental form. Thus sea-salt crystallizes in cubes, but it also appears in regular octohedrons; fluor spar appears in cubes, in regular octohedrons, and in regular tetrahedrons; alum forms both cubes and regular octohedrons. This is because the cube, the regular octohedron, and the regular tetrahedron, constitute really but one fundamental form, termed the regular system, and are all geometrically and mechanically derivable one from the other. Calcareous spar forms rhombohedrons, but it also forms regular six-sided prisms and six-sided pyramids; also three-sided pyramids, and a prodigious number, amounting to several hundreds, of modifications of these forms; but all reducible, both theoretically and practically, to the fundamental rhombohedron of Iceland spar. In point of fact, then, calcareous spar exhibits only one form, but modified. Salt, alum, and fluor spar, also each exhibit geometrically but one form, variously modified. But although, as in calcareous spar, the extent of modification may be very great, it is never seen to crystallize in the form of the cube, regular octohedron, or regular tetrahedron, nor in any other form not geometrically derivable from its fundamental rhombohedron.

The second point is, that many different substances have the same crystalline form, as is seen in the case above quoted, of alum, salt, and fluor spar; to which may be added galena, iron pyrites, several metals, and many chlorides, bromides, iodides, fluorides, and sulphurets. This arises from the fact that the number of crystalline fundamental forms is very small compared with that of crystallizable bodies. It is chiefly in the regular system, that of the cube, that we see so many different substances assuming the same form, because the regular system is a very limited one; whereas in the other systems—in which the angles may vary, since we may have oblique rhombs or prisms of many different angles, but can have only one cube—there is much greater variety. We cannot, therefore, strictly say that each substance has a different form, but that each substance has a form to which it adheres, although other bodies may have the same.

It is evident that crystalline form must depend on the fact that the molecules of bodies are arranged in right lines, and at certain angles. When the right angle prevails, we have the cube and its derivatives, and the rectangular prism, which differs from the cube in the unequal length of its axes. When other angles occur, the result is an oblique prism, a rhombohedron, or an oblique octohedron, &c.

The great frequency of the cube and its derivative forms probably depends on the tendency of molecules of equal size to arrange themselves in lines at right angles to each other. But there are many instances of substances crystallizing in this form, which depend on isomorphism, that is, on the fact that, in certain compounds, one of the elements may be replaced by another without altering the crystalline form.

Chloride of sodium forms cubic crystals. But if the sodium be removed, and replaced by its equivalent of potassium, the new compound still crystallizes in cubes. Nay, if we remove the chlorine from the chloride of sodium, and replace it by bromine and iodine, the form is still unaltered. And if in the bromide or iodide of sodium we replace the sodium by potassium, the new salts assume the same form. Here, then, are six salts, the chlorides, bromides, and iodides of potassium and of sodium, which have the same crystalline form, the cube. These salts are said to be isomorphous.

To take another example. Alum, which is composed of sulphuric acid, alumina, potash, and water, forms regular octohedrons. But if the potash be replaced by soda or by oxide of ammonium, we obtain two salts, soda alum and ammoniacal alum, which are not to be distinguished from common alum by the form of their crystals. And, further, if the alumina, which is a sesquioxide, be replaced by the sesquioxide of iron, of manganese, or of chromium, we obtain three new alums of the same form. In each of these, as in common alum, the potash may be replaced by soda, or by oxide of ammonium, without affecting the crystalline form. So that we can have 12 alums, all differing in composition in some important point; yet all isomorphous.

Without quoting more examples, although many more might be adduced, it will be obvious from these that in each of the two groups the identity of form among the members

of the group depends on an analogy in composition; or, in other words, when one element can replace another without change of form, the replacing element is analogous in properties to that which it replaces; and, further, the function and position in the compound of the replacing element are the same as those of that for which it is substituted.

Thus, in chloride of sodium the chlorine is negative, the sodium positive; and while the positive sodium is replaceable by the positive potassium, a body singularly analogous to it, the negative chlorine is only replaceable by the negative iodine or bromine, the analogy of which to chlorine is very striking.

Alum consists of 1 eq. of the sulphate of a protoxide (sulphate of potash) with 1 eq. of the tersulphate of a sesquioxide (tersulphate of alumina), and 24 eqs. of water. The potash (oxide of potassium) in the sulphate, is replaceable by soda or oxide of ammonium, bodies entirely analogous; while the alumina (sesquioxide of alumina) can only be replaced by other sesquioxides, such as those of iron, manganese, and chromium, which are extremely analogous to it.

When we consider these facts, it would appear that the atoms, or molecules (groups of atoms) of the replacing body, besides their general analogy to the body replaced, are most probably of the same volume with those of the latter. This may help to explain how they can take the place of the expelled body, and yet not alter the form of the compound. For if their volume were different, it is not easy to see how the angles of the crystal should not be altered.

We can give no further explanation of isomorphism than this, that certain elements appear to be themselves isomorphous, and when this is the case they can replace each other in compounds without affecting the crystalline form.

Among the elements, various groups of such as are isomorphous, that is, with those of the same group, have been detected. These groups are given in the following table; and it will be seen that, as a general rule, the bodies in each group are not only isomorphous, but also in the highest degree analogous in properties.

The following isomorphous groups have been established, and the existence of more is highly probable:—

1.

Silver	Ag
Gold	Au

2.

Arsenious acid (in its unusual form)	AsO_3
Teroxide of antimony	SbO_3

3.

Alumina	Al_2O_3
Sesquioxide of iron	Fe_2O_3
.. chromium	Cr_2O_3
... manganese	Mn_2O_3

4.

Phosphoric acid	PO_5
Arsenic acid	AsO_5

5.

Sulphuric acid	SO_3
Selenic acid	SeO_3
Chromic acid	CrO_3
Manganic acid	MnO_3

6.

Hypermanganic acid	M_2nO_7
Hyperchloric acid	ClO_7

7.

Salts of potash	KO
Salts of oxide of ammonium	AmO
(Or ammonia NH_3 + water, $HO = NH_4O$)	

8.

Oxide of silver	AgO
Oxide of sodium	NaO

9.

Baryta	BaO
Strontia	SrO
Lime (in arragonite)	CaO
Oxide of lead	PbO

10.

Lime (in Iceland spar)	CaO
Magnesia	MgO
Protoxide of iron	FeO
„ manganese	MnO
„ zinc	ZnO
„ cobalt	CoO
„ nickel	NiO
„ copper	CuO
„ lead (in plumbo-calcite)	PbO

It is remarkable that groups of three are very frequent. Of course, where two or more elements have the same crystalline form, or are isomorphous, similar compounds of these elements must also be isomorphous. Thus, if potassium, sodium, and lithium be isomorphous, their protoxides, their chlorides, their sulphurets, must likewise be isomorphous, each with those of the same kind, chlorides with chlorides, &c.

What has been stated regarding the fact that substances of a totally different nature may have the same form, must not be confounded with isomorphous. Both alum and common salt crystallize either in cubes or in octohedrons, but they are not isomorphous; they merely happen to agree in crystalline form. But potash alum is isomorphous with soda alum, chloride of sodium with chloride of potassium, and so forth.

When we find two compound substances, of analogous properties to be isomorphous, this fact leads us to conclude that they are analogous in constitution. Thus, alumina is isomorphous with oxide of chromium, and analogous to it. Now, alumina is a sesquioxide, and we conclude that oxide of chromium is likewise a sesquioxide; a conclusion amply confirmed by other considerations. Selenic acid is found to be isomorphous with, and highly analogous to, sulphuric acid; arsenic acid is isomorphous with, and analogous to, phosphoric acid. We conclude, that since sulphuric acid is a teroxide and phosphoric acid a pentoxide, so selenic acid will prove to be a teroxide and arsenic acid a pentoxide. And this is found to be the case.

When two salts not isomorphous are in solution together, and the solution is evaporated, the two salts will crystallize either successively if of different solubility, or at the same time if of equal solubility, but quite distinct each from the other. The molecules of the one are only attracted by those of its own kind. The two salts may thus be easily separated. But if two isomorphous salts be dissolved, no matter in what proportion, every crystal will contain both, and they cannot be separated by crystallization. This is often a source of great inconvenience. Thus, when potash alum (common alum) is contaminated or adulterated with the isomorphous iron alum, it is impossible to purify it by crystallization. The iron alum is so similar to common alum that no one would suspect it, from its taste or colour, to contain iron, although in general the salts of sesquioxide of iron have a strong inky taste and brown colour. But when used in dyeing or calico printing, the presence of a little iron alum renders the alum totally useless, nay, injurious. It is the isomorphism of the two alums which causes them to adhere so firmly together.

In a few instances, as may be seen by the tables, the same element appears in two isomorphous groups; that is, in one set of compounds it is isomorphous with one group, in another set with another.

It has been stated, that the same body always crystallizes in the same form, insomuch that many bodies may be recognised by their crystals. But it was also mentioned that there were some exceptions to this general rule, and these are very curious.

We can conceive readily that the same composition might be found in two entirely different crystalline forms; for two compound bodies may have the same composition, and yet may differ in constitution, that is, in the arrangement of the same atoms. For example, if two compounds each contained 3 eqs. of the same metal and 4 of oxygen, they might yet be totally different; for one might be made up of two compounds, namely, one formed of 2 eqs. of metal and 2 of oxygen, and another of 1 of metal and 2 of oxygen—together, 3 of metal and 4 of oxygen; the other might be made up of two different compounds—of one containing 2 of metal and 3 of oxygen, and one containing 1 eq. of metal and 1 of oxygen—together, as before, 3 of metal and 4 of oxygen. And it would be quite natural that these compounds should have different crystalline forms.

But when we find elementary bodies crystallizing in two distinct forms not mutually derivable, it is not easy to un-

derstand how this should occur. Yet it does occur, and not unfrequently.

Sulphur exists in three distinct solid states, two of which are crystalline; carbon is found also in three solid states, two of them crystalline; and phosphorus occurs in two solid modifications, only one of which has yet been crystallized. These modifications of the same body, whether crystallized or not, in which different properties appear, are called allotropic modifications, and the phenomenon is called allotropism.

When sulphur is melted by heat, and allowed to cool, it forms small rectangular four-sided prisms. But when dissolved in bisulphuret of carbon, it forms large and broad crystals, which are oblique octohedrons. In its third allotropic state, sulphur, instead of being yellow, crystalline, and brittle, is brown, amorphous (that is, destitute of crystalline form), and tough.

Carbon, in the diamond, forms transparent regular octohedrons. In graphite it is opaque, black, and crystallized in scales or prisms. In charcoal, lamp-black, and anthracite, it is black and amorphous.

Phosphorus, in its ordinary state, is translucent, nearly colourless, very fusible, and it takes fire when heated to rather short of 100° Fahr. In its allotropic state, it is of a deep brownish-red, amorphous, much less fusible, and very much less inflammable.

In attempting to explain these remarkable facts, we must suppose, either that in one state the molecules contain more or fewer ultimate atoms than in another, or else that these atoms, if equal in number, are differently arranged. Hence the terms allotropic and allotropism, signifying that the atoms or the molecules are turned another way.

The occurrence of allotropic modifications of elementary bodies illustrates that hypothesis of the transmutation of elements formerly alluded to, but not explained. If, it is said, the ultimate atoms of an element, when grouped into molecules in one manner, exhibit certain properties, and when differently grouped (whether the difference consist in the number of atoms which go to form a molecule, or simply in their arrangement), acquire new properties, is it not possible, nay, even probable, that by some such difference of grouping one elementary body may be transformed into another? It has been stated by Dr Samuel Brown, that he succeeded in converting carbon into silicon, and iron into rhodium. And in the former case he supposes the molecule of silicon to be formed of three times as many atoms as that of carbon, the atoms being the same.

It must be admitted that such results are quite within the limits of possibility, and that the phenomena of allotropism, up to a certain point, favour the notion. But, in the first place, it must be remembered, that in the case of allotropic modifications, it is the physical properties which are chiefly affected, while the element retains its chemical characters. Thus, the physical properties of the diamond are as different as can well be imagined from those of lamp-black or charcoal. But the chemical characters are the same. In all its forms, carbon, when heated in oxygen or in air, burns, and is converted into carbonic acid gas; 6 parts of carbon invariably yielding 22 parts of carbonic acid. Moreover one allotropic form may, in general, be easily converted into another. Even the intractable diamond, under certain circumstances, passes into black, amorphous charcoal. Any one of the forms of sulphur may be converted into the other two. Ordinary phosphorus is converted, by a certain degree of heat, into the red variety; and this, when still more strongly heated, is reconverted into the ordinary form.

Now, if silicon be an allotropic form of carbon, it cannot be at pleasure either produced from carbon or reconverted into carbon. In the experiments where silicon is supposed to have been formed, only a fractional part of the carbon at best underwent the change, and this, as it were, accidentally, if the change really occurred.

But, secondly, the experiments of Dr Brown have not yielded in the hands of other chemists any such result; and chemists in general are of opinion, that the silicon found by Dr Brown must have been derived from the substances employed, in which it may have been accidentally present as an impurity.

Lastly, we may again point out that if an element is intended to perform any function in nature—and carbon, for example, has a most important function as the chief element of all organized tissues, as well as of all products of organic life—such element must possess a degree of stability and permanence, altogether inconsistent with the possibility of its being, under ordinary circumstances, transmutable into an element of different properties. Without this stability, neither compounds, nor analysis, nor chemistry could exist.

Various methods are employed in order to obtain bodies in the form of crystals, since crystallization is one of the best and most convenient means of purifying any substance. During crystallization the molecules of the same body attract each other, and seem to repel all others, except such as are isomorphous. When several salts are present in a solution, and it is evaporated till crystals appear, especially on cooling, the crystals of the different salts can be easily distinguished and separated.

Many substances crystallize best when their solution is boiled or evaporated down to the point at which it deposits its crystals on cooling, most substances being more soluble in hot than in cold liquids. But some, such as common salt, which are almost equally soluble in hot and in cold water, are best crystallized by boiling down the solution, while the crystals form in the hot liquid. Others crystallize when left to spontaneous evaporation; others, such as sulphur, are best crystallized, in one form at least, by fusion, and allowing the melted mass to cool slowly till half consolidated. The part still fluid being poured off, the interior is found lined with crystals projecting inwards.

Some bodies are crystallizable by sublimation, their vapour assuming at once the solid state.

A large proportion of those substances which crystallize from their solution in water, combine in the act of crystallizing, with a greater or less amount of water, which is called water of crystallization, being essential to these crystals. One eq. of dry or anhydrous alum takes up, in forming the ordinary crystals of alum, 24 eqs. of water. The carbonate, sulphate, and phosphate of soda, when crystallized, all contain more than half their weight of water. Such crystals are apt to lose part of their water on exposure to air, and to become opaque or fall to powder. This is called efflorescence. Salts containing no water of crystallization are called anhydrous. Such are the carbonate, sulphate, and nitrate of potash, common salt or chloride of sodium, and many others.

We have been led to consider briefly the subject of crystallization, from the relation of crystalline form to the atomic or molecular constitution of matter. There remain two other subjects connected with this, namely, combination by volumes in the gaseous state, and what is called the atomic volumes of different substances.

COMBINATION BY VOLUMES.

When we compare the quantities of different bodies which combine together, in the solid or liquid state, we cannot trace any simple or obvious relation between their volumes, such as exists between their weights. But when we compare the same substances in the gaseous form, the most simple relations at once become manifest.

Eight parts by weight of oxygen, as we know, combine with

1 part of hydrogen to form water. Now 8 parts of oxygen are in volume exactly equal to half of the 1 part of hydrogen. Or, in other words, 2 volumes (2 cubic inches, for example) of hydrogen unite with 1 volume of oxygen to form water; and the water thus formed, if measured in the state of gas or vapour, is equal in volume to the hydrogen, or 2 volumes. Two volumes of steam, therefore, contain their own bulk, or 2 volumes of hydrogen, and half their bulk, or 1 volume, of oxygen; so that 3 volumes of the gases, 2 of hydrogen and 1 of oxygen, when combined, are contracted into 2 volumes of steam or gas of water.

In all cases where two gases combine, we can trace some such simple ratio. The commonest are, 2 volumes to 1, the 3 volumes condensing into 2; 1 volume to 1, without condensation, and yielding, therefore, 2 volumes of the compound, as when 1 volume of chlorine and 1 volume of hydrogen unite to form 2 volumes of hydrochloric acid; and 1 volume to 3, the 4 volumes being condensed into 2. This is seen when 1 volume of nitrogen and 3 volumes of hydrogen unite to form 2 volumes of ammonia.

It will be seen that the doctrine of combination by volumes in the gaseous state confirms that of combination by weight, and equally establishes the fact that the combining proportions are fixed and invariable. The reason why we can trace relations so simple between the combining volumes of bodies in the state of gas must be connected with the molecular constitution of gases, and with the distance between their particles.

In solids, the force of cohesion preponderates over that inherent repulsive force which tends to remove the particles of matter farther apart. In liquids, these two forces are exactly balanced, so that the particles move freely in all directions. But in gases, the repulsive force or elasticity, which is derived apparently from the heat present in all matter, has entirely overpowered cohesion, and removed the particles to a much greater distance. Thus, in steam, the gas of water, the particles are so far asunder, that a given weight of water in that state occupies about 1400 times the volume it did in the liquid form.

Indeed, cohesion is so effectually overpowered in gases, that the particles would go on separating still further, in virtue of their mutual repulsion or elasticity, were it not for the force of gravitation, and also for the pressure of the atmosphere; which forces, in gases, hold an exact equilibrium with their elasticity. Heat enables elasticity to prevail, and thus causes gases to expand enormously in volume. Cold, on the contrary, contracts them. Diminished pressure has the same effect as increase of temperature; and increased pressure has the effect of cold on gaseous substances.

It appears probable, that if we could compare all gases under parallel circumstances as to heat and pressure, say, for example, at a hundred, or any other number of degrees above their respective boiling points (that is, the points at which they respectively assume the form of gas, overcoming cohesion), we should find that their particles are at equal distances; or, in other words, that equal volumes contain an equal number of atoms or of molecules. Or, if not, there would at least be a very simple ratio between them.

We have already assumed that the atoms of different elements have different weights; and on this supposition, if equal gaseous volumes contain an equal number of atoms, the weights of equal gaseous volumes must be to each other as the atomic weights. In that case, also, the densities of gases, if we adopt the same standard of reference, must coincide with the atomic weights.

Now this is actually, to a great extent, the case; and where the atomic weights and densities of gaseous bodies, both referred to hydrogen as unity, do not coincide, they at least exhibit some very simple multiple ratio. This is seen in the following table, in which the density as well as the atomic weight of hydrogen is made = 1:—

Gas or Vapour.	Specific Gravities.		Chemical Equivalents.	
	Air = 1.	Hydrogen=1.	By volume.	By weight.
Hydrogen...	0 0690	1·00	100	1·00
Nitrogen.....	0·9727	14·00	100	14·00
Carbon (hypothetical)	0·4213	6 00	100	6 00
Chlorine.	2·4700	35·50	100	35·50
Iodine....	8 7011	127·10	100	127·10
Bromine....	5·3930	80·00	100	80·00
Mercury.	6·9690	101·00	200	202·00
Oxygen..	1·1025	16 00	50	8·00
Phosphorus	4·3273	64 00	25	16·00
Arsenic............ ...	10·3620	150·00	25	37·50
Sulphur......	6·6480	96·00	16·66	16·00

The densities of gases are generally, however, referred to that of atmospheric air as unity, which conceals the relation between densities and atomic weights.

But it must not be overlooked that, although these facts may depend on the circumstance that equal gaseous volumes contain equal numbers of atoms, which are consequently at equal distances, and differ in the weight of the individual atoms; yet it is also quite possible that the difference in weight of equal gaseous volumes may depend on this, that equal volumes contain unequal numbers of atoms, or that the atoms are united into molecules of unequal size and weight, and placed at different distances in different bodies. It is even possible that the atoms of all bodies might be, individually, of equal weight, and that the difference in their combining proportions might depend on the number of atoms grouped in one molecule, and therefore on differences of size and weight in these complex molecules, not in the ultimate atoms. These are questions which cannot be resolved with certainty; but, if we assume that in gases equal volumes contain equal numbers of atoms, then the facts of combination by volumes follow naturally from the hypothesis.

In some substances, such as oxygen and sulphur, the density in the form of gas is such, that the combining weight is represented, not by a whole volume, but by a fraction, which in sulphur is $\frac{1}{6}$th of a volume. One volume of hydrogen unites with $\frac{1}{6}$th of a volume of the vapour of sulphur to form hydrosulphuric acid. If water be regarded as composed of 1 atom of oxygen and 1 of hydrogen, the atom of oxygen is represented by $\frac{1}{2}$ volume; whereas the atoms of hydrogen, chlorine, bromine, iodine, and nitrogen, are each represented by an entire volume. The table already given exhibits one or two instances, besides those of oxygen and sulphur, where the atom occupies only part of a volume. It is not easy to give a reason for this; but it is possible, that in the case of sulphur, for example, it depends on the existence of allotropic modifications. I. sulphur, in one of its three allotropic forms, has a vapour or gas six times denser than in another, it is evident that $\frac{1}{6}$th of a volume of the former will have the same weight as 1 volume of the latter. And it is certainly probable that each allotropic solid form has a density of vapour peculiar to itself; for there is reason to think that the different allotropic forms of an element differ in the number of atoms grouped in each molecule—a character which is likely to belong to such an allotropic modification, whether it be in the solid, liquid, or gaseous state.

ATOMIC OR EQUIVALENT VOLUMES.

The relation between the atomic weight and the specific gravity of bodies in the gaseous form has been briefly indicated in the preceding section. But the subject admits of being considered under different points of view, according to the notions entertained of the atomic constitution of

gases. On the supposition, for example, that the atoms, or ultimate particles of all elementary gases, with their surrounding spheres of heat, possess the same volume, all such gases would contain, in equal volumes, the same number of atoms. But as it is certain that compound gases do not, in all cases, contain the same number of atoms in equal volumes, it is quite possible that elementary gases may also differ in this respect; and, as above stated, the combining volumes of sulphur and of some other elements agree with this conclusion. It is therefore generally admitted that equal volumes of different elementary gases contain different numbers of atoms; that, for example, 1 volume of oxygen contains twice as many atoms, and 1 volume of sulphur (in the form of gas) six times as many atoms, as 1 volume of hydrogen, 1 volume of nitrogen, or 1 volume of chlorine.

This obviously implies that the atoms, with their spheres of heat, are of different sizes; and, to take the cases above mentioned, that the atoms of oxygen gas are $\frac{1}{2}$ the size, and those of sulphur $\frac{1}{6}$ the size of the atoms of hydrogen, nitrogen, chlorine, &c. This is what is called the *atomic volume* of gases. It is not meant that we can ascertain the absolute volume of the atoms, but the relative or comparative volume of the atoms or particles of two or more gases.

Now, since the specific gravity of a gas depends on the number of atoms in a given volume, and on the weight of these atoms, it is evident that the atomic weight, divided by the specific gravity, must give the (relative) atomic volume.

For example, let hydrogen be taken as the standard for the specific gravity of gases, as it is for their atomic weights; then the atomic weight of hydrogen, = 1, divided by its specific gravity, = 1, will yield the quotient 1 for the atomic volume of hydrogen. Again, the atomic weight of oxygen, = 8, divided by its specific gravity, = 16 (that of hydrogen = 1), gives the quotient 0·5, or $\frac{1}{2}$, as the atomic volume of oxygen; and the atomic weight of sulphur, = 16, divided by its specific gravity as gas, = 96 (that of hydrogen = 1), gives the quotient 0·1666 or $\frac{1}{6}$, as the atomic volume of sulphur.

We thus see that, on the supposition above adopted that the atoms of different gases differ in size, we can prove that, whatever be the size of an atom of hydrogen gas, an atom of oxygen gas must be half, and that of an atom of sulphur gas one-sixth that size.

It is further obvious, that the number of atoms in equal volumes must be inversely as the atomic volume; or that the specific gravity of a gas, divided by its atomic weight, will give the number of atoms in a given volume. Hydrogen being retained as the standard, then we have $\frac{1}{1} = 1 =$ the number of atoms in 1 volume of hydrogen:—$\frac{16}{8} = 2 =$ the number of atoms in 1 volume of oxygen; and $\frac{96}{16} = 6 =$ the number of atoms in 1 volume of gas of sulphur.

More briefly, the atomic volume and the number of atoms are the inverse of each other: so that we have $\frac{1}{6}$ and 6, $\frac{1}{2}$ and 2, 1 and 1.

If, while we make hydrogen the standard of atomic weights, we make air the standard of the specific gravity of gases, then we obtain, as quotients, a series of numbers equally comparable among themselves, but less simple and easy to retain than the above. We should have, for example, $1 \div 0·0694 = 14·409$ for hydrogen; $8 \div 1·1026 = 7·2554$ for oxygen; and $16 \div 6·9000 = 2·3188$, for the atomic volumes of hydrogen, oxyen, and sulphur respectively; and these numbers are to each other as 1, $\frac{1}{2}$, and $\frac{1}{6}$.

In the case of solids and liquids, the relation between atomic weight and specific gravity is far from being so simple, in consequence of the force of cohesion interfering with and disturbing the results. We cannot ascertain whether the atoms of solid bodies have the same size in different bodies or not; and we cannot tell whether the difference of specific gravity depends on a difference in the number of the atoms in an equal volume, a difference in the size of the atoms, or a difference in the size of the interstices between the particles, or possibly on two or more of these causes.

Some chemists assume that there are no interstices, but that the atoms wholly fill up the space within the circumference of the body. On this supposition, the atomic weight, divided by the specific gravity (in solids and liquids), must give the atomic volume. It is difficult, however, to admit the absence of interstices or pores in solids and liquids, if we consider them formed of atoms; and it is perhaps better to use the term *equivalent volume* instead of *atomic volume*.

The equivalent volume, then, of a solid or liquid is obtained by dividing the atomic weight (or rather equivalent number) by the specific gravity in the solid or liquid state. Water, the standard for the specific gravity of liquids and solids, may be made the standard of equivalent volumes.

Thus the atomic weight of water, = 9, divided by its specific gravity, = 1, gives the quotient 9 as its equivalent volume. The atomic weight of potassium, 39·26, divided by its specific gravity, 0·865, gives 45·387 for its equivalent volume; and the atomic weight of carbon, 6, divided by its specific gravity in the form of diamond, = 3·5, the quotient 1·717 for the equivalent volume of the diamond.

On the other hand, the specific gravity, divided by the atomic weight, gives the relative number of atoms in a given volume, and in the case of potassium this is $0·865 \div 39·26 = 0·0220$; in the case of carbon it is $3·5 \div 6·04 = 0·5794$. Finally, in the case of water, the relative number of atoms in a given volume, which may be made the standard, is $1 \div 9 = 0·1111$. If, for convenience, the number for water is made 1000, then that for potassium becomes 198·0, and that for carbon becomes 5215.

Assuming, likewise for convenience, the equivalent volume of water (the standard) to be (instead of 9) 1000, the equivalent volume of potassium becomes 5043, and that of carbon 191·666.

We thus perceive that the equivalent (or atomic) volume of carbon is about twenty-five times less than that of potassium, and that the number of atoms of carbon contained in a given volume is about twenty-five times greater than in the case of potassium. This compression of so large a number of atoms into a given volume may be the cause of the great hardness of the diamond.

The whole subject of equivalent volumes is full of interest; but, as chemists have only recently begun to study solid and liquid bodies in this point of view, our knowledge on the subject is still very imperfect and limited For what has lately been done, we are chiefly indebted to Kopp and to Schrœder.

Playfair and Joule have very lately published the first part of an elaborate investigation into the volumes occupied by bodies both in the solid form and when dissolved in water; and they have obtained results of an unexpected nature as well as of very great value.

The reader is referred to their paper in the Memoirs of the Chemical Society. Here we have only space to allude to the subject, and to mention that, among other curious results, these chemists have found that many salts, when dissolved in water, do not add to the bulk of the water more than is due to the water actually present in the salts. Thus, for example, alum, 1 eq. of which contains 23 equivalents of the elements potassium, aluminum, sulphur, and oxygen, besides 24 eqs. of water, dissolves in water without increasing its bulk more than the addition of the 24 eqs. of water must necessarily do; so that the 23 eqs. above mentioned occupy no additional space, and must either be contained in the pores or interstices of the water, or disappear altogether as far as the occupying of space is concerned, if water be supposed to have no pores.

They have further shown that when salts do add to the bulk of the water in which they are dissolved, the increase of the bulk corresponds to that of a volume, or some multiple of a volume, of water. It is evident that these and similar researches must soon greatly extend our knowledge of the mechanical constitution of matter.

There is another circumstance connected with chemical combination which must be briefly noticed. We have seen that bodies of different composition may have the same crystalline form, if they only differ by the substitution of one element for another isomorphous with it. But we find, also, that bodies have the same composition, that is, the same relative quantities or proportions of their elements, while their properties are totally different. In fact, this phenomenon in compound bodies is closely analogous to allotropism in elementary ones. It is not very frequent in inorganic chemistry, but very common in organic compounds. Thus cyanogen (a compound radical) forms with oxygen three compounds, cyanic acid, fulminic acid, and cyanuric acid, all three of which have exactly the same proportions of cyanogen and oxygen, but differ entirely in properties. This is accounted for by the fact, that in the first 1 eq. of cyanogen is united to 1 eq. of oxygen; in the second, 2 eqs. of cyanogen to 2 eqs. of oxygen; and in the third, 3 eqs. of cyanogen to 3 eqs. of oxygen. Such compounds are said to be polymeric, and correspond to those allotropic modifications of elements in which the molecules contain a different number of atoms.

But there are also cases in which not only the proportion but the absolute number of the elements is the same, while yet the properties are different. Aldehyde consists of 4 eqs. carbon, 4 eqs. hydrogen, and 2 eqs. oxygen. Acetic ether contains 8 eqs. carbon, 8 eqs. hydrogen, and 4 eqs. oxygen. It is, therefore, polymeric with aldehyde; and besides the difference in the number of atoms, there is an obvious difference in their arrangement. But butyric acid contains, like acetic ether, 8 eqs. of carbon, 8 eqs. hydrogen, and 4 eqs. oxygen. In these two compounds, then, the absolute number of atoms is the same, as well as their relative proportion; but the two bodies are totally different. This can only be explained by a difference in the arrangement of the same number of the same elements. Accordingly, in acetic ether they are arranged in two groups, acetic acid and ether, combined together; while in butyric acid two other groups, namely, dry butyric acid and water, are united. Such compounds are said to be isomeric, and sometimes metameric.

It is quite evident that both isomerism and polymerism are natural corollaries from the atomic hypothesis. If elements combine by atoms, it is obvious that a compound which contains twice or thrice as many atoms as another, or in which the same number or a multiple of it is arranged differently, might be expected, *a priori*, to exhibit different properties; and when we consider that, while there is no limit to the number of atoms which may combine, the slightest difference in arrangement will produce new properties as surely as a difference in number, we can see how vast is the number of different compounds producible on these principles from a few elements. This, as we shall see, is remarkably the case in organic chemistry.

Having now briefly noticed the most important laws of chemical combination, as well as various circumstances which are connected with it, it might be expected that we should offer some explanation of these phenomena. But we must confess that we are unable to do this. In the ordinary language of science, combination is attributed to a force called chemical attraction or affinity. But it is easy to see, that to say that two bodies combine together in consequence of chemical attraction or affinity between them, while it has the appearance of an explanation, really explains nothing, and amounts to no more than saying, that these bodies combine because they combine. For when we ask what is chemical attraction, we can obtain no other answer than that it is the force or cause in virtue of which different bodies unite; just as cohesion is the cause in virtue of which two or more portions of the same body are held together. But in neither case have we any knowledge of the real nature of this force, nor can we say with certainty that an attraction exists. The same is true of gravitation, and of all natural forces. We know not their nature, and we think that we explain them when we call them attractions, and speak of the attraction of gravitation, the attraction of cohesion, and chemical attraction. All that we really know is that a compound is formed, but how, or in what manner, we cannot tell; just as we see that particles cohere to form a mass, and that all bodies possess weight, without being able in the least to explain either phenomenon.

So true is this, that while some admit as many forces as there are different phenomena, others conceive that gravitation, cohesion, and affinity, as well as other so-called attractions, are all the result of one and the same force, acting under different circumstances, or at different distances. This, however, for the present, is purely hypothetical. We know nothing of natural forces except their effects, just as we know nothing of matter except its properties.

One hypothesis, however, concerning chemical attraction has enjoyed considerable popularity, and, as it has affected the language of the science, it is necessary to notice it.

It has long been known that bodies charged with electricity either attract or repel each other; and it has been found that there are two kinds or forms of electricity, which are called positive and negative, or vitreous and resinous. It is still a disputed point whether these are really distinct, or whether the positive be merely the excess, the negative the deficiency, of the same agent. However this may be, when two bodies are charged with the same kind of electricity, they repel; when charged with opposite kinds, they attract each other; that is, in the former case they move away from each other, in the latter they move towards each other.

Now, according to the electrical hypothesis, all bodies are naturally charged with one or the other electricity, and such as are negatively charged are supposed to attract such as are positively electric. Oxygen is said to be strongly negative, and such bodies as hydrogen and potassium as strongly positive. These form the extremes of an electric series of all the elements, which, when placed in their proper position, are found to be negative in regard to all lying between them and the positive end; and positive in regard to all between them and the negative end of the scale. Thus sulphur is positive with regard to oxygen, chlorine, bromine, iodine, and fluorine, all of which lie nearer the negative end; but negative to all the metals, and to hydrogen, which lie towards the positive end.

Now it is found that the strongest affinities, that is, the strongest tendencies to combine, really do exist between the most negative and the most positive elements, and that two bodies lying contiguous in the scale exhibit usually feeble affinity for each other, and when combined are very easily separated.

According to this electro-chemical hypothesis, every compound, however complex, consists of two constituents, one positive, the other negative, which unite because they are so.

One circumstance which seems to favour this hypothesis is this, that when any compound is decomposed by a current of electricity, the positive element always appears at the negative pole, and the negative element at the positive pole, which is supposed to be due to the fact, that unlike electricities attract each other, while like electricities repel each other.

On the other hand, there are circumstances which do not so easily admit of explanation. The elements, in their un-

combined state, exhibit no electricity of any kind, such as is supposed to be inherent in them. Again, when two oppositely electrified bodies attract each other, as soon as they touch, the electricity of both is neutralized and disappears, or becomes insensible. Now, if two elements combine, in virtue of their opposite electricities, when combined these electricities must be neutralized and disappear. What, then, retains the elements in combination, since we cannot suppose them, after contact, to continue powerfully negative and positive? This difficulty renders the electro-chemical hypothesis very doubtful.

Nevertheless, there is a very decided relation between electricity and chemical action. For every case of chemical action produces electricity, and this is the foundation of the galvanic pile and battery. Moreover, electricity, in certain circumstances, promotes chemical action, while in others it causes decomposition. It has been shown by Faraday, that the electricity of a galvanic arrangement may be accurately measured by the amount of decomposition it effects. We cannot tell what is the real nature of the connection between chemical action and electricity, but that relation exists. Indeed, it would seem that force, using that term in its most general sense, may take the form either of chemical force or of electricity, and may also be transformed into mechanical force, or into heat, and that any one of these, as also light and magnetism, is capable of taking the form of any of the others.

This seems to indicate that all these forms of energy are modifications of one and the same power. This is a subject of much interest, both theoretically and practically. It has been much studied of late, and promises to clear up our views on these important points.

In the meantime, the electro-chemical doctrine is the foundation of the prevalent or dual view of chemistry, and of the arrangement usually followed, as will be more fully explained when we come to treat of the elements in their order.

Before doing so, however, it is necessary to explain the system of notation employed by chemists, without a knowledge of which all chemical works would be utterly unintelligible. This notation is a system of abbreviation, the symbols employed being simply the names of the elements contracted into one or two letters. No other signs are used except ciphers, and the signs $+$, $-$, and $=$, in their usual acceptation, signifying addition, subtraction, and equality.

The symbols for the elements are the first letters of their Latin names; and where two or more have the same initial letter, a second letter is added to distinguish them. Thus O is the symbol for oxygen, H for hydrogen, C for carbon; while osmium is represented by Os, mercury (hydrargyrum) by Hg, chlorine by Cl. These symbols are all given in the second column of the table of equivalents, p. 438

The symbol of an element, by itself, signifies an equivalent of that element. O stands not for oxygen abstractly, but for 1 eq., or 8 parts by weight of oxygen (hydrogen = 1).

A cipher subjoined to the symbol multiplies it. Thus O_3 means 3 eqs. of oxygen, Cl_5, 5 eqs. of chlorine, &c.

Two symbols placed side by side express a compound of 1 eq. of each element. Thus, HO means water, a compound of 1 eq. of hydrogen and 1 of oxygen. HCl, hydrochloric acid, 1 eq. of hydrogen and 1 of chlorine; KCl, chloride of potassium, 1 eq. of potassium (kalium) and 1 of chlorine, &c. &c. Two symbols joined by the sign $+$, signify the same thing; but for the sake of brevity the former notation is preferred for binary compounds.

If a cipher be attached to the right of and below one of the symbols, it multiplies that symbol only. Thus, SO_3 is sulphuric acid, 1 eq. of sulphur and 3 of oxygen; PO_5 is phosphoric acid, 1 eq. of phosphorus and 5 of oxygen; Cu_2O is suboxide of copper 2 eqs. of copper and 1 of oxygen; Fe_2O_3 is sesquioxide of iron, 2 eqs. of iron and 3 of oxygen.

When two binary compounds, that is, compounds of two elements, are placed side by side, or separated only by a comma, or united by the sign $+$, this means a compound of the two. Thus HO, SO_3 is hydrated sulphuric acid, composed of 1 eq. of water and 1 of sulphuric acid; and it may be written either HO, SO_3, or $HO + SO_3$; but the comma is preferred to indicate the union of two binary compounds.

When three or more binary compounds are combined, it sometimes becomes advisable to use the sign $+$ in addition to the comma. Thus $KO, HO, 2\,SO_3$, or $KO, SO_3 + HO, SO_3$, equally represent the bisulphate or acid sulphate of potash; which is viewed as either composed of 1 eq. of potash (KO), 1 of water, and 2 of sulphuric acid, or 1 eq. of neutral sulphate of potash, and 1 eq. of hydrated sulphuric acid.

When a large cipher is *prefixed* to the symbol of a compound, or to those of several compounds, it multiplies all to the next comma or $+$ sign; as in the first formula for bisulphate of potash above given, in which $2\,SO_3$ means 2 eqs. of sulphuric acid. If written thus, $2\,SO_3, KO, HO$, the 2 multiplies only the SO_3. When it is required to multiply the whole of a complex formula, as often happens in the chemical equations to be presently described, the symbols to be multiplied are included within brackets. Thus $2(KO, SO_3)$ means 2 eqs. of neutral sulphate of potash; while $2\,KO, SO_3$ would signify a compound of 2 eqs. of potash and 1 of sulphuric acid.

Such are the whole of the rules for the use of our chemical notation in expressing the view we entertain of the constitution of chemical compounds. This notation, or these formulæ are very simple, very brief, and thoroughly clear and unmistakable. They are mere abbreviations, and, as such, are of the utmost value, as enabling us to express, in very small space, and in a form very obvious to the senses, a number of facts concerning the relative weights and the supposed arrangement of the combined elements, which would, if written fully, occupy pages of print. To take an example, alum, a complex salt, is represented by the formula—

$$KO, SO_3 + Al_2O_3, 3\,SO_3 + 24\,HO.$$

This tells us that chemists consider alum as composed of 1 eq. of neutral sulphate of potash, 1 eq. of neutral tersulphate of alumina (composed of 1 eq. of alumina, a sesquioxide, and 3 eqs. of sulphuric acid), and 24 eqs. of water. This is seen at a glance, but we see also much more. We see that in the sulphate of potash the oxygen of the acid is 3 times that of the base; and that in the sulphate of alumina, where the base contains 3 eqs. of oxygen, the oxygen of the acid is still 3 times as much, since there are 3 eqs. of the acid to 1 of the base. We see that 1 eq. of alum contains 1 eq. of potassium, 2 of aluminum, 4 of sulphur, 24 of hydrogen, and 40 of oxygen; that all the hydrogen is in the form of water, &c. &c. And all this, and much more, is to be easily seen in a formula which occupies but half a line.

We see, then, that our symbols and formulæ enable us to express, in the most compendious form, the fullest and most exact account of what we believe to be the constitution of any compound. Should we require to express a different view, it is done with the utmost facility, and the different or opposite views are presented to the eye in the most distinct and intelligible manner. Thus, oil of vitriol, if considered as being hydrated sulphuric acid, a compound of the dry acid and water, is represented by HO, SO_3 But if considered as a compound of hydrogen and not of water, its formula becomes H, SO_4, which means that hydrogen is here supposed to be combined with the hypothetical compound radical SO_4; a view which is regarded

as more probable than the other. In like manner, sulphate of potash may be viewed either as KO, SO_3, or K, SO_4. It is impossible for us to ascertain with certainty which of these views is the true one, because in both cases the resulting composition is the same. It is only the arrangement or constitution which differs. But the two opinions are quite as clearly and far more briefly expressed in the formulæ than they can be in words. Whatever view can be imagined as to the constitution of any compound, however complex, it is just as easily expressed by symbols, and they are therefore in constant use. The student must, therefore, in the outset, make himself familiar with them, which is very easily done.

These, however, are not nearly the whole of the advantages derived from the use of symbols and formulæ. They enable us, besides, to express, in by far the most convenient and the clearest manner, the results, real or supposed, of any chemical change among substances of known composition. This is done by means of equations, which are just as simple as the formulæ themselves.

The first half or section of the equation contains the formula or formulæ of the substance or substances which undergo change. The second consists of the formulæ of the substances formed or liberated by the change. These must of course be equal, otherwise the explanation is false or imperfect.

The action of potassium on water is thus represented:—

$$K+HO=KO+H.$$

This shows that potassium seizes the oxygen of water; while the hydrogen is liberated. Again, the action of hydrochloric acid on oxide of silver is thus represented:—

$$HCl+AgO=HO+AgCl.$$

Here the hydrogen of the acid and the oxygen of the oxide unite to form water; while the chlorine of the acid and the metal of the oxide combine to form chloride of silver.

The more complex the example, the more useful is the equation, as placing the whole clearly before the eye. When hydrochloric acid acts on peroxide of manganese the equation is as follows:—

$$MnO_2+2HCl=MnCl+2HO+Cl.$$

This shows that for 1 eq. of peroxide of manganese 2 eqs. of hydrochloric acid are required; that 1 eq. of chlorine unites with the metal, forming chloride of manganese; that the 2 eqs. of hydrogen form water with the 2 eqs. of oxygen; and that 1 eq. of chlorine is set free. In this way chlorine is prepared.

Another method for obtaining chlorine consists in the action of sulphuric acid on chloride of sodium (sea-salt) and peroxide of manganese. The equation is

$$NaCl+MnO_2+2\,SO_3=NaO, SO_3+MnO, SO_3+Cl,$$

which tells us that 1 eq. of salt, 1 of peroxide of manganese, and 2 of sulphuric acid, yield 1 eq. of sulphate of soda, 1 eq. of sulphate of protoxide of manganese, and 1 eq. of chlorine. This is the manufacturing process.

Such equations offer another great advantage, that, namely, of enabling us to calculate precisely how much of the materials we ought to use, and how much of the products we ought to obtain.

Nitric acid is prepared by the action of oil of vitriol, or hydrated sulphuric acid, or nitrate of potash, according to the equation—

$$KO, NO_5+2\,(HO, SO_3)=(KO, HO, 2\,SO_3)+HO, NO_5.$$

Here 2 eqs. of oil of vitriol act on 1 eq. of nitrate of potash, yielding 1 eq. of bisulphate of potash and 1 eq. of hydrated nitric acid.

Now since the equivalent of a compound is the sum of those of its elements, the equivalent of nitrate of potash must be (in round numbers)

Nitrate of Potash.	Oil of Vitriol.
$K = 40$	$S = 16$
$N = 14$	$H = 1$
$O_6 = 48$	$O_4 = 32$
$KO, NO_5 = 102$	$HO, SO_3 = 49$
	and $2\,(HO, SO_3) = 98$

Hence we must use, for 102 parts of nitrate of potash, 98 of oil of vitriol. The products are—

Bisulphate of Potash.	Nitric Acid (hydrated).
$K = 40$	$N = 14$
$S_2 = 32$	$H = 1$
$H = 1$	$O_6 = 48$
$O_8 = 64$	
$KO, HO, 2\,SO^3 = 137$	$HO, NO_5 = 63$

On the one hand the materials employed, 102 parts of nitrate of potash, and 98 of oil of vitriol, amount to 200 parts. On the other, the products, 137 parts of bisulphate of potash, and 63 of hydrated nitric acid, also amount to 200 parts. Any other proportion of the materials would imply waste or loss of a part.

Should any theoretical view of a process require to be tested, it may be done by comparing the amount actually obtained of any one or all of the products with that indicated by the proper equation. Should they differ very much, it is a proof, if nothing have been lost in the process, that the equation, and consequently the theory on which it rested, is erroneous.

The use of these equations, and the calculations connected with them, enable us to see clearly how it happens, that when two neutral salts decompose each other, the resulting salts are also neutral. Thus, if sulphate of potash and nitrate of baryta, two neutral salts, act on each other, they yield nitrate of potash and sulphate of baryta, which are also neutral, according to this equation—

$$KO, SO_3+BaO, NO_5=KO, NO_5+BaO, SO_3.$$

Here the equivalents are, before the change,

$$KO, SO_3=\begin{cases}KO = 48\\ SO_3 = 40\end{cases}\quad 88 \qquad BaO, NO_5=\begin{cases}BaO = 76\\ NO_5 = 54\end{cases}\quad 130$$

After the change, we have

$$KO, NO_5=\begin{cases}KO = 48\\ NO_5 = 54\end{cases}\quad 102 \qquad BaO, SO_3=\begin{cases}BaO = 76\\ SO_3 = 40\end{cases}\quad 116$$

Now it will be seen that the quantity of potash which neutralizes 40 parts of sulphuric acid, namely 48 parts, is exactly sufficient to neutralize 54 of nitric acid; and that the quantity of nitric acid which neutralizes 76 of baryta, namely 54 parts, exactly suffices to neutralize 48 parts of potash. In short, as before stated, the equivalent numbers are proportional, and this is seen in the equations without the trouble of calculation.

From the more complex nature of organic compounds, the formulæ which express them are more complex, but in principle precisely the same. Many organic compounds contain 3 or 4 elements: thus, oxalic acid is $C_2\,O_3$, HO, or, according to the most recent researches, double this, $C_4\,H_6$, 2 HO, which implies, that in the first formula it is a monobasic acid, containing 1 eq. of basic water, replaceable by bases; and in the second that it is bibasic, that is, has 2 eqs. of replaceable water. Acetic acid is $C_4\,H_3\,O_3$ HO; butyric acid, $C_8\,H_7\,O_3$, HO; benzoic acid $C_{14}\,H_5\,O_3$, HO. Oxide of ethyle or ether is $C_4\,H_5\,O$; alcohol, its hydrate, is $C_4\,H_5\,O$, HO; all these consist of 3 elments, carbon, hydrogen, and oxygen, the number of eqs. of which is often much larger. Thus stearic acid is $C_{34}\,H_{33}\,O_3$, HO; Melissic acid is $C_{60}\,H_{59}\,O_3$, HO. Then we have hydrocyanic acid, which is $C_2\,NH$; cyanic acid, $C_2\,NO$, HO; cyanuric acid, $C_6\,N_3\,O_3$, 3 HO; urea, $C_2\,H_4\,N_2\,O_2$; gly-

cocine, $C_4 H_5 NO_4$; leucine, $C_{12} H_{13} NO_4$; ethylamine, $C_4 H_7 N$; phenylamine, $C_{12} H_7 N$; quinine, $C_{20} H_{12} NO_2$; indigo, $C_{16} H_5 NO_2$; gelatine, $C_{82} H_{67} N_{13} O_{32}$; albumen, $C_{216} H_{169} N_{27} S_2 O_{65}$, &c., all of which contain nitrogen, which in hydrocyanic acid only is without oxygen, and in albumen is also associated with sulphur. We have given these organic formulæ to show both their somewhat complex nature, and the extreme facility and conciseness of the mode of notation. It will be seen that all these organic compounds are formed from a very small number of elements, never, if we exclude the incombustible part or ash, exceeding 5, and most frequently only 3, carbon, hydrogen, and oxygen, or 4, these with the additions of nitrogen. The same four elements form innumerable organic compounds.

The most complicated changes in organic chemistry are just as easily expressed. When sugar undergoes fermentation it yields alcohol and carbonic acid, as in the equation—

Dry Grape Sugar.		Alcohol.		Carbonic Acid.
$C_{12} H_{12} O_{12}$	$=$	$2(C_4 H_5 O, HO_2)$	$+$	$4\, CO_2$.

In many organic compounds, and, indeed, in entire series of compounds, we admit the existence of certain permanent groups, which are called compound radicals, and which play exactly the part of elementary bodies. It is often convenient to adopt a single symbol for each such compound radicle; for this gives to its compounds the simple formulæ of inorganic bodies. The following are some of the admitted compound radicals:—

		Symbol.			Symbol.
Cyanogen	$= C_2 N$	$=$ Cy	Benzoyle	$= C_{14} H_5 O_2$	$=$ Bz
Methyle	$= C_2 H_3$	$=$ Me	Acetyle	$= C_4 H_3$	$=$ Ac
Ethyle	$= C_4 H_5$	$=$ Ae	Formyle	$= C_2 H$	$=$ Fo

We do not assert that all so-called compound radicals actually exist in a separate state, although cyanogen and several others do so. But even if none of them did, we derive, from assuming their existence, the advantage of being able to represent a series of compounds related together in a very simple manner. Thus the compounds of cyanogen above named may be written $H Cy$, $Cy O$, HO, Cy_3, O_3, $3\,HO$. Those of ethyle (ether and alcohol) become $Ae\,O$ and $Ae O$, HO. Acetic acid becomes $Ac O_3$, HO, and benzoic acid $Bz O$, HO. Ethylamine takes the formula $NH_2 Ae$, or $Ad\,Ae$ ($Ad = NH_2$, stands for amide); perchloride of formyle or chloroform, $C_2 H Cl_3$ may be also written $Fo Cl_3$. In this way, even very complex compounds may be expressed as simply as the simplest inorganic bodies. Compare hydrocyanic acid, $H Cy$ with hydrochloric acid, $H Cl$; oxide of ethyle, $Ae O$, with oxide of potassium; acetic acid (hydrated) $Ac O_3$, HO, with hydrated sulphuric acid, SO_3, HO_3; and hyduret of benzoyle, $C_{14} H_5 O_2$, H or $Bz H$, with sulphuretted hydrogen SH.

Organic acids and bases are sometimes written simply with the initial letter of their names, above which is placed $+$ for a base, and $-$ for an acid. Thus $\overset{+}{Q}$ means quinine, $\overset{+}{M}$, morphine. $\overset{-}{T}$ stands for tartaric, and $\overset{-}{C}$ for citric acid.

CHEMICAL NOMENCLATURE.

Before proceeding to the description of the elements and of their compounds, it is necessary to say a few words on the nomenclature employed. This is far from being in a satisfactory state. It was first proposed about the time of Lavoisier's discoveries, and was founded on his theory of combustion. But the science has made, of late years, such rapid progress, that we can no longer employ the same principles of nomenclature, at least in many cases; and yet, as no better system has hitherto been proposed, the old one retains its place, with a large number of heterogeneous additions.

The elements are named on various principles. Such as have long been known retain their old names, as iron, sulphur, &c.; those of more recent discovery have been named either from some property, or, in the case of some metals, after some of the planets, &c. Thus, oxygen is so named because it was supposed to be the cause of acidity in compounds; hydrogen, from its producing water; nitrogen, from producing nitric acid; chlorine and iodine, from their colour; bromine, from its smell, &c. Of the metals, potassium, sodium, magnesium, calcium, strontium, from occurring in potash, soda, magnesia, lime (calx), strontia, &c.; barium, from the weight of its compounds; cerium, mercury, palladium, selenium, tellurium, and uranium, after the heavenly bodies—Ceres, Mercury, Pallas, the Moon, the Earth, and Uranus. The remaining elements are named on similar principles. The Latin names of all metals end in *um*, as aurum, argentum, cuprum, plumbum; for gold, silver, copper, and lead. Only one non-metallic body, selenium, ends in *um*, but this is because it was at first supposed to be a metal. On the whole, the names of the elements are arbitrary, and the less significant they are the better. Oxygen, for example, is no longer considered as the only producer of acids, for many acids are known which contain no oxygen, and the name would be almost better applied to hydrogen, which forms many acid compounds.

In naming binary compounds, we first observe whether they are acid or not. If acid, they are called acids, and the name of one of the elements is prefixed, with the termination *ic* or *ous*. Thus we have sulphuric acid, carbonic acid, phosphoric acid, nitric acid, and many others.

When there are two acids containing the same element united to oxygen, that which contains less oxygen has the termination in *ous*. Thus sulphurous and nitrous acids contain less oxygen than sulphuric and nitric acids.

Should other acids containing the same elements be discovered, the prefix *hypo* is employed in addition. Thus, after sulphurous and sulphuric acid had long been known, other acids were discovered, one of which is called hyposulphurous, another hyposulphuric acid; which means that the former contains less oxygen than sulphurous, the latter less oxygen than sulphuric acid. We have also hyponitrous, hypophosphorous, hypochlorous acids, and hypochloric acid.

When a compound of oxygen is not acid, it is called an oxide of the element which is combined with oxygen. Water is an oxide of hydrogen, and we have oxides of nitrogen, carbon, and all the metals.

An oxide consisting of 1 eq. of each element is called a protoxide. Water is protoxide of hydrogen, and there are protoxides of almost all the metals, as protoxide of lead, of iron, of manganese, &c.

When the proportion in an oxide is that of 1 eq. of the other element to $1\frac{1}{2}$ of oxygen, that is, 2 to 3, it is called a sesquioxide, as, sesquioxides of iron, aluminum, chromium, manganese.

When we find 1 eq. to 2 of oxygen, it is called a deutoxide or binoxide, and in some cases peroxide, meaning the oxide having most oxygen; as deutoxide of hydrogen, of nitrogen, of tin, of manganese, of lead; the two latter, as well as the first, being often called peroxides.

When the proportion is 1 to 3, the compound is called a teroxide, as teroxide of antimony.

When a compound, instead of oxygen, contains chlorine, bromine, iodine, or fluorine, it is called a chloride, bromide, iodide, or fluoride; and we have protochlorides, protobromides, deutochlorides, &c., terchlorides, and perchlorides or perbromides, periodides, &c., just as with oxides.

When the compound contains, instead of oxygen, chlorine, &c., sulphur, phosphorus, carbon, selenium, &c., it is called a sulphuret, phosphuret, carburet, selenuret, &c.

Examples—Chloride of sodium, bromide of carbon, iodide of lead, deutochloride or bichloride of mercury, protochloride of mercury, deutoiodide of mercury, terchloride of antimony, terfluoride of silicon, perchloride of manganese,

sulphuret of potassium, phosphuret of lead, carbonet of iron, seleniuret of copper, bisulphuret of carbon, bicarburet of nitrogen, tersulphuret of arsenic, protosulphuret of iron, pentasulphuret of potassium, &c. &c.

Such is the method employed in naming binary compounds.

When two binary compounds combine, this is expressed in the name. If one of them be acid, as commonly happens, and the other basic or alkaline, the name of the acid goes first, with the termination in *ate* for an acid in *ic*, that in *ite* for an acid in *ous*. Thus sulphuric acid and potash (oxide of potassium) form sulphate of potash; nitric acid and oxide of lead, form nitrate of (oxide of) lead. Sulphurous acid and ammonia form sulphite of ammonia.

When there are 2 or 3 eqs. of acid, or more, to 1 eq. of base, we prefix *bi*, *ter*, *quadri*, &c. Thus we have bisulphate of potash, tersilicate of lime, quadroxalate of potash.

When there are 2, 3, or more eqs. of base to one of acid, the prefixes *di*, *tri*, &c., are employed; as dinitrate of mercury, trisilicate of potash.

When we wish to express, in general, excess of acid over base, we use the prefix *super*, as supercarbonate of lime; for excess of base, generally, we use *sub*, as subnitrate of mercury, subsulphate of mercury. In double salts we express the names of both bases, as sulphate of alumina and potash, oxalate of chromium and potash.

Observe, that instead of sulphate, nitrate, &c., of oxide of lead, oxide of iron, &c., we say, for shortness sake, sulphate of lead, nitrate of silver, &c. But it is always understood that the compound contains an oxide of the metal united with the acid. The oxides of potassium, sodium, lithium, barium, strontium, calcium, magnesium, aluminum, yttrium, glucinium, zirconium, and thorinum, are also called potash, soda, lithia, baryta, strontia, lime, magnesia, alumina, yttria, glucina, zirconia, thorina, and we speak of the salts of potash, soda, &c., instead of saying the salts of oxide of potassium, or of potassium.

It is in organic chemistry that the chief difficulties of nomenclature occur. In the case of organic acids they are named like inorganic acids, as acetic, butyric, oxalic, tartaric, citric acids, &c., but generally from the source which yields them. The organic bases are made to terminate in *ine*, as morphine, quinine, nicotine, glycocine, methylamine, ethylamine, dimethylamine, triethylamine, &c., as will be fully explained when we come to treat of them.

Compound organic radicals generally terminate in *yle*, as ethyle, methyle, cetyle, acetyle, formyle, benzoyle, and their compounds, are named accordingly; as oxide or chloride of ethyle, terchloride of formyle, hyduret of acetyle, hyduret of benzoyle, cyanide of ethyle, &c.

But with these and a few similar exceptions, the enormous number of organic compounds have been named without system, and constitute a perfect chaos, which will continue to annoy chemists until a rational and consistent method of nomenclature shall be devised. An attempt has been made by Gmelin; but the names, though systematic, are so uncouth, and in many cases so liable to be confounded together, that no one has adopted Gmelin's system.

We are now prepared to enter on the consideration of the elements individually, and of the compounds formed by their union. In order to facilitate the statement and comprehension of the facts, some arrangement must be followed; and, although the science is not sufficiently advanced to admit of a perfectly consistent classification, yet, by attending to the observed analogies, we may obtain a very convenient working arrangement.

It is generally founded on the electro-chemical relations of the elements, as already explained; but it coincides very closely with the obvious and natural division of the elements into metals and non-metallic bodies or metalloids, in the first instance; and then the further subdivision of both, according to the degree of affinity for oxygen.

When any binary compound of oxygen is decomposed by an electric current, the oxygen *invariably* appears at the positive pole, while the other element goes to the negative pole. This proves that oxygen is always negative compared to all other elements. In like manner, hydrogen always goes to the negative pole, as do also such metals as potassium and sodium. Now, as there are no substances which have so strong an affinity for oxygen as these three, it is plain that the degree of affinity is measured by the degree of electric opposition between two elements. At one end of the electro-chemical scale, therefore, we place oxygen as being the most negative of all bodies; at the other, hydrogen, potassium, and sodium, as being the most positive. All the other elements are placed according to their relation to oxygen on the one hand, to hydrogen and the alkaline metals on the other.

Thus chlorine is positive in relation to oxygen, for when a compound of these elements is decomposed by the current, the chlorine appears at the negative pole; but it is negative in relation to all metals, and to all or nearly all the non-metallic bodies except oxygen. The true position of fluorine is unknown; but it is intensely negative, and must stand very near to oxygen and chlorine, perhaps between them, perhaps even outside of oxygen, as it may prove to be negative in regard to that element. But with the exception of this doubtful case, chlorine is negative to all but oxygen, and therefore ranks next to it. Bromine and iodine follow closely, and are positive to oxygen and chlorine, negative to all the rest, bromine being the more negative of these two. Carbon, sulphur, phosphorus, selenium, boron, and silicon, are all strongly negative with regard to hydrogen and metals, but yet even more strongly positive to oxygen; they exhibit, therefore, strong affinities on both sides. Nitrogen holds a nearly isolated position, having affinities of considerable energy to all the other classes of elements, but not belonging decidedly to any. This is a most important character, which is essentially necessary to fit nitrogen for the important part it has to perform as an indispensable element of all living organisms or tissues.

The metals, as a class, are positive to oxygen, chlorine, and its congeners, sulphur, and the like; but their positive energy varies from the highest in potassium, sodium, and lithium, to the lowest in gold, platinum, and iridium. Consequently these latter metals, and others like them, are negative to such as potassium. Such metals as mercury, copper, lead, zinc, iron, &c., hold an intermediate position, and are negative to such as potassium, positive to gold, &c. It is difficult to arrange the individual metals accurately, but they are easily divided into groups, as we shall presently see.

The only so-called non-metallic element which has a place among the most intensely positive is hydrogen. But there is much reason to think that hydrogen, which has hitherto been seen only as a gas, is in reality the gas or vapour of a very volatile metal. At all temperatures above 600°, the vapour of mercury, and at a white heat those of arsenic, zinc, cadmium, potassium, and sodium, are gases, just as hydrogen is at ordinary temperatures.

We shall commence with oxygen gas, beyond all question the most important element, and consider after it those which stand nearest to it. But, in consequence of the extreme importance for the understanding of what is to follow, and also in a practical sense of hydrogen and of nitrogen—which last has no well-marked place of its own—we shall interpolate these elements between oxygen and chlorine. After chlorine will come bromine, iodine, fluorine—the last placed here from the perfect analogy between its compounds and those of the three preceding elements; and after them, because its exact place is uncertain, since we are not acquainted with it in an uncombined state. This is the group of the negative, that is, highly negative, non-metallic ele-

ments, or supporters of combustion, with the addition of hydrogen and nitrogen.

The next group is that of the less negative or more positive non-metallic bodies, namely, carbon, sulphur, selenium, phosphorus, boron, and silicon. These elements are also called the combustible non-metallic bodies or metalloids. The non-metallic elements are 13 in number, but it seems probable that silicon will prove to be metallic, since, according to very recent statements, it has been deposited on metallic surfaces with a high metallic lustre. This, however, requires confirmation. If it prove true, silicon will then be called silicium.

The metalloids or non-metallic elements are bad conductors or non-conductors of heat and of electricity, and are destitute of the metallic lustre. At least, none of them combine the two properties of conducting power and metallic lustre. Selenium has a lustre approaching the metallic, and so has iodine, while carbon in one state conducts electricity well.

The metals, on the other hand, all possess both these characters; they are excellent conductors of heat and electricity, and they are distinguished by the metallic lustre when in a compact state, although in the state of powder or that of a spongy mass they may not exhibit this character. It will always appear, however, on burnishing, even in dull metallic powder.

We shall begin the study of the metals with the most highly positive, or those at the opposite end of the scale from oxygen, and proceed regularly to the more negative or less positive metals. We begin, then, among the metals, with potassium and sodium, pass on through lithium, which, with the two first, form the group of the alkaline metals, or metals of the alkalies proper, to those of the alkaline earths, barium, strontium, calcium, and magnesium; thence to those of the earths proper, aluminum, zirconium, yttrium, glucinium, thorinum. The next group is that of those of the heavy or common metals, which form very strong bases with oxygen, iron, manganese, zinc, cadmium, cobalt, nickel, and tin. The next contains such metals as are remarkable for forming acids with oxygen, arsenic, antimony, chromium, vanadium, molybdenum, tungsten, titanium, columbium. The next consists of metals having a less powerful attraction for oxygen, yet still forming bases with it, as bismuth, copper, lead, mercury. And the last group contains the noble metals, or those which have the feeblest attraction for oxygen, such as silver, gold, platinum, iridium, palladium, rhodium, ruthenium, osmium. There are a few metals which have not been mentioned in this enumeration, because they are not as yet known in a state of purity, and therefore their precise place is not quite fixed. Cerium, lantanium, didymium, erbium, and terbium seem to have their place between the third and fourth groups, but nearer the third if not within it. Pelopium and niobium belong apparently to the fifth or acidifiable metals. But the whole of these imperfectly known metals are of so little importance, being very rare, and as yet applicable to no purpose, that we shall do no more than indicate their existence.

Such is the arrangement we propose to follow. It will be found to a great extent natural, for most of the groups are strongly marked by nature, and indeed interesting from the extreme analogy between their constituent members.

When we have described the two first elements, oxygen and hydrogen, we shall then proceed, before taking up a third, to give an account of the compounds formed by the two first; when the third element, nitrogen, has been reviewed, we shall mention its compounds, first with oxygen, then with hydrogen; and, in short, under every element we shall describe its compounds with those previously considered. By this means we shall very soon become acquainted with the most important compounds, and thus acquire a much more extensive knowledge of chemistry in a short time than we could in a far longer period, if we described all the elements first, before speaking of any compounds, which would be a more strict and regular plan.

Our limited space compels us to be brief, so that we shall only notice essential and practically important points, and allude shortly to the technical applications of the bodies described. It will be impossible to enter into any detail as to the processes by which these substances are prepared. For these the reader must consult larger works.

NON-METALLIC ELEMENTS, OR METALLOIDS.

(A.) NEGATIVE, OR SUPPORTERS OF COMBUSTION.

1. *Oxygen.*

Symbol O. Equivalent = 8.

Oxygen is the most abundant and the most important of all the elements. It constitutes $\frac{1}{5}$th of the atmosphere, $\frac{8}{9}$ths of all the water in our globe, and fully $\frac{1}{2}$d of alumina and silica, $\frac{1}{3}$d of lime, and $\frac{1}{5}$th of potash; these being the chief ingredients of all the rocks in the earth's crust, and of the soils on its surface. It also forms a part of all the other ingredients of rocks, such as magnesia, oxide of iron, and carbonic acid, and of all abundant minerals, except only rock salt, and the sulphurets of a few metals. It is, moreover, an essential component part of all organized beings, of all tissues, and of all but a very few products of vegetable life. The quantity of it in our earth is prodigious beyond all conception, and its presence in the atmosphere is indispensable to animal life.

In its purest state, it is only known to us as a gas, which cannot be condensed into the liquid state by the most intense cold combined with the highest pressure that we can apply to it; that is, its boiling and melting points are beyond the reach of our appliances.

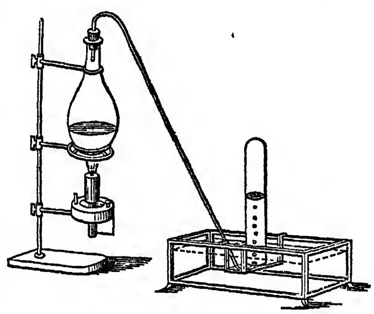


Fig. 1.

Oxygen gas is best obtained by applying heat to the chlorate of potash, a salt which yields, when heated, the whole of its oxygen, as is shown in the following equation:—

Chlorate of Potash.		Chloride of Potassium.		Oxygen.
KO, ClO_5	=	KCl	+	O_6

It is also obtained by heating peroxide of manganese, which loses part of its oxygen, and is reduced to sesquioxide. Thus:—

Peroxide of Manganese.		Sesquioxide of Manganese.		Oxygen.
$2\ MnO_2$	=	Mn_2O_3	+	O

Oxygen may be obtained by several other processes, which we have not space to mention.

It is collected over water, which has hardly any action on it. It is a transparent, colourless, tasteless, and inodorous gas. It is distinguished from other gases by its power of supporting combustion. Any burning body introduced into it burns with increased intensity and brilliancy. A candle, or a stick, or a string, with the smallest spark on it, bursts out into flame in this gas. Nay, a candle just blown out, and without even a spark, if introduced, while the wick is yet warm, into oxygen, bursts into a brilliant white flame in a short time.

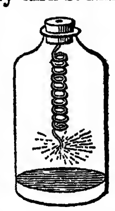


Fig. 2.

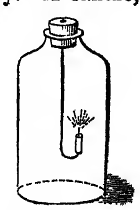


Fig. 3.

Sulphur and charcoal burn very brightly in it; phos

phorus gives out a splendid white light of dazzling intensity; and even iron, if heated to redness in it, burns with bright sparks, especially in the form of steel, as a watch-spring. Many other metals may be burned in oxygen. In short, it combines with most of the elements, with the phenomenon of combustion, or evolution of heat and light, to be presently explained.

Oxygen gas is a little heavier than atmospherical air; that is, if a given bulk of air, at a certain temperature, and under a certain pressure, weigh 1000 parts (grains, ounces, or pounds), an equal volume of oxygen gas, at the same temperature and pressure, will weigh 1111 parts. According to some, this number is a little too high, the true number being 1102·6. But the first number is very near the truth, and it is easily remembered. The number 1111 is said to represent the specific gravity or density of the gas, compared to air as a standard, 1000 being the number adopted as the specific gravity of air. The reader will understand that specific gravity or density means the relative weights of equal volumes, and is always, therefore, a relative, not an absolute property. For gases, air is made the standard of density; for liquids and solids, water.

An animal confined in oxygen at first feels little inconvenience; but after a time it appears to stimulate too powerfully, and would ultimately cause death, although it is not, like some gases, irrespirable.

Oxygen enters into combination with all the other elements, except only fluorine, which has not yet been made to combine with oxygen. The compounds of oxygen are of very great importance, as has been already stated in various places. Many compounds of oxygen, especially such as contain three or more, and occasionally two eqs. of oxygen for one eq. of the other elements, possess acid properties; and it was formerly supposed that every acid must contain oxygen, and that oxygen was the cause of acidity. But we are now acquainted with a large number of acids containing no oxygen; and if any element can be said to be the cause of acidity, it is rather hydrogen, which is found in many acids without oxygen, and in most of those which contain oxygen. But, in truth, acidity is a property belonging to the compounds, and not derived in any peculiar manner from either oxygen or hydrogen, both of which form many compounds which are not only not acid, but basic or alkaline; so much so, that all protoxides of metals are powerful bases, and neutralize acids.

The uses of oxygen are most important. Diluted with nitrogen in the atmosphere, it becomes not only respirable by animals, but indispensable to their existence. It is also essential to all such processes of combustion as are carried on in atmospherical air, and therefore assists in producing artificial heat and light. It is also a necessary agent in the important process of the decay of dead vegetable and animal matter, that process by which these are not only prevented from accumulating and proving injurious, but are at the same time converted by oxidation into those compounds which form the food of a new generation of plants. In fact, decay is a slow combustion, without the evolution of light, and with a very slow and hardly sensible development of heat.

It was at one time believed that oxygen was indispensable to every combustion; that every combustion was an oxidation. But it is now seen that it is only in such combustions as occur in our atmosphere or in pure oxygen that oxygen is essential. There are many combustions in which oxygen has no share. Thus phosphorus, antimony, and most of the metals in a state of fine division, take fire spontaneously, and burn in chlorine gas, or in the vapour of bromine or of iodine. Many metals, when heated, burn in the vapour of sulphur; but, as all ordinary and useful combustions take place in air and depend on oxygen, the term combustion is still commonly applied to those cases in which oxygen is concerned. The strict definition of the term, however, is this, chemical combination, attended by the evolution of heat and light.

In reference to combustion, oxygen is often called the supporter of combustion, and the bodies which burn in it or in air are called combustible. In like manner, chlorine and its congeners are also called supporters of combustion; but, if we reflect on the definition of combustion just given, we shall see that the two combining bodies are equally supporters of the combustion, and equally combustible. The common language is founded on the fact, that the heat and light appear to proceed from the so-called combustible (such as a candle) in the air or oxygen. But this is an illusion, depending on the fact that one of the two bodies (the air or oxygen) is a gas; and the other—whether solid, liquid, or gaseous—is placed in the middle of it, and surrounded by it. In these circumstances, combustion can only take place where the two bodies meet, which is only at the surface of the central body or combustible, whether it be a coal, or oil, or a jet of gas. If we reverse the conditions, and cause, for example, a jet of oxygen to escape into an atmosphere of coal gas, and apply a light to it, the oxygen appears to take fire, as the coal-gas did in air, and continues to burn, the heat and light appearing at the surface of the jet of oxygen, because there only action can take place. In this form of experiment we might call oxygen the combustible, and coal-gas the supporter of combustion. But, as before stated, both bodies are alike supporters of the combustion, and both alike combustible, and the appearances depend on the arrangement of the experiment. In all ordinary cases, oxygen *appears* to be the supporter of combustion, and the other body the combustible, so that practically these terms are so applied without leading to misconception.

The binary compounds of oxygen with the other elements are generally very important, and are of three kinds; 1*st*, Acid, as sulphuric, nitric, and chromic acids; 2*d*, Alkaline or basic, as the protoxides of potassium, sodium, calcium, iron, lead, silver, &c., and sesquioxides, such as those of aluminum, iron, chromium; 3*d*, Neutral bodies, that is, neither acid nor basic, but sometimes playing the part of one or the other; as water, deutoxide of manganese, deutoxide of lead. The nomenclature of all oxides has been already explained.

The acid oxides are negative compared with the basic oxides, which are positive. Hence they tend to combine together, and when such a ternary compound is decomposed by the electric current, the acid always appears at the positive, the base at the negative pole. Such compounds of a negative with a positive oxide are saline bodies, although when they are insoluble in water the usual saline characters are not seen. Examples, sulphate of potash, KO, SO_3; nitrate of soda, NaO, NO_5; these and many others have all the characters of salts. Sulphate of baryta, BaO, SO_3; carbonate of lime, CaO, CO_2; these are insoluble, but yet are true salts.

These ternary saline compounds of oxygen are undoubtedly formed when the acid and the base meet. Thus KO and SO_3 form KO, SO_3, sulphate of potash. But we do not know that in these salts the base and acid continue to exist as such; and it is now considered probable that they do not, but that the acid and base, in forming the salt, undergo a change, whereby the metal of the base forms one constituent, and all the other elements together, that is, the acid + the oxygen of the base form the other. It is only a question of the arrangement of the elements which are certainly present, for nothing is added, and nothing taken away. The old view is expressed in the formula KO, SO_3, for sulphate of potash. The new one, which is exactly equal to it, is expressed by K, SO_4, and the group SO_4 is supposed to form a compound radical, analogous in properties to chlorine, and like it forming salts by combining with metals. We shall return to this question when treating of acids, such as hydrochloric acid or sulphuric acid. Mean-

time, the reader should render himself familiar with both views of the salts which contain oxygen.

We now, for the reasons formerly given, deviate from the strictly natural order, and proceed to describe hydrogen, as being, next to oxygen, perhaps the most important of the elements, especially with regard to its compounds.

2. *Hydrogen.*

Symbol H. Equivalent = 1.

This element is, like oxygen, very abundant in nature, but almost invariably in some form of combination. It is said to occur uncombined among the gaseous products of volcanoes, which is not improbable. But it is chiefly found in union with oxygen, in water, of which it constitutes $\frac{1}{9}$th part by weight. As the quantity of water in the sea, rivers, lakes, marshes, and streams, in the atmosphere, suspended as vapour, or separating in the form of clouds, rain, snow, hail, and dew, is prodigiously great; the actual amount of hydrogen is very large. Besides the sources of water just mentioned, all animals and vegetables contain from $\frac{1}{2}$ to $\frac{3}{4}$ths of their weight of water; and hydrogen is also an essential constituent of the animal and vegetable tissues, and of all animal and vegetable products, more especially of all such as are oily or resinous, and of such bodies as wood, starch, sugar, gum, and the vegetable acids and bases of alcohol, ether, and similar compounds; of coal, bitumen, asphalt, petroleum, and fire-damp, the explosive gas of coal mines, in the mineral kingdom.

Hydrogen is easily prepared by the action of zinc or iron filings, or clippings, in diluted sulphuric and hydrochloric acids. The change is represented in the following equations.

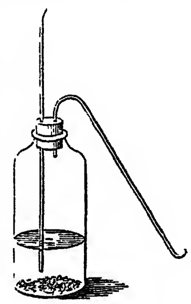


Fig. 4.

Zinc.		Sulphuric Acid.		Sulphate of Zinc.		Hydrogen.
Zn	+	HO, SO_3	=	ZnO, SO_3	+	H

and

Zinc.		Hydrochloric Acid.		Chloride of Zinc.		Hydrogen.
Zn	+	H Cl	=	Zn Cl	+	H

It will be seen, that in both cases the metal (and iron acts precisely as zinc does) takes the place of the hydrogen, which is set free. The sulphate of zinc and chloride of zinc formed are salts as analogous to each other as the acids were. The two processes are therefore in fact the same; but yet the equations differ. This depends on the view taken of the constitution of sulphuric acid or oil of vitriol, which in the first equation is represented as composed of water and dry acid. But if we take the newer view of the constitution of the acid, and consider it as a compound of hydrogen with the hypothetical compound, radical SO_4, if we represent it by H, SO_4, instead of the equivalent formula **HO, SO_3**, then the two equations become as like each other as the two operations are. Thus—

Zinc.		Sulphuric Acid.		Sulphate of Zinc.		Hydrogen.
Zn	+	H, SO_4	=	ZnO, SO_4	+	

The only difference now is, that in one case the zinc and hydrogen are united to a simple radical, chlorine, in the other to the compound radical SO_4. But it must be remembered that chlorine is only called simple or elementary because we cannot prove it to be compound, not because we know absolutely that it is simple. Indeed, it is considered probable that chlorine will one day prove to be a compound; and, in that case, the two equations would be exactly of the same kind. As it is, if we use the newer expression for sulphuric acid and sulphate of zinc, the analogy in all essential points is complete. Both acids are compounds of hydrogen, and both the salts formed are compounds of the metal with the radicals Cl and **SO_4**. The fact, that while the older view of sulphuric acid (which regards it as a compound of water with dry acid) represents these two similar processes by different equations, the newer view gives them the same form; is a very strong argument in favour of the latter, according to which sulphuric acid, and all acids which, like it, contain hydrogen along with oxygen, are compounds of hydrogen and of water, like hydrochloric acid and all acids analogous to it, of whose constitution only one view is possible. What used to be two series of acids are thus reduced to one series, and the salts of both may be regarded as forming part of the same series as their respective acids, if we define acids and salts under the name of saline compounds as formed of hydrogen and metals (which have many points of analogy) with radicals, whether simple or compound.

Let R stand for any radical capable of forming an acid and salts, any salt-forming radical; and let X represent any metal or hydrogen; then the general formula of all such acids as sulphuric and hydrochloric acids, and all such salts as sulphates and chlorides—that is to say, such acids as nitric, phosphoric, selenic, silicic acids, &c., as well as hydrobromic hydriodic, hydrofluoric, hydrosulphuric acids, &c., and the nitrates, phosphates, seleniates, silicates, &c.—and the bromides, iodides, fluorides, and sulphurets, &c.—the universal formula for all such compounds is X R.

For X we may substitute the symbol of any metal, or of hydrogen; and for R, that of any salt forming radical, simple, or compound; and thus we obtain such special cases of the general formula, as H Cl; HF; HS; H, SO_4; H, NO_6; H, PO_6; KCl; NaBr; CaF; PbS; Ba, SO_4; Ag, NO_6; &c. The reader, by referring to the table of symbols, will easily discover what are the elements whose symbols are used, and will see that the series of which the general formula, as above explained, is X R, includes a very large number of acids and of salts, perfectly analogous in properties, which were formerly, and even still are, placed in two different series.

We have taken the opportunity of the process for making hydrogen to explain the principle on which this great simplification is effected, and so large a number of compounds of hydrogen, namely, all the important acids, are classed together, instead of separately. The reader will find frequent occasion to avail himself of what has now been explained.

To return to hydrogen. When prepared as above explained, it appears as a gas, and is collected over water. Like oxygen, it is known only in the form of gas, never having been yet liquefied by the most intense cold and pressure. When pure it is colourless, tasteless, and inodorous, but when prepared from zinc, and especially from iron, it has a peculiar smell, arising from the presence of an oil formed by impurities in the metals. Hydrogen prepared from water by the electric current has no smell. It is the lightest body known, its specific gravity being 69·4 compared to air as 1000. It is exactly 16 times lighter than oxygen.

A burning body introduced into hydrogen is extinguished for want of oxygen; but the hydrogen, being heated by the flame, and in contact with the oxygen of the air at the mouth of the vessel, takes fire and burns away very rapidly from its lightness, if the mouth of the vessel be upwards; and very slowly, for the same reason, when the mouth of the jar is turned downwards, which prevents it from readily mixing with the air. The flame of burning hydrogen is very feebly luminous, but intensely hot, that is, much heat and little light are evolved in its combination with oxygen. When hydrogen is mixed with oxygen, or even with air, and a light applied, explosion ensues, and both gases disappear, water being the only product. The mixed gases are also exploded by the electric spark, and by contact with platinum, in the form of sponge or of powder, as we shall see presently.

Hydrogen is highly positive, and has a very strong affinity for oxygen, with which it forms at least two compounds, water, HO, and deutoxide of hydrogen, HO_2; and

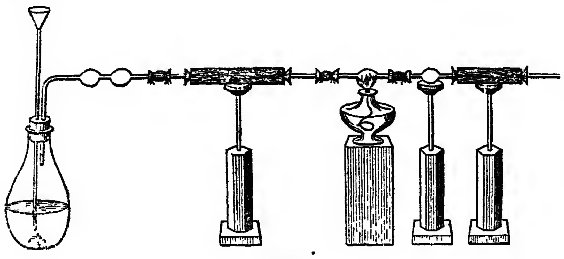


Fig. 5.

probably a third, a teroxide or peroxide, HO_3, if recent statements to that effect shall be confirmed. By reason of this attraction for oxygen, hydrogen is much used by chemists as a deoxidizing agent, especially when aided by a red or white heat. When the gas is passed through a red-hot tube containing the oxide to be reduced, water is formed, and the substance which was combined with oxygen is left in a state of purity.

It has also been used from its lightness for filling balloons; and a balloon of very moderate size filled with hydrogen has a great ascending power. But coal-gas is so much cheaper, and, although heavier than hydrogen, yet with a large balloon has so much ascending power, that it has supplanted hydrogen for this purpose.

It is used also, when burned in a jet with oxygen, which gives what is called the oxy-hydrogen blow-pipe, to produce the most intense heat that is known, except perhaps that of a powerful galvanic battery, and that of the sun's rays collected in the focus of a large burning-glass. This will be explained in treating of the combination of oxygen and hydrogen.

Lastly, hydrogen is made, in this country, the standard or unity of equivalent or atomic weights; for which purpose it is well adapted as having by far the lowest equivalent among the elements.

Hydrogen with Oxygen.

(1.) *Water* $HO = 9$.

We have already mentioned the various circumstances which cause these two gases to combine. If mixed and kept at the ordinary temperature, or in any heat short of a strong red heat, they have no action on each other. But the contact of flame, or of any other red-hot body, the passage of the electric spark, which is intensely hot, and the contact of platinum, cause the combination to take place with explosion. The flame and the electric spark act by their intense heat; but the action of platinum is more obscure. Spongy platinum, and the fine powder of that metal called platinum black, although cold, cause the mixed gases to explode as readily as flame does. Even polished slips of platinum, if perfectly clean, will cause them to combine, though more slowly; and it is then seen that the contact of the cold metal first causes a part of the gases to unite; this produces warmth; the metal being warmed by it, acts more vigorously; more heat is developed, so that by degrees the metal becomes red-hot, and if any of the mixed gases be still uncombined, it causes them to explode. In the case of the powder or the sponge, especially the former, all this takes place so rapidly from the enormous surface of the metal, that it becomes red-hot as soon as it is introduced, and fires the mixture as rapidly as a flame.

But all this does not explain how the platinum causes the gases to combine at first. There are two views on this point, both suggestions, and neither established. One supposes that the surface of the metal attracts the particles of both gases, because there is not the same repulsion between a solid and a gas as between two gases, or the particles of the same gas; that consequently the particles of the two gases come on the surface of the metal nearer to each other than elsewhere, and near enough for affinity to act. According to the other view, proposed by Doebereiner, the pores of the spongy or powdery metal are filled with oxygen absorbed from the air, and condensed with so great a force as to occupy only $\frac{1}{800}$th part of its former bulk. This condensation he ascribes to a peculiar molecular attraction; and he states, that the powder when heated gives off a large amount of oxygen, although there is certainly no combination between the metal and any part of the oxygen. As this condensed oxygen is denser than if it were liquid, although still gaseous, its particles come near enough to those of the hydrogen to combine with them. Either explanation, if true, still leaves unexplained how the platinum attracts the gases, or condenses the oxygen. Doebereiner constructed a lamp for instantaneous light on this principle. It is very ingenious, but the spongy platinum is apt to lose its efficacy, from the vapours of various substances adhering to it. Other metals, and even other porous bodies, exhibit the same property, though in an inferior degree, and usually only when aided by heat.

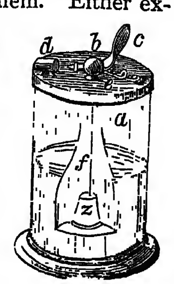


Fig. 6.

When oxygen and hydrogen, from whatever cause, combine, either by combustion or explosion, it is always in the proportions to form water; that is, invariably 2 volumes of hydrogen gas to 1 volume of oxygen gas. Any excess of

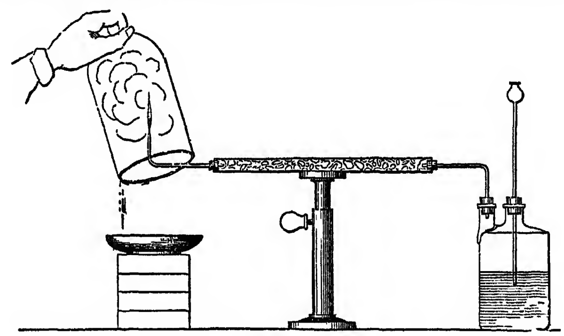


Fig. 7.

either is left uncombined. As the two gases both disappear, it is plain that, if we measure the volume that has disappeared, that is, the contraction in volume, by comparing the residue with the original volume, ⅔ds of that loss of volume must be hydrogen and ⅓d oxygen. This enables us to use hydrogen to determine the amount of free oxygen in air, or in any gaseous mixture, as will be explained under atmospheric air.

The composition of water has been proved in many different ways, both synthetically and analytically. It is a point of great importance with reference to the analysis of other bodies.

Synthetically, oxygen and hydrogen, carefully measured, are made to burn together in a jet, and the water produced is collected and weighed. The weight of the gases consumed is known from their volume and densities, and that of the water is exactly their sum. 8 lb. of oxygen and 1 lb. of hydrogen yield 9 lb. of water. $O + H = HO$.

Or hydrogen gas is passed over a weighed portion of oxide of copper in a tube heated to redness. (See Fig. 5.) The oxygen of the oxide combines with hydrogen, forming water, which is carried onward by the current of gas into a small weighed apparatus containing chloride of calcium, which retains all the water. The increase of weight in this

vessel gives the amount of water formed; the loss of weight in that containing the oxide of copper now reduced to a metal, gives the amount of oxygen, and the difference is the hydrogen. 39·7 grains of oxide of copper yield 9 grains of water, and 31·7 of metallic copper. The loss, 8 grains, is oxygen, and the difference, 1 grain, is hydrogen. The equation is $CuO + H = HO + Cu$.

Analytically, the composition of water is proved by passing a weighed quantity of its vapour over a red-hot metal, such as iron, excluding air. The increase of weight in the metal, which is oxidized at the expense of the water, gives the oxygen, and the difference is hydrogen; or the

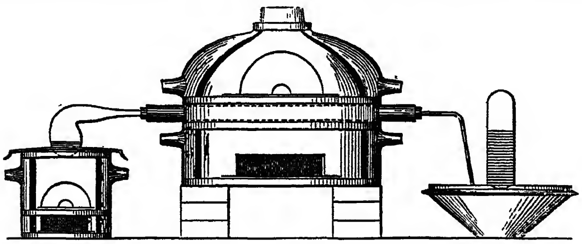


Fig. 8.

hydrogen may be collected and measured or weighed. This process, however, is difficult, and only used as an illustration. Potassium placed in contact with water, under the surface is oxidized, disengaging hydrogen, which may be collected, the oxide dissolves in the remaining water, and this may be evaporated, and the amount of potash determined in the form of a salt, such as the sulphate.

Or, water may be decomposed by the electric current, and the two gases separately collected and measured. They are invariably in the proportion of 2 volumes of hydrogen to 1 of oxygen, and as oxygen is 16 times heavier than hydrogen, 1 volume of oxygen must weigh 8 times as much as 2 volumes of hydrogen.

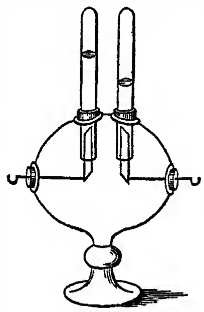


Fig. 9.

In these different ways the composition of water has been proved. Its formula is HO, at least in this country. On the Continent, where atoms and volumes are believed to agree, the formula of water is H_2O. This is merely a question of what is the weight of 1 atom of hydrogen. We consider that 1 atom of hydrogen weighs the eighth part of 1 atom of oxygen. The French chemists say that it weighs only $\frac{1}{16}$ of 1 atom of oxygen, so that 2 atoms are required to yield the proportion of 1 to 8. The same remark applies to the volume. We consider the atom of hydrogen as represented by twice the volume of 1 atom of oxygen; they regard 1 atom of hydrogen as having the same volume as 1 atom of oxygen. But they agree with us as to the equivalent, for they regard the equivalent of hydrogen, in water, as formed of 2 atoms.

The properties of water are well known. It is of all compounds the most important, being essential to both animal and vegetable life. It has neither colour, taste, nor smell, melts at 32° Fahr., and boils at 212° Fahr. It is therefore solid at all temperatures below 32°, and gaseous at all above 212°.

It has a remarkable power of dissolving solid matters, and on this its use chiefly depends.

Water is the standard of specific gravity for liquid and solid bodies, and its specific gravity is made 1, 10, 100, or 1000, according to the writer's choice.

It is remarkable that the point of greatest density in water is not, as might be expected, about 33°, when it is about to freeze, but about 39°·5, and it becomes lighter both above and below that degree of heat. This has a most important practical effect, for when deep water is cooled by frost, the water keeps sinking as it cools till its temperature falls below 39°·5 when it becomes lighter, and remains at the surface till frozen, and then it is lighter still. From that point, therefore, there is no further mixture of the colder with the warmer water, and below the crust of ice and the upper stratum of water, there remains a mass of water at 39°·5, which is only cooled very slowly by conduction. This is one reason why deep lakes are never entirely frozen, and why in the hardest winters the ice never extends far from the surface. Were it otherwise, the freezing would begin at the bottom, the whole mass, however deep, would soon be frozen, and the summer might not suffice to melt it all again.

There is another reason why freezing and melting are slow operations. When a body melts, a large amount of heat disappears or becomes latent, and is employed in giving the liquid form to the solid body, without raising its temperature above the melting point till all is melted. In congelation again, this latent heat reappears and prevents the temperature from falling below the freezing point, however intense the cold applied, till the whole is frozen. For these reasons, the freezing of large masses of water, and the melting of large masses of ice, are both very slow operations.

The same thing occurs when water is boiled or converted into vapour. This takes place at 212°; but so great is the amount of heat that disappears in forming steam, that if a vessel of water be placed on white-hot coals, the water will boil away slowly, but will never rise above 212°, while any water retains the liquid form. And, in like manner, when steam is condensed by cold, all this heat becomes sensible and keeps up the temperature at 212°, whatever cold be applied, till the vapour is entirely liquefied, when the temperature begins at once to fall.

A familiar proof of the enormous amount of latent heat in steam is obtained in the fact, that boiling water at 212°, and steam at 212°, produce totally different effects on the skin. The scald from steam is very greatly more severe than that from boiling water at the same temperature. Again, if we add 4 oz. of boiling water to 16 oz. of water at 60°, the mixture is barely tepid; but if we force 4 oz. of steam at 212° into 16 oz. of water at 60°, the whole 20 oz. will be found to boil briskly. Hence the use of steam as a heating agent, which has the advantage that it cannot heat any substance in open vessels beyond 212°, and cannot therefore char or injure them.

Besides boiling at 212°, under the ordinary atmospheric pressure, water is slowly converted into vapour, or it evaporates at all temperatures. In this way water rises into the air from the sea, lakes, rivers, &c., and falls again as rain, snow, and dew. Some heat is required for evaporation as well as for boiling; the necessary heat is taken from the surrounding bodies, and cold is the result. Water, at a temperature not very far above the freezing point, is so much cooled by its own evaporation, that part of it is frozen by the evaporation of the rest. Ice is actually thus obtained on cool nights in hot climates. The same result is obtained at ordinary temperatures, if the pressure be diminished, which accelerates evaporation. This is well illustrated by Wollaston's cryophorus.

Under diminished pressure water boils at temperatures below 212°. For this reason it boils lower on the top of a mountain than at its base. 212° is the boiling point of water at the sea level, under the average pressure, or with the barometer at or near 29 to 30 inches. In ascending mountains, the boiling point falls 1° Fahr. for every 440 feet of ascent. The height of mountains may be thus pretty accurately measured, provided the state of the barometer be noted below, at the level of the sea, as well as on the hill top.

Under increased pressure, as when the steam is not allowed to escape freely, water boils at temperatures above

212°, and higher, in proportion as the pressure is higher; as is well shewn by Dr Marcet's machine. This occurs in the high-pressure steam engine, in which the steam cannot escape till its elasticity is so far increased by heat, as to overcome the pressure on the piston or on the safety-valve. When such increased pressure is suddenly taken off, by allowing the steam to escape, while the temperature is far above 212°, the steam rushes out with great force, and the temperature within rapidly sinks to 212°. This is the principle of the high-pressure engine; while in the low-pressure form, the steam is simply allowed to enter the cylinder below the piston, and after it has forced up the piston-rod, is condensed by a jet of cold water, steam being at the same moment admitted above the piston, and so on alternately. For full details on these matters the reader must refer to works on mechanics and on the steam engine.

Water, when frozen, increases in volume to a considerable extent, so that ice is lighter than water, and floats on its surface. This expansion takes place with irresistible force; and hence the freezing of small portions of water which has filled the spaces between the layers of the hardest rocks, bursts them asunder. For this reason hard frost is perhaps the most powerful agent in the disintegration of rocks.

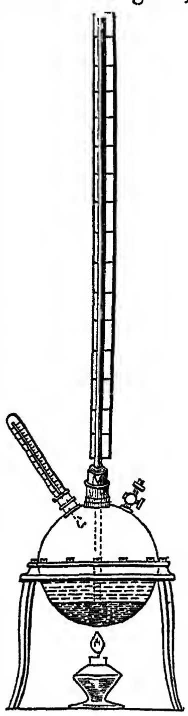


Fig. 10

The chemical characters of water are very important. It combines with dry or anhydrous acids, producing the hydrated acids, which, as has been explained, may be viewed also as hydrogen acids. Thus hydrated sulphuric acid may be represented either as HO, SO_3 or H, SO_4. Water combines also with anhydrous bases, forming hydrates of the bases. Thus anhydrous lime, CaO, combines with water, forming hydrate of lime or slaked lime, CaO, HO. Thirdly, water combines with neutral salts, forming hydrates. Thus sulphate of magnesia, MgO, SO_3 combines with 1 eq. of water to form the hydrated salt, MgO, SO_3, HO. Lastly, water combines with salts, both anhydrous and hydrated, in another form, which is called water of crystallization. The hydrated sulphate of magnesia, MgO, SO_3, HO, takes up 5 eqs. more of water to form the usual crystallized salt, which is represented as follows, $MgO, SO_3, HO + 5$ aq. It is easily shown that these 5 eqs. are in a different state of combination from the first eq.; for a gentle heat expels the five, but a red heat is required to expel the sixth. Again, this equivalent of water may be replaced by a neutral salt or by sulphate of potash, yielding the double salt, $MgO, SO_3 + KO, SO_3$, which cannot be done with the five others. Here we see that water plays the part of a neutral salt; whereas in hydrated acids it plays that of a base, and in hydrated bases that of an acid; being replaceable in the former case by bases, in the latter by acids, and, as we have seen, in the case of its combining with neutral salts, by neutral salts.

But there is a fourth form in which water combines with other bodies, that, namely, in which it dissolves them. Here we have not the same distinct evidence of its combining in definite proportions; inasmuch as, although there be a limit to the quantity of any solid substance water can dissolve, there is none to the quantity of water that may be made to combine with a given weight of any such body. In other words, aqueous solutions may be diluted to any extent. It is probable that water forms with each substance certain definite liquid compounds, characterized by their special densities, boiling points, &c.; and that these are miscible in any proportion. Professor Graham, who has already investigated the diffusion of gases, has long been engaged in profound researches on the mutual diffusion of aqueous solutions. He has obtained very interesting results; but our space forbids our entering on these, especially as the investigation is still in progress.

Heat, as a general rule, increases the solvent power of water, while cold diminishes it. There are a few exceptions. Thus common salt is not materially more soluble in hot than in cold water; and hydrate of lime is less soluble in hot water than in cold. In general we can obtain crystals of substances soluble in water by boiling them with that fluid till it is saturated, when, on cooling, as its solvent power diminishes, it deposits in crystals what it cannot retain in solution. Crystals are also obtained by the slow or spontaneous evaporation of aqueous solutions. Some substances crystallize best in the one method, some in the other.

In consequence of its great solvent power, water is never found pure in nature. Even rain-water dissolves gases, and minute portions of solid matters which it meets with in falling through the atmosphere. We can always detect ammonia, carbonic acid, and sea-salt in rain-water, even when collected in clean vessels at a distance from towns. The salt is no doubt carried into the air from the sea by high winds, and is therefore more abundant during or immediately after a strong gale blowing from the sea. As soon as rain reaches the earth, it begins to dissolve a part of almost everything it meets with in the rocks or soil through which it filters, such as sea-salt, gypsum, silicate of potash, carbonate of lime (in virtue of the carbonic acid already in the rain-water, as well as of that it takes up from the soil), carbonate of magnesia, carbonate of iron, compounds of iodine or bromine, if present; also fluoride of calcium, phosphate of lime (soluble in solution of carbonic acid), and organic matters. According to the amount of dissolved matter, which varies exceedingly, spring and river water is hard or soft, or becomes mineral water. When the solid matter dissolved does not exceed from 1 to 6 or 8 grains per gallon, the water is soft, especially if the proportion of supercarbonate of lime be small. But when more solid matter is present, especially supercarbonate of lime and gypsum, when there are from 10 to 15, 20, 30, 50, 80, 100, or even, as sometimes happens, 150 grains of solid matter in a gallon, the water is more or less hard, the salts of lime decomposing soap, and rendering necessary a large consumption of it to obtain detergent effects. Moreover, the supercarbonate of lime is decomposed on standing, or when boiled, and deposits a crust of neutral carbonate of lime, which renders hard water totally unfit for use in steam boilers, and in fact ruinous to the boilers by the effects of the crust, to the presence of which many explosions have been justly referred. The methods of detecting the presence of these impurities, and of improving the quality of hard water, will be mentioned under the head of the substances named.

When the amount of foreign matter exceeds a certain proportion, and especially if it consist of salts of soda and magnesia, of iron, of sulphurets of metals, or of sulphuretted hydrogen, of alkalies, or of carbonic acid, the water is called a mineral water, although all water is mineral. Sea-water is a true mineral water. Such as are charged with carbonic acid are called acidulous or sparkling waters; such as contain saline matters are saline waters; those containing sulphur, iron, or alkalies, are respectively sulphureous, chalybeate, or alkaline waters.

Pure water can only be had by distillation; and even in distilled water there are often traces of ammonia and carbonic acid.

The importance of water to man cannot be over-estimated. It is essential to both animal and vegetable life, the best soil being barren if no rain fall. It is almost equally essential to almost all chemical operations, among which vegetation may be included. It is through water that plants are supplied with their whole food, namely, carbonic acid, ammonia, silicate of potash, sulphate of lime, sea-salt, carbonates of iron, magnesia, lime; phosphates of lime and magnesia; iodides, bromides, and fluorides; the carbonates and phosphates, which are insoluble in pure water, being dissolved in water containing free carbonic acid, which also contributes powerfully to the disintegration, and to the rendering soluble of the useful constituents of felspar and of clay, which is half-decomposed felspar.

In the animal body, every part, solid or liquid, consists chiefly of water, which forms at least $\frac{3}{4}$ths of the weight of all the soft solids, and about $\frac{3}{8}$ths of that of the bones.

We shall see that, besides its use as a solvent, and as a constituent of organized tissues, water takes a share, *by its elements*, in the formation of almost all organic compounds whatever. It is certainly of all compounds the most valuable and useful.

(2.) *Deutoxide of Hydrogen*, $HO_2 = 17$.

Water can take up an additional eq. of oxygen, and is thus converted into the deutoxide. This compound is obtained, in a diluted form, by the action of hydrochloric acid on successive portions of deutoxide of barium, which sets free an eq. of the deutoxide; thus, $Ba\,O_2 + H\,Cl = Ba\,Cl + HO_2$. The deutoxide of hydrogen and the chloride of barium both dissolve in the water in which the process is carried on. Sulphuric acid, cautiously added, removes the barium as the insoluble sulphate, leaving free hydrochloric acid as before; thus, $Ba\,Cl + HO,\ SO_3 = Ba\,O,\ SO_3 + H\,Cl$. In the filtered liquid, a second portion of deutoxide of barium is dissolved, and the whole process is repeated till the liquid is sufficiently charged. It is thus concentrated by evaporation *in vacuo*, and when pure has the consistence of a thin syrup. Its preparation is a tedious and delicate process; and when made it can only be preserved in a freezing mixture for a time, as it undergoes spontaneous decomposition, and that very rapidly, at ordinary temperatures. Phosphoric acid, and even sulphuric acid, may be substituted for the hydrochloric acid.

The deutoxide of hydrogen readily parts with half its oxygen, and is reduced to water by contact with organic matters. It disorganizes the skin, causing a white spot. It gives off oxygen spontaneously, and the presence of various powders hastens the change. When oxide of silver, for example, is introduced into it, rapid effervescence ensues, and there is given off, not only the second eq. of oxygen of the deutoxide, but also the oxygen of the oxide of silver, which is thus reduced to the metallic state, or deprived of oxygen, by one of the most powerful oxidizing agents, which we should rather expect to yield oxygen to it. The explanation appears to be, that the *motion* of the particles of decomposing deutoxide is mechanically communicated to those of the oxide of silver, and the equilibrium of that compound being thus destroyed its elements separate. Several other oxides are decomposed in the same way.

The deutoxide of hydrogen has been occasionally used to oxidize certain substances in chemical research, and has been proposed as a remedy. In both ways it may probably prove useful, but the difficulty of preparing it and preserving it will, for the present, very much limit its employment.

(3.) *Ozone.*

This name has been given, on account of its pungent smell, to a substance formed under several circumstances; as when electric sparks are passed through dry oxygen gas; or better, when water is decomposed by the electric current, when it (ozone) is found in the oxygen collected at the positive pole; and, finally, when phosphorus is slowly oxidized in atmospherical air, which thus acquires the odour of ozone.

By whatever method it is formed, its quantity is always singularly small, so that it has hitherto been found impossible to obtain it pure, or to analyse it quantitatively. But its odour is very powerful, resembling that of chlorine, and also that which is observed in thunder-storms. As to its other properties, it is a most energetic oxidizing agent, and therefore contains oxygen, probably in large quantity. Its presence is easily detected either by the smell, or by its power of decomposing iodide of potassium, setting free the iodine, and of oxidizing the salts of protoxide of manganese, so as to form peroxide.

From these characters, and from its occurring where oxygen is in the nascent state, as at the positive pole of the battery, and in presence of water, it is supposed, on good grounds, to be either an isomeric (or allotropic) form of deutoxide of hydrogen, or a teroxide of hydrogen. Recent researches tend to show that there are probably two compounds included under the name ozone, and that the ozone formed in the electrolytic decomposition of water is really teroxide of hydrogen, while that formed in dry oxygen gas is an allotropic modification of oxygen gas.

It is probable, from the facility with which it is formed, and the equal facility with which it is decomposed, that ozone is very often produced in the atmosphere, and acts powerfully on other bodies. It destroys organic substances, even when diluted with much air or oxygen, so that neither cork nor caoutchouc can be used to connect the apparatus in which it is prepared. Hence it probably plays an important part in hastening the oxidation or decay of dead organic matter.

3. *Nitrogen.*

Symbol N. Equivalent = 14.

This element, like hydrogen, is here introduced out of its strict place, on account of its great importance, and especially of the importance of its compounds.

Nitrogen occurs, mixed with oxygen, in our atmosphere, of which, when dry, it constitutes about $\frac{4}{5}$ths. It is also found in all organized tissues, and in the juices of plants and animals, as an essential constituent. In the crust of the earth it occurs in certain spots, in the form of the nitrates of potash and soda, that is, compounds of these bases with nitric acid. It is also an ingredient of ammonia, which exists in the atmosphere, and is produced from volcanoes.

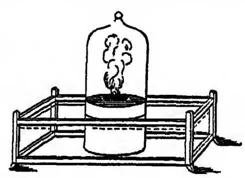


Fig. 11.

Nitrogen is best obtained from air, by removing the oxygen by means of phosphorus, which, if made to burn under a bell gas, inverted over water, combines with the oxygen, forming phosphoric acid, and this acid is dissolved by the water, leaving the nitrogen pure. It may also be obtained by the action of chlorine on a solution of ammonia.

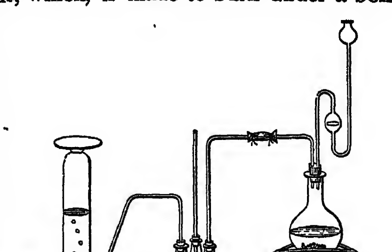


Fig. 12.

However prepared, nitrogen always appears as a transparent, colourless, tasteless, and

inodorous gas. Water absorbs only a very minute portion of it. It is rather lighter than air, in the proportion of 972·2 to 1000. This must be so, since a mixture of it with oxygen, which is rather heavier than air, has the density of air. It extinguishes the flame of any burning body, and does not take fire itself as hydrogen does. It cannot support animal life when respired, but it is not poisonous, as some gases are. Animals soon die in pure nitrogen gas, but this is simply from the want of oxygen. For at all times we breathe air, which is only a mixture of oxygen with four times its volume of nitrogen, not only without injury, but with advantage, for it serves to dilute the oxygen and render it fit for respiration. It will be seen that nitrogen is characterized entirely by negative properties.

It is one of those gases which has hitherto resisted all attempts to condense it into the liquid state.

Nitrogen has very remarkable and important chemical relations. Its affinities for oxygen and for hydrogen are both considerable, and pretty nearly equal, and it is capable of combining both with the positive and the negative elements. But its compounds, from the fact that it has affinities in every direction, and those not the strongest, are in general easily decomposed, and frequently with explosive violence. To those complex organic compounds in which it is an essential ingredient, it gives a tendency to undergo transformations of all kinds, by which they are fitted for the functions they have to perform; and it is such compounds alone that undergo the transformation called putrefaction, and another similar one, by which they become ferments, or exciters of fermentation.

Nitrogen and Oxygen.

Nitrogen forms several compounds with oxygen, which have been already alluded to as an example of multiple proportions. Besides these, there is atmospheric air, a mixture, not a compound, of these gases, which we shall consider after them.

(1.) *Protoxide of Nitrogen*, $NO = 22$.

This compound is obtained by the action of heat on nitrate of ammonia, thus:—$NH_3, HO, NO_5 = 4\,HO + 2\,NO$. Here all the hydrogen is oxidized to water, and the remaining oxygen is just sufficient to convert into protoxide the nitrogen, both of the acid and of the base.

The protoxide is, at ordinary temperatures, a gas, transparent and colourless, having a sweetish taste and faint smell; it is absorbed by water to some extent, but may be collected over that liquid, although it cannot be long kept in contact with it. It supports the combustion of burning bodies pretty much as oxygen does, evidently because it contains half its volume of that gas. It may be breathed, but cannot be thus taken for more than a short time, because its action paralyses the muscles of the mouth, which cease to grasp the tube, and common air enters. An animal confined in the gas soon dies, after exhibiting symptoms of excitement.

When respired by man, it first produces a sensation of thrilling and warmth in the chest, spreading to the extremities, followed, as we have stated, by paralysis of the muscles of the mouth, which puts a stop to the further breathing of it. Then, usually after a very short period of quiet and almost of stupor, the patient becomes excited, sings, laughs, leaps, dances, sports, and begins to indulge in violent muscular actions, to which an irresistible tendency is felt. The laughter which occurs in most cases is entirely without object, and as it excites laughter among the bystanders, the patient is apt to take offence and to threaten them. He is generally, however, good humoured, unless force be roughly applied to restrain him, when he becomes violent. In the course of a minute or two all has passed suddenly off, and the patient returns to full consciousness with a bewildered stare, having either no recollection, or a very confused one, of what he has done and felt. He usually describes his sensations as agreeable, and states that at a certain time he became unconscious or nearly so. In some cases this excitement either does not appear or is only brief and transient, passing into complete unconsciousness and apparent stupor. In this state, and frequently also in that of excitement, insensibility to pain is present, as we have often ascertained. In fact, the action of the gas, as well as its taste and the sensation it produces in the chest, are the same as those of the vapour of ether and of chloroform. The reason why it produces, in general, excitement, and rarely complete unconsciousness, is simply this; that being a gas, it must be breathed from a bag through a tube; that, by paralysing the muscles of the mouth, it puts an end to the inhalation of the gas before enough has been taken to produce full coma and anæsthesia, except in a few individuals who are more easily affected. Ether and chloroform, being volatile liquids, can be poured on a sponge or cloth, and held to the mouth and nose of the patient, so as to insure a full dose. But where by chance an insufficient dose of them is given, the stages of excitement, laughter, singing, &c., appear just as with the laughing gas. We have repeatedly produced entire coma and insensibility to pain by this gas in persons easily affected; and as we have repeatedly inhaled all three substances, we can testify to the identity of the effects, bearing in mind the impossibility, in most cases, of giving a full dose of the gas.

This gas is formed of 2 volumes of nitrogen and 1 volume of oxygen the three volumes after combination occupying the space only of two. This condensation to the amount of $\frac{1}{3}$d renders the gas a heavy one. For we have—

	1 vol. oxygen, weighing	=	1111
	1 vol. nitrogen, ...	=	972
	1 vol. nitrogen, ..	=	972
which yield	2 vols. protoxide of nitrogen, weighing		3055
Consequently	1 vol. of protoxide, weighs		1527

and this number 1527, represents its specific gravity.

By a pressure of upwards of 50 atmospheres at 32° Fahr., or by a less pressure at lower temperatures, this gas is liquefied. The condensed gas is a very mobile liquid, which, on the tube being opened, assumes the form of gas with explosive rapidity, producing intense cold by its vaporization. The most intense cold yet produced has been obtained by means of this gas *in vacuo*. It has also been solidified by the cold produced by its own evaporation.

(2.) *Deutoxide of Nitrogen*, $NO_2 = 30$.

Prepared by the action of moderately strong nitric acid on copper.

Copper.		Nitric Acid.		Nitrate of Copper.		Deutoxide of Nitrogen.
$3\,Cu$	+	$4\,NO_5$	=	$3\,(Cu\,O, NO_5)$	+	NO_2

It is a gas, transparent and colourless, not absorbed by water. It cannot be tasted, smelled, nor inhaled, on account of its action on common air, with the oxygen of which it forms red, suffocating, corrosive vapours of nitrous acid, NO_4. This character distinguishes it from all other gases.

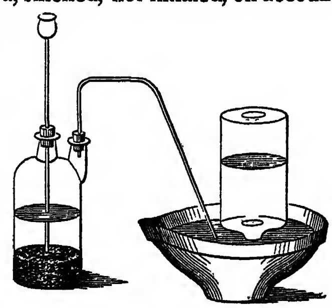


Fig. 13.

It is formed of equal volumes of oxygen and nitrogen united without condensation. Hence its specific gravity is the mean between those of oxygen and nitrogen.

	1 vol. oxygen,	weighing	1111·1
	1 vol. nitrogen,	...	972·2
yield	2 vols. deutoxide,	...	2088·3
and	1 vol,	... weighs	1041·6

It is, therefore, very little heavier than air. As it contains, like the preceding gas, half its volume of oxygen, it supports the combustion of some burning bodies, especially of phosphorus, if introduced into it in full combustion, when the phosphorus burns nearly as brightly as in oxygen.

This gas is absorbed by a solution of sulphate of protoxide of iron (green vitriol), which it turns black. The black liquid absorbs oxygen powerfully.

The attempt to inhale this gas is most dangerous, because, meeting with air in the mouth and air passages, it forms nitrous acid, which is corrosive. The gas itself appears to be poisonous.

When mixed over water with half its volume of oxygen, that is, as much as it already contains, there is instantly formed the red gas of nitrous acid, which is quickly absorbed by the water, the gases entirely disappearing. The action is $NO_2 + O_2 = NO_4$.

(3.) *Hyponitrous Acid,* $NO_3 = 38$.

Hardly known in a pure state. It seems to be a liquid, blue at ordinary temperatures, colourless at 32°, and very volatile, its vapour being red, like that of nitrous acid. When the vapour of this acid is passed through nitric acid, it gives it either a blue colour or an olive colour, according to the quantity, nitric acid being probably also formed, and its orange colour mixing with the blue, produces the olive. Hyponitrous acid forms some salts, and enters into some compounds derived from organic substances. Its vapour is obtained by heating starch with nitric acid, but is not free from nitrous acid.

(4.) *Nitrous Acid,* $NO_4 = 46$.

Obtained by mixing oxygen and deutoxide of nitrogen as already explained, or by heating nitrate of lead. The change in the latter case is—

Nitrate of Lead.		Oxide of Lead.		Oxygen.		Nitrous Acid.
$Pb\,O, NO_5$	$=$	$Pb\,O,$	$+$	O	$+$	NO_4

It is a volatile liquid, colourless when cold, straw-yellow when somewhat warmer, and orange-yellow or orange-red when warm. Its vapour is deep red. It is very corrosive. It has a remarkable action on the solar spectrum, which Sir D. Brewster has described. It forms salts, called nitrites, and in organic chemistry it is frequently substituted for its equivalent of hydrogen, producing what are called nitro-compounds, such as nitro-benzoic acid, nitraniline, and others, to be afterwards described; gun-cotton is one of these, being woody fibre, or cellulose, in which a certain amount of hydrogen has been replaced by nitrous acid.

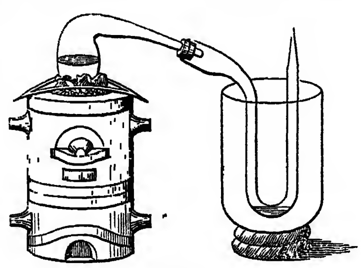


Fig. 14.

(5.) *Nitric Acid,* $NO_5 = 54$.—*Hydrated Nitric Acid,* HO, NO_5 or H, NO_6.

This acid is obtained by heating nitrate of potash with its own weight of sulphuric acid. The action is as follows:—

Nitrate of Potash.		Sulphuric Acid.		Bisulphate of Potash.		Nitric Acid.
KO, NO_5	$+$	$2\,(HO, SO_3)$	$=$	$(KO, HO, 2\,SO_3)$	$+$	HO, NO_5.

The acid collects in the receiver as a colourless fuming liquid in the middle of the process, but is coloured by a little nitrous acid at the beginning and end. When coloured, it is easily purified by redistilling, when the red vapours of nitrous acid pass off first, and the colourless acid then distils. By collecting separately the first tenth or twentieth part in the original process, all impurities adhering to the neck of the retort are washed away, and the rest is quite free from all traces of sulphuric acid or of potash.

Nitric acid, when pure, has the specific gravity 1520, compared to that of water as 1000. It is highly corrosive, and stains the skin yellow. It readily yields part of its oxygen to bodies having an attraction for it, being itself reduced to nitrous or hyponitrous acid, or to deutoxide of nitrogen. Its action on metals and on organic substances, especially oils, is very violent. It combines with bases to form salts, called nitrates, which at a red heat oxidize all oxidizable matter, often with explosion. Nitrate of potash, or nitre, is the oxidizing agent in gunpowder.

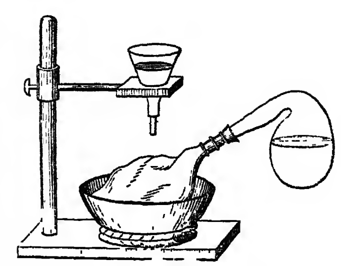


Fig. 15.

The presence of free nitric acid is detected by its power of decolorizing solution of indigo, and by its causing solutions of the salts of protoxide of iron to become nearly black; and when it is in the form of a nitrate, sulphuric acid is first added to set it free, and then the salt of iron.

Nitric acid is much used as an oxidizing agent, both in chemistry and the arts. It is employed, somewhat diluted, to corrode copper in etching. By means of nitric acid sugar and starch are converted into oxalic acid. Nitric acid is also used in medicine.

The acid we have described is the hydrated acid, and may be viewed either as composed of water and dry acid, HO, NO_5, or as formed of hydrogen, with the hypothetical radical, NO_6; thus, H, NO_6. It was long supposed that the anhydrous acid did not exist in a separate form, and that the 1 eq. of water in HO, NO_5 could not be removed. But it has recently been shown, that the dry acid NO_5 may be obtained by the action of chlorine or dry nitrate of silver; thus, $Ag\,O, NO_5 + Cl = Ag\,Cl + O + NO_5$. Anhydrous nitric acid forms crystals which are volatile and easily decomposed by heat or otherwise. But the hydrate, as in other cases, is the true active permanent acid.

Atmospherical Air.

Our atmosphere, as already mentioned, consists chiefly of nitrogen and oxygen gases. But these, although present in atomic proportion, or very nearly so (for their proportion is very close to N_2O) are not combined, but only mixed together. This is proved by the fact that air has no new properties, but only those of oxygen diluted by nitrogen, and also by this, that a mixture of the two gases, in due proportion, is found to have all the properties of air. The circumstance that two gases of different densities are found uniformly mixed, is explained by the diffusion of gases. When two vessels, one full of carbonic acid gas, the other of hydrogen, gases which *do not combine*, are made to communicate by a tube, the hydrogen being uppermost, they are found in a very short time equally and uniformly mixed, although the lower gas is more than 20 times heavier than the upper one. The force by which this is effected is the same which affects the perfect and uniform mixture of oxygen and nitrogen in the atmosphere, and is called the force of diffusion.

The proportions of these gases in air is 4 volumes of nitrogen to 1 volume of oxygen; and, by weight, about 79 parts of nitrogen to 21 of oxygen, which is very nearly in the proportion of 2 eqs. N to 1 eq. O, or $N_2\,O$.

Besides these gases, air contains also, as essential ingredients, watery vapour in variable amount, and carbonic acid and ammonia in very small proportion. It contains also traces of all volatile substances in quantities too small to be ascertained.

The uses of the air are well known It is essential to

the life of animals, which respire it, consuming its oxygen, and replacing it by carbonic acid gas. It is equally essential to plants, which consume its carbonic acid, replacing it by oxygen, and which also consume its ammonia. By its oxygen it supports combustion and the decay of dead organic matter, both of which also replace the oxygen they consume by carbonic acid.

It is of great importance to be able to ascertain the amount of oxygen in air, because that gas is constantly consumed by respiration, combustion, and decay. This is called eudiometry, and is done in various ways. The oxygen of a measured portion is removed by phosphorus, or by copper clippings moistened with acid; or the air is mixed with a known volume of hydrogen, not less than $\frac{4}{10}$ths, or half the volume of the air, and the electric spark passed through the mixture, or spongy platinum introduced. In either case the hydrogen unites with the oxygen, both gases disappear, and water is formed, leaving the nitrogen with any excess of hydrogen. The loss of volume, divided by 3, gives the volume of the oxygen. Thus, if 100 volumes of air are mixed with 50 of hydrogen, and exploded over mercury by the electric spark, the 150 volumes are found reduced to 90, while water is deposited. The loss of volume here is 60 volumes. But in water there are 2 volumes of hydrogen to 1 volume of oxygen; consequently 60 volumes of the gases which have disappeared consist of 40 of hydrogen and 20 of oxygen; or $60 \div 3 = 20$ volumes—the amount of oxygen in 100 volumes of air.

Fig. 16.

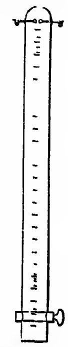


Fig. 17.

Air is thus found, where it has perfect freedom of motion and mixture, to contain everywhere 20 volumes of oxygen in 100, whether it be examined in towns, in the country, at the level of the sea, or on the highest mountains. But in confined and ill-ventilated places the proportion of oxygen is found to be smaller, while that of carbonic acid is larger, and the air in consequence unfit for respiration.

The proportion of oxygen and that of carbonic acid in air, although the former amounts to 20 volumes in 100, the latter only to at most 1 volume in 1000, have been found uniform in all parts of the world, and at all times and periods. Air, hermetically sealed up 2000 or 3000 years ago, in Herculaneum, and in the Egyptian catacombs, has been found the same as at the present day. This alone would indicate that there is a relation between these two gases, oxygen and carbonic acid. But since we know that animals consume the oxygen replacing it by carbonic acid, that plants consume carbonic acid, replacing it by oxygen, and that carbonic acid contains its own volume of oxygen, we see that there is a balance between animal and vegetable life, which are mutually dependent, each restoring to the air what the other has removed, and consuming what the other has produced, and thus preserving constant the composition of the air; each while living in it rendering it fit for the life of the other. Should any cause suddenly increase the amount of one of them—and some causes, such as volcanic action, and the combustion of fuel in manufactures, &c., do tend to increase that of carbonic acid—the vegetable kingdom instantly seizes on it, more luxuriantly, purifies the air, and at the same time produces more food for animals, so that an increase of the food of plants (carbonic acid) causing an increase of vegetation, is followed by an increase of food for animals and of animal life, and thus the balance is kept up between the animal and vegetable worlds by means of oxygen and carbonic acid, the atmosphere being the scene of action.

Air contains a variable amount of water in the form of vapour. The quantity which it can take up depends on the temperature, and when it is saturated with vapour at a given temperature, cooling even to the extent of 1 degree causes a deposition of moisture, and thus gives rise to dew, rain, snow, and hail. If the air at a given temperature be not saturated with moisture, it does not deposit any until cooled down below that point at which the vapour present is sufficient to saturate it. This is called the Dew Point, and when we know the dew point at any temperature, or what is the same thing, the difference between the temperature of the air and the dew point, we can calculate, from tables constructed for the purpose, the amount of water in the air at the time. Instruments for ascertaining this are called hygrometers, and the most accurate is the dew point hygrometer, founded on the principles just explained. Some vessel or apparatus is cooled below the temperature of the air, till dew appears on its surface, and its temperature is noted. It is then allowed to become warmer spontaneously, and the temperature again noted at the moment the dew again disappears. The mean between the two temperatures is taken as the true dew point.

Air is the standard of specific gravity for gases, and its specific gravity is made 1000. 100 cubic inches of air weigh about 31·5 grains, and by weighing the same, or any known volume of another gas, its specific gravity is ascertained by a simple proportion. 100 cubic inches of hydrogen weigh only about 2·25 grains, while 100 cubic inches of oxygen weigh 34·5 grains nearly. Hence we obtain the specific gravities of—

Air,	1000·0
Hydrogen,	69·4
Oxygen,	1111 1
Nitrogen,	972·2

Air has, in perfection, all the physical properties of permanent gases. It is perfectly elastic, that is, its volume varies inversely with the pressure to which it is subjected. 100 cubic inches of air under the ordinary pressure, or that of 1 atmosphere, become 50 cubic inches under 2 atmospheres, and 200 under half an atmosphere of pressure. This is supposing the temperature unchanged; for air, like all elastic fluids, expands much when heated, and contracts when cooled. The amount of change due to heat is $\frac{1}{480}$th of the volume, at 32° Fahr. for every degree of Fahr. while the pressure is the same.

The pressure of the atmosphere depends on its weight, which, from the enormous extent of the atmosphere, is very great, amounting to about 15 lb. on every square inch of surface at the level of the sea. As we ascend, on a hill, for example, this pressure gradually diminishes, because there is less air above than before. For this reason, as before mentioned, water boils at a lower temperature as we ascend higher, the boiling point falling nearly 1° Fahr. for every 440 feet of ascent.

The pressure of the atmosphere is measured by the barometer, which consists of a long tube, first filled with mercury, and then inserted with the open end in a cup of that liquid. The mercury falls to about 29 or 30 inches, and remains stationary at that point, the weight of the column of mercury in the tube being counterpoised by that of the air, pressing on the surface of the mercury in the cup.

By means of this instrument, the details of which belong to mechanical philosophy, the pressure of the atmosphere is found to be constantly varying, in the same place, between certain limits, from about 28 inches of mercury to 31 inches. This depends on the varying amount of air over any point, which again depends on the motions caused in the air by changes of temperature and other causes, such as the rotation of the earth on its axis. These changes of pressure are the causes in part, and in part also the effects of winds, which are the motions of the air. A sudden fall in the barometer, indicating a sudden diminution of pressure,

shows the existence of a partial vacuum over the spot where it is observed. The surrounding air rushes into this vacuum with violence proportioned to its degree, and thus restores the former pressure, or a greater. Hence, a sudden fall of the barometer is invariably followed by high winds; while a steady barometer indicates steady weather. The effect of diminished pressure on evaporation has been already mentioned.

The presence of carbonic acid gas in air is easily detected by lime or baryta water, which attract it, forming the insoluble carbonates of lime or baryta. Ammonia, though always present, can hardly be detected, on account of its minute quantity. But it is easily shown to be present in rain-water, which, in passing through the air, dissolves it; by adding a drop of sulphuric acid, evaporating nearly to dryness, and adding lime, when the smell of ammonia is at once perceived. This ammonia is the source whence plants derive probably the greater part of their nitrogen, and while plants absorb it greedily, animal life, and still more the decay of dead animal and vegetable matter, restores to the air the ammonia it has lost, as fast as it is consumed; so that here also a balance exists between plants and animals in regard to a constituent of the atmosphere.

Nitric acid is formed in the air, especially during thunderstorms, partly by the oxidation of ammonia, partly, it is believed, by the direct oxidation of nitrogen. But it is not to be detected in the air, being instantly removed by water. It appears to contribute to the supply of nitrogen to plants.

Nitrogen and Hydrogen.

(1.) *Ammonia.* $NH_3 = 17$.

This very important compound, as has just been mentioned, is produced during the decay of organic matters containing nitrogen. It is formed artificially by the action of heat on such organic compounds; and it seems to be given out occasionally from volcanoes.

It is best obtained from sal-ammoniac, hydrochlorate of ammonia, or chloride of ammonium (for the salt has all these names), by heating it with slaked lime, when the ammonia is given off as a gas. The change is—

	Hydrochlorate of Ammonia.		Slaked Lime.		Chloride of Calcium.				Ammonia.
	NH_3, HCl	+	CaO, HO	=	$CaCl$	+	$2HO$	+	NH_3
or	NH_4, Cl	+	CaO, HO	=	$CaCl$	+	$2HO$	+	NH_3

Ammonia is a gas, transparent and colourless, of a very pungent and peculiar odour, and a burning taste. It must be collected over mercury, or by displacement, being lighter than air; for water instantly absorbs it, acquiring its taste and smell. It extinguishes burning bodies without itself taking fire, although a jet of it may be set fire to in oxygen gas. It is fatal to animals when inhaled. Ammonia is a very powerful base or alkali; neutralizing the strongest acids; it is, in fact, the type of all volatile organic bases, a numerous class, and belongs strictly to organic chemistry. We shall, therefore, postpone to that section the consideration of its principal relations, viewing it here as a compound of nitrogen and hydrogen.

It consists of 3 volumes of hydrogen and 1 volume of nitrogen, which form, not four, but two volumes of ammonia. It is lighter than air, its specific gravity being 590·2. Cold water absorbs about 600 times its volume of the gas, becoming thereby lighter, and acquires all its pungency, being a powerful rubefacient and diffusible stimulant. Its salts, except the carbonate, have no smell.

Although a very powerful base, it is expelled from its salts by almost all fixed bases, on account of its volatility.

Ammonia is reduced to the liquid state by a pressure of about 17 atmospheres at the ordinary temperature.

Its presence is recognised by its smell when free, and by its forming thick white fumes of sal-ammoniac when a rod dipped in hydrochloric acid is brought near it. When combined, it is first set free by the addition of lime or potash, and the tests are then applied.

The uses of ammonia are numerous. It is an important part of the food of plants, and a most valuable ingredient, therefore, in manures. It is much used by chemists in their researches, and also in medicine and pharmacy. It is commonly employed in the form of solution in water, called aqua, or liquor ammoniæ, which is made by causing a current of the gas to pass through water kept cool, till it is saturated.

Large quantities of ammonia, formed by the action of heat on coal, are now obtained from the water of gas-works in the form of sulphate.

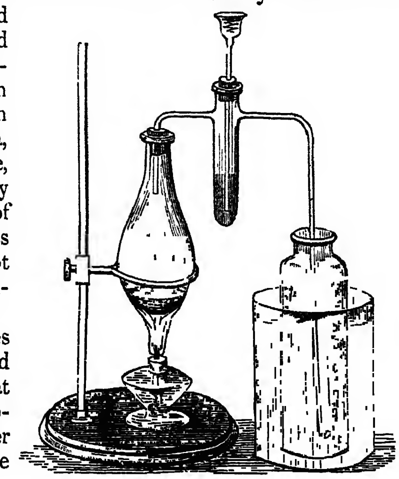


Fig. 18.

(2.) *Ammonium.* $NH_4 = 18$.

This is a hypothetical compound, or, at least, has not yet been obtained in a separate form; but there are good reasons for admitting its existence in the salts of ammonia. It is believed to have the properties, at all events the chemical properties, of a metal, and to be closely related to potassium. The arguments in favour of the existence of ammonium, are as follows:—

1. When a salt of ammonia is decomposed by the electric current in contact with mercury, the mercury is converted into a soft semisolid mass many times the volume of the mercury, which resembles entirely the compounds of mercury with metals, such as potassium, sodium, &c. Hence it is believed to contain a metal, and is called the amalgam of ammonium; the compounds of mercury with other metals being called amalgams. 2. This amalgam, left to itself, is soon decomposed, and yields nothing but mercury, ammonia, and hydrogen. Hence, if there be a metal combined with the mercury, that metal is formed of ammonia and hydrogen. 3. The salts of ammonia with oxygen acids are isomorphous with those of potash, provided they contain 1 eq. of dry acid, 1 eq. of ammonia, and 1 eq. of water. The salts of ammonia with hydrogen acids are isomorphous with those of potassium, without this 1 eq. of water. Now let us compare the formulæ of the two classes of isomorphous salts, which, according to the doctrine of isomorphism, ought to have an analogous constitution. We find—

Sulphate of potash	KO, SO_3
Chloride of potassium	KCl
Sulphate of ammonia	NH_3, HO, SO_3
Hydrochlorate of ammonium	NH_3, HCl

Here, at first sight, we perceive no analogy in either case. But if we assume that the salts of *ammonia* are really salts of *ammonium*, the analogy is at once evident, especially if we use a single symbol for ammonium, for example, Am. We have then—

Sulphate of oxide of ammonium, NH_4O, SO_3, or AmO, SO_3
Chloride of ammonium, NH_4Cl, or $AmCl$
Sulphate of potash, KO, SO_3
Chloride of potassium, KCl.

Here we see that ammonium, NH_4 or Am, and oxide of ammonium, NH_4O or AmO, can replace potassium and potash (oxide of potassium) without changing the form of the compound. Now oxide of ammonium, NH_4O, is the

same thing as ammonia *plus* water, $NH_3 + HO$, and this explains why 1 eq. of water exists in addition to ammonia in all the salts of oxygen acids with ammonia which are all likewise isomorphous with those of potash. If this eq. of water be excluded we obtain different compounds, not true salts of ammonia. For every salt of potassium there is a corresponding salt of ammonium, of like form, and perfectly analogous properties; and wherever oxide of potassium is present, it is replaced, not by ammonium, but by oxide of ammonium, in other words, by the elements of ammonia and water. There is no way known in which this remarkable analogy and isomorphism can be explained, except the hypothesis of ammonium, and it explains all the facts perfectly. The only difference between the salts of ammonium on this hypothesis and those of potassium, beyond what exists between the salts of any two analogous metals is, that while potassium is elementary, ammonium is compound. But it must be remembered that potassium, like all the elements, is not absolutely elementary but only cannot be shown to be compound, and that this may one day be done. We have been thus particular in explaining the doctrine of ammonium, because it is the type, like ammonia, of a numerous class of organic compounds, in which the analogy to potassium comes out still more strongly.

The salts of ammonia, then, on this hypothesis, now almost universally admitted, are salts of ammonium. Sulphate of ammonia, NH_3, HO, SO_3 is considered to be sulphate of oxide of ammonium, NH_4O, SO_3 or Am O, SO_3. When a hydrogen acid such as hydrochloric acid, H Cl, acts on ammonia, it is believed not to combine with it, as expressed in the old formula of sal-ammoniac, NH_3, H Cl, but to react on it, the hydrogen of the acid forming with the ammonia ammonium, with which the chlorine combines. $NH_3 + HCl = NH_4Cl = Am\,Cl$.

The reason why oxide of ammonium does not exist uncombined, seems to be, that the attraction of the oxygen for the fourth eq. of hydrogen, held as it must be by a feebler attraction than the three others, is sufficient to break up the molecule, forming water, and of course, ammonia. $NH_4O = HO + NH_3$. This result is also promoted by the very strong tendency of nitrogen and hydrogen to form ammonia.

Since ammonia *plus* water is equal to oxide of ammonium, which is isomorphous with dry or anhydrous oxide of potassium or potash, it is obvious that, to form a body analogous to and isomorphous with the hydrate of potash (caustic potash), ammonium must take up 2 eqs. of water. For we have—

Oxide of potassium, dry, KO
Oxide of ammonium, NH_4O
Hydrated oxide of potassium, KO, HO
Hydrated oxide of ammonium NH_4O, $HO = NH_3 + 2HO$

The amalgam of ammonium is best made by passing a melted amalgam of sodium into a warm solution of chloride of ammonium, when the mercury swells up till it rises out of the liquid. The amalgam of sodium should contain no more than 1 part of sodium to 10 of mercury, and it is quite liquid at little more than 100° Fahr.

(3.) *Amide.* $NH_2 = 16$.

This compound, like ammonium, is not yet known in a separate state, probably on account of its strong attraction for a third eq. of hydrogen or for other bodies. But there are, especially in organic chemistry, many compounds which appear to contain it, and are of considerable interest. They are called in general amides, and individually are named from the acids which yield them; as oxamide from oxalic acid, benzamide from benzoic acid, &c. They are always formed from a salt of ammonia (ammonium) by the separation of water, one eq. of which is formed by oxygen from the acid and hydrogen from the ammonia which is thus reduced to amide. To take an example—benzoate of ammonia, NH_3, HO, $C_{14}H_5O_3$ or NH_4O, $C_{14}H_5O_3$, losing 2 eqs. of water becomes benzamide, NH_2, $C_{14}H_5O_2$. Some mineral acids seem to yield amides, and amide certainly combines with metals, as with potassium, sodium, &c., and forms various inorganic compounds. White precipitate, a medicinal compound of mercury, contains mercury, chlorine, and amide. With platinum and some other metals, amide forms remarkable basic compounds, analogous to ammonia.

Indeed, there is every reason to believe that ammonia itself is not a binary compound of nitrogen and hydrogen, but is really composed of amide and hydrogen. We shall return to amide under organic chemistry, to which its most important compounds belong.

4. *Chlorine.*

Symbol Cl. Equivalent = 35·5.

Having considered, somewhat out of the natural order, the very important elements hydrogen and nitrogen, we now resume the arrangement we have adopted, and next to oxygen we find chlorine, which has many points of analogy with it, but at the same time forms part of a group in which a still more striking analogy prevails. We have entered into considerable detail in regard to the preceding elements, a knowledge of which is essential to the understanding of the principles of chemistry, and which are also of the highest practical importance; but our space will not permit us to describe so minutely the remaining elements, nor is it necessary to do so, since the laws already explained apply to all.

Chlorine is found in vast quantities, combined with sodium in sea and rock salt, a compound which is present in every natural water, more or less, and also in all plants and animals. A few other metals such as potassium, calcium, magnesium, lead, mercury, and silver, occur in combination with chlorine; the three first in sea-water, and chloride of potassium in the ashes of plants, and in the animal juices.

It is prepared by the action of hydrochloric acid on peroxide of manganese, or by that of sulphuric acid and chloride of sodium on the same oxide. The first process is—

Peroxide of Manganese.		Hydrochloric Acid.		Chloride of Manganese.		Water.		Chloride.
MnO_2	+	2 H Cl	=	Mn Cl	+	HO	+	Cl

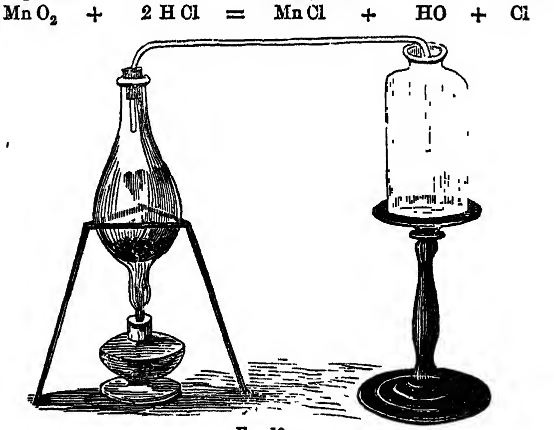


Fig. 19.

The second, which is the manufacturing process, is thus represented.

Peroxide of Manganese.		Chloride of Sodium.		Sulphuric Acid.		Sulphate of Soda.		Sulphate of Manganese.		Chlorine.
MnO_2	+	Na Cl	+	$2\,SO_3$	=	(NaO, SO_3)	+	(MnO, SO_3)	+	Cl

Chlorine is a greenish-yellow gas (hence its name), which may be collected over warm water, or by displacement, being heavier than air. It is absorbed both by cold water and by mercury. It has a very pungent and suffocating smell, and irritates the air passages dreadfully, unless much diluted. Its specific gravity is 2500. Under a pressure of about 4 at-

mospheres it is liquefied. Water absorbs several times its volume of the gas, acquiring its odour.

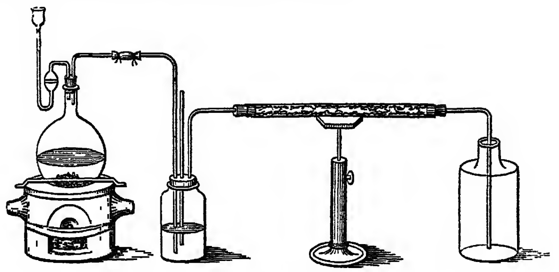


Fig. 20.

In chlorine gas, a candle burns with a feeble smoky flame, the hydrogen of the tallow alone combining with it, while the carbon is separated as smoke. A jet of hydrogen, when heated by a flame, readily burns in chlorine with a pale light, forming hydrochloric acid. Phosphorus, and most metals in a state of fine division, take fire spontaneously in chlorine, forming chlorides. Perhaps the most striking properties of chlorine are those of bleaching vegetable colours, and of destroying fetid or noxious effluvia. These effects it produces apparently by its attraction for the hydrogen, which is present in all such bodies. Chlorine is remarkable for the strength of its attractions for the more positive elements, such as hydrogen and the metals. With hydrogen it forms an acid, with oxygen several acids, with metals it forms salts.

Chlorine is much used for bleaching, and for disinfecting. Much diluted with air, it is also used with advantage for inhalation in pulmonary affections. Many of its compounds, such as hydrochloric acid, and chloride of sodium or sea-salt, are of great utility and value. In describing its compounds with the preceding elements, we shall take that with hydrogen first, as the most important.

Chlorine and Hydrogen.

Hydrochloric Acid. $H\,Cl_s = 36\cdot5$.

Chlorine and hydrogen gases, when mixed, do not combine till exposed to the sun's rays, when they combine with explosion; or to diffused light, when the combination takes place more slowly; or when a flame is introduced or the electric spark passed through them, in both which cases explosion ensues, hydrochloric acid being formed.

The acid is best prepared by the action of oil of vitriol (sulphuric acid), aided by heat, on sea-salt, which is as follows:—

	Sea Salt.		Sulphuric Acid.		Sulphate of Soda.		Hydrochloric Acid.
	$NaCl$	+	HO, SO_3	=	NaO, SO_3	+	HCl
or	$NaCl$	+	H, SO_4	=	Na, SO_4	+	HCl

It is a colourless transparent gas, of a pungent and suffocating acid smell, and very sour burning taste, forming gray fumes with the moisture of the air. It has an intense attraction for water, which instantly absorbs it, and must be collected over mercury, or by displacement. It is rather heavier than air, being formed of

1 vol. chlorine,	weighing	2500
1 vol. hydrogen,	...	69·4
which yield 2 vols. hydrochloric acid,	. .	2569·4
So that 1 vol. of hydrochloric acid must weigh		1284·7

This acid, like all similar ones, forms thick white vapours with ammonia. These vapours in this case are solid particles of sal-ammoniac or chloride of ammonium, and are soon deposited as a powder.

Hydrochloric acid gas is absorbed by water, which takes up if kept cool about 500 times its volume of the gas, increasing considerably in bulk and also in density. The saturated solution has the specific gravity 1210, fumes strongly, and is corrosive. This solution is the form in which the acid is chiefly used, and is best made by heating 1 eq. of salt, with 2 eqs. of oil of vitriol, previously diluted with rather less than half its bulk of water. The gas is conducted by a bent tube into a bottle containing cold water, which is kept cool, the tube just dipping below the surface. However rapid the current of gas, not a particle escapes, if the water be kept cool, till it is saturated. The water becoming heavier as it absorbs the gas, descends, lighter particles taking its place, and thus a constant mixture is effected without external agitation.

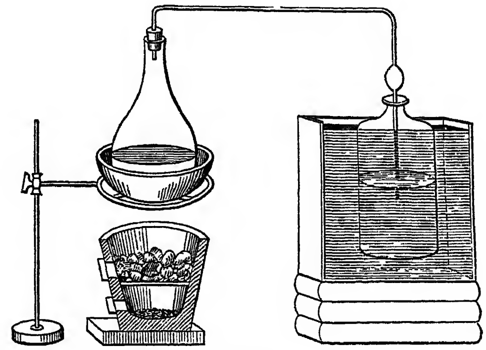


Fig. 21.

This aqueous solution of the acid, commonly called liquid hydrochloric acid, is a most valuable solvent for mineral substances. It converts metals and metallic oxides into chlorides, most of which are soluble in water. If M be any metal, and MO any metallic oxide, then we have

$$M + HCl = MCl + H, \text{ and } MO + HCl = HO + MCl.$$

The only insoluble chlorides are those of silver and mercury (protochloride).

Both in itself, and in its action on metals, and on their oxides, hydrochloric acid is the type of acids in general. For, as we have already explained under hydrogen, sulphuric acid and other oxygen acids may be viewed as compounds of hydrogen with compound radicals, instead of being regarded as consisting of anhydrous or dry acids and water. Let X stand for any acid radical or salt radical, simple or compound, M for any metal, H for hydrogen; we then have the following general formulæ, examples of which are placed below each:—

General Formulæ.	Acid.	Salt.
	HX	MX
Radical chlorine, Cl	HCl	MCl
Radical of sulphuric acid, $SO_4 = Su$	HSu	MSu
Radical of nitric acid, $NO_6 = Nt$	HNt	MNt
Radical cyanogen, $C_2N = Cy$	HCy	MCy

We shall see that there are several other acids with simple radicals, analogous to hydrochloric acid. At present, our object is to show that hydrochloric acid is the type also of those acids which contain compound radicals, when viewed in this manner, and that chlorides of metals are the types of the salts of those acids, in point of constitution, just as sea-salt, (chloride of sodium), is the type of all salts in reference to properties.

Hydrochloric acid gas has been liquefied by high pressure and cold combined.

Chlorine and Oxygen.

Chlorine has no very strong affinity for oxygen, but can be made to combine with it indirectly, forming several compounds, which are remarkable in general for being easily decomposed, often with explosion, on account of the feeble attraction between these elements. These compounds are difficult to study, for this reason, and are not fully understood. We shall therefore notice them briefly, only dwelling a little on the most important. They form two well

marked groups, both acid; but those of the second group are the more permanent.

1st Group.—Bleaching and explosive compounds.

These seem to be three in number, namely, 1. Hypochlorous acid, ClO; 2. Chlorous acid, ClO_3; and, 3. Hypochloric acid, CO_4. They are all either gaseous, or extremely volatile liquids, all of a much deeper yellow colour than chlorine; all explode on very slight causes, separating into chlorine and oxygen; and all possess bleaching properties, due probably to the easy separation of the chlorine they contain. They are only to be obtained by indirect processes, such as the action of chlorine on peroxide of mercury, that of hydrochloric acid on chlorate of potash, and that of sulphuric acid on the same salt. They are very dangerous, exploding with violence on the approach of a flame, often from a very slight rise of temperature, or even from the pressure of an inch or two of mercury. They seem to form among themselves compounds of similar properties, some of which compounds have been described as chlorochlorous and chloroperchloric acids. But their composition is still rather doubtful, from the extraordinary similarity of properties in all. Only one of them is practically important, and that one, hypochlorous acid, only in the form of a somewhat complex substance, containing one of its salts, namely, the bleaching powder, or chloride of lime, as it is inaccurately called. As the formation of this compound is connected with that of chloric acid, we shall describe both processes together.

2d Group.—Colourless, permanent, strongly acid compounds.

These are two in number, namely, 4. Chloric acid, $Cl\,O_5$; and, 5. Perchloric acid, $Cl\,O_7$.

Chloric acid, $Cl\,O_5 = 75{\cdot}5$, is chiefly important and useful in the form of chlorate of potash, which is prepared as follows:—A current of chlorine gas is passed through water, in which slaked lime is suspended until the lime is entirely dissolved. In this first stage of the process, there is formed the bleaching liquor, or solution of bleaching powder. The powder is made by placing dry slaked lime in contact with chlorine gas till it refuses to absorb any more. The bleaching powder of commerce, thus prepared, contains a good deal of unaltered lime, which is left undissolved when it is acted on by water. The solution of bleaching powder thus made is the same as the bleaching liquor prepared by passing chlorine through a mixture of lime and water.

The change, in the formation of the bleaching compound, is as follows:—

$$\underset{\text{Hydrate of Lime.}}{2\,CaO,HO} + \underset{\text{Chlorine.}}{Cl_2} = \overbrace{\underset{\text{Hypochlorite of Lime.}}{(CaO,\,ClO)} + \underset{\text{Chloride of Calcium.}}{CaCl}}^{\text{Bleaching compound.}} + \underset{\text{Water.}}{2\,HO}$$

The bleaching compound is thus a sort of double salt, formed of hypochlorite of lime and chloride of calcium, and contains the elements of 2 eqs. lime and 2 eqs. chlorine; hence the common name of chloride of lime.

This substance only bleaches in contact with acids. When it seems to do so alone, which it does very slowly, it is from the action of the carbonic acid of the air on it. The stronger acids at once disengage the whole 2 eqs. of chlorine, hence the very powerful bleaching action. The change is as follows, with sulphuric acid:—

$$\underset{\text{Bleaching Powder.}}{(CaO,\,ClO) + CaCl} + \underset{\text{Sulphuric Acid.}}{2\,SO_3} = \underset{\text{Sulphate of Lime.}}{2\,(CaO,\,SO_3)} + \underset{\text{Chlorine.}}{Cl_2}$$

Now, from the bleaching solution we can prepare chlorate of lime, and from that chlorate of potash. For, when the bleaching liquor is boiled, it loses its bleaching powers, and the following change takes place:—

$$\underset{\text{Bleaching Powder.}}{3\,[(CaO,\,ClO) + CaCl =]} \underset{\text{Chlorate of Lime}}{(CaO,\,ClO_5)} + \underset{\text{Chloride of Calcium.}}{3\,CaCl}$$

If now we add to the solution 1 eq. of chloride of potassium, and evaporate, chlorate of potash crystallizes, and only chloride of calcium remains dissolved.

$$\underset{\text{Chlorate of Lime.}}{(CaO,\,ClO_5)} + \underset{\text{Chloride of Calcium.}}{5\,CaCl} + \underset{\text{Chloride of Potassium.}}{KCl} = \underset{\text{Chlorate of Potash.}}{(KO,\,ClO_5)} + \underset{\text{Chloride of Calcium.}}{6\,CaCl}$$

In practice, the chloride of potassium is added to the bleaching solution before boiling it, when the object is to obtain chlorate of potash. This salt, being sparingly soluble in cold water, crystallizes readily when the solution is boiled down to a certain point, leaving in solution the very soluble chloride of calcium.

From chlorate of potash, chloric acid may be obtained by distillation with sulphuric acid, but when concentrated, a part is decomposed by the heat. The addition of a little water prevents this, and we obtain a solution of chloric acid nearly pure. When free from water, it forms crystals. Its solution is colourless and strongly acid, oxidizing organic matter, and forming with ammonia a dangerously explosive salt. It is only used in the form of chlorate of potash prepared as above. This salt, when heated, gives off all its oxygen quietly, as explained under oxygen. But when mixed with combustible matter, such as sulphur, phosphorus, charcoal, or sugar, the mixture deflagrates or explodes by the contact of a spark, by friction and percussion, and in the case of charcoal even spontaneously, so that it is too dangerous to be employed for gunpowder. But when duly mixed with sulphur or phosphorus, gum and water, with the addition of a little charcoal, the mixture is extensively used for lucifer matches, exploding and setting fire to the sulphur on the match, by friction on any hard body. A mixture of chlorate of potash with sugar takes fire on being touched with sulphuric acid, which, acting on the chlorate, produces hypochloric acid, and this at once sets fire to the sugar.

Perchloric acid, $Cl\,O_7 = 91{\cdot}5$, is easily obtained, in combination with potash, by heating the chlorate of potash till $\frac{1}{3}$d only of its oxygen is expelled, which is known by the melted salt becoming quite thick and pasty, and requiring a stronger heat to expel the remaining $\frac{2}{3}$ds of the oxygen. The cooled mass consists of perchlorate of potash and chloride of potassium; thus—

$$\underset{\text{Chlorate of Potash.}}{2\,(KO,\,ClO_5)} = \underset{\text{Perchlorate of Potash.}}{(KO,\,ClO_7)} + \underset{\text{Chloride of Potassium.}}{KCl} + \underset{\text{Oxygen.}}{O_4}$$

It is dissolved in the smallest possible quantity of boiling water, and on cooling the very sparingly soluble perchlorate of potash crystallizes. This salt distilled with sulphuric acid and a little water, yields a solution of perchloric acid; the acid when dry forms crystals. Perchloric acid is colourless and strongly acid. It produces in all solutions of potash a very sparingly soluble precipitate of perchlorate of potash, quite insoluble in weak alcohol. Hence the acid is used to distinguish and to separate potash from soda, the perchlorate of soda being very soluble even in alcohol.

Perchlorate of potash explodes feebly with combustible matter on heat being applied. It is not easy to see how an acid containing 7 eqs. of oxygen should be less disposed to yield oxygen to combustible matter than one with 5 eqs. only. But there is evidently something in the constitution of the molecule which renders it more permanent than that of chloric acid, which itself is far more permanent than those of hypochloric, chlorous, and hypochlorous acids.

Chlorine and Nitrogen.

When chlorine gas is placed in contact with a warm solution of chloride of ammonium (sal-ammoniac), it is absorbed, and oily drops are formed, which sink through the liquid. These are frightfully explosive, especially on simple contact with greasy, oily, or combustible substances. This explosive compound has been described as a compound of nitrogen with chlorine, $N\,Cl_4$, or, according to some, $N\,Cl_3$. But very recent researches have shown that this is not the case, and

that this compound contains also hydrogen. We do not therefore, at present, know any compound of these elements.

5. *Bromine.*

Symbol Br. Equivalent = 80.

Bromine stands unquestionably next to chlorine, and is so very analogous to it, that a very brief notice will suffice. It is found united to sodium, potassium, or magnesium, in very small proportion, in sea-water, and in saline springs. Those of Kreuznach are comparatively rich in bromides, as is also the water of the Dead Sea, which is simply a concentrated sea-water.

It is obtained from the mother liquor or bittern which remains after salt-water has been evaporated to yield crystals of salt, and refuses to yield any more. This liquid contains much of the chlorides of potassium, calcium, magnesium, and a small proportion of some bromide or bromides. If we pass through it a current of chlorine, or, what is the same thing, add to it a little sulphuric acid and peroxide of manganese, which, with the chlorides, produce free chlorine;

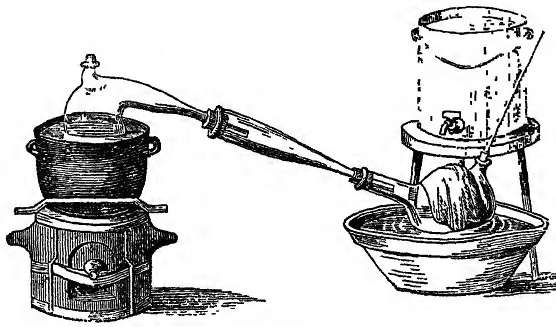


Fig. 22.

the chlorine displaces the bromine, which, being set free, colours the liquid of a strong orange-yellow. Heat is applied, and the vapour of water, distilling over, carries with it the vapour of bromine, which collects in the receiver, partly as heavy drops of a deep red colour, which are pure bromine, partly as an aqueous solution of bromine of an orange colour, which floats above. Excess of chlorine must be avoided, as it combines with the bromine, forming a chloride of bromine. If the aqueous solution be shaken with a little ether, the ether dissolves the bromine and rises to the surface, of a deep red colour. This is added to the nearly pure bromine collected below, and the whole is then mixed with as much solution of caustic potash as entirely destroys the colour, by which the bromine is converted into two salts, bromate of potash and bromide of potassium. (Chlorine with potash undergoes a similar change, and chlorate of potash was formerly thus prepared.) The change is represented as follows:—

Bromine.		Potash.		Bromate of Potash.		Bromide of Potassium.
Br_6	+	6 KO	=	KO, Br O_5	+	5 K Br

The solution is dried up and ignited, which expels the oxygen of the bromate, converting it also into bromide; so that we have (KO, Br O_5) + 5 K Br = 6 K Br + O_6. Lastly, the bromide of potassium is heated with sulphuric acid, a little water, and peroxide of manganese, when pure bromine passes over, with some water. The greater part of the bromine collects below an aqueous solution of a small part of it, and may be withdrawn by a pipette.

Bromine is a heavy dark red volatile liquid, of a most pungent odour, strongly affecting the mucous membrane of the nose and eyes, and producing a profuse catarrhal discharge. Its vapour must be carefully avoided. It is named, indeed, from its strong smell. Its vapour or gas is of the same red colour as that of nitrous acid, and very dense, its specific gravity being about 5500, rather more than twice as heavy as chlorine gas. Bromine is very poisonous; a drop placed on the beak of a small bird soon proving fatal. It has feeble bleaching properties compared to chlorine.

Bromine is in all its relations so perfectly analogous to chlorine, that it is unnecessary to go into detail. What is true of chlorine is true of bromine, with regard to the other elements, in all cases where bromine combines with them. The chief difference is, that its equivalent is higher, and its affinities weaker, than those of chlorine, which displaces it from all its compounds.

With hydrogen it forms hydrobromic acid, H Br_6; equivalent = 81; perfectly analogous to hydrochloric acid, but much more dense. It is absorbed by water with even greater energy.

With oxygen it forms bromic and perbromic acids, analogous in composition and properties to chloric and perchloric acids. Bleaching oxides or acids of bromine are not yet known.

To bromine and nitrogen the same remarks apply as to chlorine and nitrogen. The compounds of bromine with metals are so like those of chlorine, that they are hardly distinguishable from them.

Bromine will probably be found useful in medicine. At present its chief use is, with chlorine and iodine, in photography. It contributes to the formation of the most sensitive surfaces.

6. *Iodine.*

Symbol I. Equivalent = 127.

This element is the third of the remarkable group, of which the two other members have just been described. It is found in the ashes of marine plants, which form kelp, varec, and barilla. It is, no doubt, derived by the plants from the sea-water; but its proportion in that water is so small as hardly to admit of being detected directly. It is also found in the ashes of many land plants, especially such as grow near the sea; in some salt springs in small proportion, and in a few rare minerals.

It is obtained from kelp, after all the crystallizable salts have been separated by evaporation. The residual or mother liquid contains the iodide of sodium, potassium, or magnesium, mixed with chlorides, sulphurets, and sulphites, as well as various other impurities. It is extracted by adding first an excess of sulphuric acid, which disengages a vast amount of gases, hydrosulphuric and sulphurous acids, and causes a copious deposition of sulphur. On cooling, sulphates of soda, potash, and magnesia, are deposited, and the liquid, poured off from these, is heated with peroxide of manganese as long as purple vapours of iodine come off. In another method the iodine is precipitated as subiodide of copper, Cu_2 I, which is afterwards decomposed by sulphuric acid and peroxide of manganese. The vapours of iodine condense into crystals in the receiver, along with some water.

Iodine is a black solid, crystalline, very brittle, of a quasi-metallic lustre, and volatile. When dry it is converted into vapour, without melting, at 320° nearly; but if water be present the iodine passes rapidly over at 212°. Its vapour is of a fine purple or violet colour, hence the name, and is very heavy, being nearly 9 times denser than air. Heated under pressure, iodine melts to a brown liquid. It is almost insoluble in water, 1 part requiring 7000 of cold water to dissolve it; but even this colours the water brown. It is very soluble in alcohol, ether, and similar liquids. Iodine hardly possesses bleaching properties. It stains organic matter deep yellow, and corrodes it (for example, paper) rapidly. Its distinguishing character is that of striking, with a cold infusion of starch or with starch paste, a deep blue. The blue substance seems not to be a definite compound, but to consist of starch, with minute particles of iodine mechanically diffused through and adhering to it. The violet-blue colour seems to be that of finely-divided iodine, as is seen in its vapour. Heat destroys the colour of the iodide

of starch. This character distinguishes iodine from bromine, which colours starch brown.

Iodine is entirely analogous to chlorine and bromine; the three bodies forming a group in which bromine stands in every point, in form, density of vapour, strength of affinity, and atomic weight, precisely between chlorine and iodine. As bromine is perfectly analogous to chlorine in its compounds, so iodine is analogous to bromine.

With hydrogen it forms hydriodic acid, HI, which is so similar to hydrochloric and hydrobromic acids, that it cannot be distinguished from them, except by proving that it contains iodine. It is a colourless acid gas absorbed to a prodigious extent by water, forming gray fumes in moist air, and white fumes with ammonia. To obtain it, iodine is first placed in contact with phosphorus, in a tube filled with carbonic acid gas, to exclude oxygen. The two bodies combine with a flash of light, forming, according to the preparations used, either the teriodide of phosphorus, PI_3, or the periodide, PI_5. When cold, water is added, a conducting-tube adapted, and heat applied. The action is as follows, taking the periodide; but it is the same, *mutatis mutandis*, for the other:—

Periodide of Phosphorus.		Water.		Phosphoric Acid.		Hydriodic Acid.
PI_5	+	5 HO	=	PO_5	+	5 HI

The action of hydriodic acid on metals and on metallic oxides is exactly analogous to hydrochloric or hydrobromic acid. An iodide of the metal is formed; and in the one case hydrogen is liberated, in the other water is produced. The iodides of some metals have fine colours. Iodide of lead is bright yellow; periodide of mercury is of a bright scarlet.

With oxygen iodine is not known to form any bleaching compounds, but it forms iodic acid, IO_5, and periodic acid, IO_7, corresponding to chloric and perchloric acids. Iodate of potash is formed, along with iodide of potassium, when iodine is acted on by caustic potash, precisely as in the case of bromine and chlorine, $I_6 + 6\,KO = KO, IO_5 + 5\,KI$. The mixed salts being dried, alcohol dissolves the iodide, leaving the iodate, from which iodic acid may be obtained if required. Iodine may also be oxidized into iodic acid by boiling with the strongest nitric acid. Iodic acid is a crystalline solid, very soluble and very acid. Periodic acid is formed by a circuitous, indirect process. It is not applied to any use.

The compound, an explosive black powder, hitherto called iodide of nitrogen, appears from recent researches to have a different composition.

Iodine combines both with chlorine and bromine. With chlorine it forms several compounds, one of which is so like bromine, that when bromine was accidentally obtained by Liebig from the water of Kreuznach, which contains both chlorine and iodine, he took it for chloride of iodine, and thus missed the discovery of bromine, which was soon after made by Balard. The supposed chloride was then found to be pure bromine.

The compounds of chlorine both with bromine and iodine, as well as those of bromine and iodine, have nearly intermediate characters, and are not very precisely known. They are all more or less used in photography.

The iodides of metals, as well as the bromides, are entirely analogous to the chlorides, but are, those of iodine more particularly, less soluble in water.

Iodine is much used in medicine, both as iodine in tincture and ointment, and in the form of iodides, such as those of potassium, iron, zinc, lead, and mercury.

The extraordinary analogy between the three elements just considered seems to indicate something common to all three. But if they contain a common element, they must be really compounds, for their differences must depend on something peculiar to each. It is worthy of notice that the relation between them as to physical properties, affinity, and atomic weight, is precisely that between three contiguous members of what is called in organic chemistry a series of homologous compounds. Thus methylic alcohol, ethylic alcohol, and propylic alcohol, form a precisely parallel group. Now, the first of these is converted into the second by the addition of $C_2\,H_2$, and the second into the third in the same way:—

Methylic alcohol, ...	$C_2\,H_4\,O_2 + C_2\,H_2$
Ethylic alcohol, ...	$C_4\,H_6\,O_2 + C_2\,H_2$
Propylic alcohol, ...	$C_6\,H_8\,O_2$ &c &c

It is therefore quite conceivable that there may be a similar relation between chlorine and bromine, bromine and iodine. But as to what is here the common difference, corresponding to $C_2\,H_2$ in the other case, we can say nothing. We can only point out the probability that such a relation exists, and leave the question to be decided by research, when our means of research shall have been improved; for hitherto all our efforts to convert chlorine into bromine, or bromine into iodine, and *vice versa*, have failed.

7. *Fluorine.*

Symbol F. Equivalent = 18·9.

This element is not yet known in a separate form; but from the character of all its compounds, it is obviously very analogous to the three preceding elements. The reason why we have not yet obtained it uncombined is, that its affinities are so powerful, that it corrodes all vessels in which the attempt has been made. It has been suggested that it might be isolated in vessels of fluor-spar; but no distinct results have yet been obtained. According to some it is a yellow gas like chlorine; but there is reason to think that chlorine was at all events mixed with the supposed fluorine.

Fluorine is found in nature combined with calcium as fluor or Derbyshire spar, and occurs also in small proportions in mica, topaz, cryolite, and a few other minerals. Fluoride of calcium, or fluor-spar, is also an essential ingredient, in small proportion, of bones, and is to be detected almost everywhere, in rocks, soils, springs, the sea, the ashes of plants, and the animal fluids, but in very minute quantity.

With hydrogen, fluorine forms its most important compound, hydrofluoric acid (often called fluoric acid), HF, = 19·9. This acid is obtained by distilling fluor-spar with sulphuric acid in vessels of lead, silver, gold, or platinum, for it corrodes glass and porcelain. The change is as follows:—

Fluoride of Calcium.		Sulphuric Acid.		Sulphate of Lime.		Hydrofluoric Acid.
Ca F	+	HO, SO_3	=	$Ca\,O, SO_3$	+	HF

It forms a very volatile, fuming, and frightfully corrosive liquid, which produces intense heat when mixed with water; and a drop of which falling on the skin produces, even when instantly washed away, a very painful sore, which is extremely difficult to heal. The hands should be protected even against the vapour, for it penetrates under the nails, producing there sores which, from their confined position, cause intolerable pain.

It is in its relations very analogous to hydrochloric acid, &c., acting on metals and metallic oxides in the same way, and forming fluorides very similar to the chlorides. Its distinguishing character is its power of corroding glass and all silicious compounds, in virtue of the strong affinity of fluorine for silicon, with which it forms a gaseous compound. This property is not only applied to etching on glass, but to the detection of minute traces of fluorine or fluorides. The substance suspected to contain it, whether an ash, a mineral, the residue of any water, or the deposit from sea-water when boiled, is placed in a platinum vessel with pure sulphuric acid. A plate of glass is covered with melted wax, and when cold, marks are traced in the wax with a sharp point, which exposes the glass under these

marks. The plate is then laid over the vessel with the materials, to which a very gentle heat is applied. The vapour of hydrofluoric acid, if a fluoride be present, rises and acts on the exposed lines. After a certain time, longer in proportion as the amount of fluorine is smaller, the wax is removed, and the lines are found indelibly etched on the glass.

The only use to which hydrofluoric acid is applied is that of etching on glass, and dissolving silicious minerals for analysis, by which means the whole silica is dissipated as gas, and the other elements remain. The presence of fluoride of calcium in bones is probably connected with their hardness and toughness. It is conjectured that the presence of the fluoride prevents the phosphate of lime from crystallizing, as it has a strong tendency to do, and thereby becoming brittle. Fossil bones and coprolites, rich in bone earth, invariably contain a small amount of fluoride of calcium. It has been said that the proportion is greater in fossil than in recent bones; but it seems rather that, from the absence of animal matter, it is more readily detected in the former.

No compounds are yet known of fluorine with oxygen, nitrogen, chlorine, bromine, or iodine. Its affinities are so very powerful for the positive elements, that it is probable it may prove to be more highly negative than oxygen, which would account for its exhibiting little or no attraction for that element.

(B.) POSITIVE OR COMBUSTIBLE METALLOIDS.

8. *Carbon.*

Symbol C. Equivalent = 6.

This most important element occurs in nature in several forms, more or less pure. Crystallized, it is found in two allotropic forms; one transparent, hard, and colourless, is the diamond, the other black and soft, is plumbago or black lead, or graphite, the crystalline form of which is quite different. A third, amorphous form, is found in anthracite or blind coal. It occurs also, combined with oxygen, as carbonic acid gas, in the atmosphere, in waters, in the chokedamp of mines, in volcanic districts; and the same acid, combined with lime, forms marble, limestone, chalk, shells, calcareous deposits, and calcareous or Iceland spar. Other carbonates occur in the mineral kingdom, such as those of magnesia, iron, lead, copper, &c. Carbon is the chief ingredient of all animal and vegetable substances; also of coal, which is vegetable matter in an altered state, and of peat, lignite, brown-coal, wood-coal, jet, asphalt, bitumen, &c., all of which have a similar origin.

Pure carbon, in the form of diamond, which forms octahedral crystals, is distinguished by its extreme hardness and by its action on light, giving it the fine play of colours for which it is valued. Graphite occurs in micaceous scales, which are short prismatic crystals. It is black and opaque, with somewhat of a metallic lustre. Anthracite has no regular form, and is dull, black, and opaque. So also are wood, charcoal, and lamp-black; the latter being pure carbon from oils or resins, the former, like anthracite, containing, as ashes, the mineral elements of the plants which yielded them. In all its forms it is a bad conductor of heat, but when dense and compact it conducts electricity. It is totally infusible by any heat we can produce. When heated to redness in air or oxygen, it burns without flame, frequently with sparks, forming carbonic acid gas. Diamond can easily be burned in oxygen, or even in air, by the heat of a glass-house furnace. No liquid is yet known which can dissolve carbon as such.

Carbon has the power of attracting, in a manner somewhat obscure, both gaseous and dissolved matters, and collecting them in its pores. Thus it absorbs large quantities of most gases; and when introduced into a liquid, generally removes from it any organic colouring matter that may be present, and very frequently saline substances also. It absorbs and renders innocuous all offensive effluvia. Animal charcoal has the greatest power in this way, either because it is more porous, or because it contains nitrogen, and is not in fact pure carbon.

Carbon and Oxygen.

1. *Carbonic Oxide,* $CO = 14$.

This is a gas formed when carbon burns with an insufficient supply of oxygen, or when carbonic acid gas, CO_2 is passed over red-hot charcoal. It may be formed also by heating with excess of sulphuric acid, oxalic acid and its salts, formic acid and its salts, or ferrocyanide of potassium. When oxalic acid is employed, it is resolved into equal volumes of carbonic acid and carbonic oxide, while water combines with the sulphuric acid; thus—

Oxalic Acid.		Sulphuric Acid.		Diluted Sulphuric Acid.		Carbonic Oxide.		Carbonic Acid
$C_2O_3, 3HO$	+	SO_3, HO	=	$SO_3, 4HO$	+	CO	+	CO_2

Formic acid consists of $C_2H_2O_4$, or C_2HO_3, HO; and yields precisely in the same way water and pure carbonic oxide gas. $C_2H_2O_4 = 2HO + 2CO$. The ferrocyanide of potassium first yields hydrocyanic acid, which, by the action of mere sulphuric acid reacts on water, producing formic acid and ammonia, and the formic acid is decomposed as above. When mixed with carbonic acid, the gas is purified by means of lime or potash, which absorb the carbonic acid, leaving the carbonic oxide. It is collected over water.

It is a colourless gas of specific gravity 972·1, without taste or smell, which, when heated in air, takes fire and burns with a pure blue lambent flame, being oxidized into carbonic acid. In every large coal fire, the air entering below forms carbonic acid, which, passing through the deep mass of red-hot charcoal, is converted into carbonic oxide, thus, $CO_2 + C = 2CO$. The carbonic oxide rising to the surface, there burns with its peculiar blue flame, as may be seen in every large fire after it has burned so far that no more gas issues from the coal, and the whole is in a red glow. The blue flame is supposed to indicate frost, but it is evident that it indicates simply a large red-hot fire, which, of course, is more frequent in frosty weather than in summer.

This gas occurs in mines, along with carbonic acid and carburetted hydrogen. It is poisonous when inhaled.

Carbonic oxide, or a substance polymeric with it, seems to exist in some organic compounds as a radical. It is not applied to any use, although it has a share in the reduction of metal, such as iron, being formed in large quantity in the deep smelting furnaces, and having, from its tendency to take up an additional eq. of oxygen, a considerable deoxidizing power.

2. *Carbonic Acid,* $CO_2 = 22$.

This is a much more important compound. It is a gas which occurs abundantly in nature, as has been stated under carbon, both free and combined with lime and other bases. It is also abundantly formed in various natural and artificial processes, in the respiration of animals, in the decay of dead organic matters, in fermentation, and in combustion. It is from these sources principally that the carbonic acid of the atmosphere, so essential to vegetation, is supplied; and it is consumed by plants as fast as it can be produced, since its amount never exceeds, in free air, about $\frac{1}{1000}$th of the bulk or volume of the air.

To obtain it pure, carbonate of lime, that is, marble limestone or chalk, is acted on by diluted hydrochloric acid. The action is very simple. $CaO, CO_2 + HCl = CaCl + HO + CO_2$. Chloride of calcium and water are left, while carbonic acid gas passes off and is collected over water, which absorbs a certain amount of it, but not so much as to

 prevent us from thus collecting it. It must not, however, be left to stand over water, or it will be absorbed.

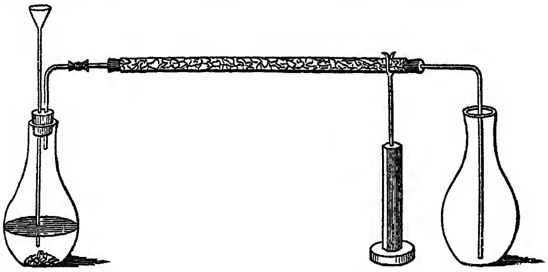


Fig. 23.

It is colourless and transparent, has a sharp acidulous taste, and a certain pungency of smell, or rather a peculiar action on the organs of respiration, and not a true odour. It extinguishes all burning bodies, and is equally fatal to animal life, being poisonous even when diluted with air, and not merely negatively injurious like nitrogen. It is distinguished from all other gases by its rendering lime-water milky from the formation of the insoluble carbonate of lime. It is a heavy gas, its specific gravity being 1527·7. We do not know the volume of the carbon in it in the state of gas, but we know that it contains its own volume of oxygen, and that the whole weight of the carbon is added to that of the oxygen in the same volume. So that we have—

One volume oxygen, specific gravity.................	1111 1
Carbon, volume uncertain, weighing	416·6
One volume carbonic acid, specific gravity.........	1527·7

If the carbon united to 1 volume of oxygen be, as gas, equal in volume to the oxygen, then 1 volume of gaseous carbon must weigh 416·6, when 1 of oxygen weighs 1111·1, and its specific gravity would be 416·6. But this would imply that the 2 volumes of the elements were condensed into 1 volume of the compound, of which we have no example. If, on the other hand, carbonic acid be formed of 2 volumes of oxygen and 1 volume of gaseous carbon, the 3 volumes condensed into 2, which is a very common occurrence, as in water, protoxide of nitrogen, &c., then the 416·6 will represent the weight only of half a volume of carbon, and the weight of an entire volume, or the specific gravity, will be 416·6 × 2, or 833·2. This latter view of the specific gravity of gaseous carbon, which cannot be directly determined, is considered the most probable. On the same supposition carbonic oxide will be formed of 1 volume of gaseous carbon and 1 volume of oxygen, united without condensation, or so as to form 2 volumes of the compound, which is also a very common occurrence, as in hydrochloric acid, &c. We have mentioned this here, to explain how chemists calculate the probable density, in the gaseous form of a substance, such as carbon, which is not known in that form, except in compounds.

From its weight, carbonic acid gas may be poured out of one vessel into another, like water; and if a lighted candle be first placed in the lower vessel, it will be quickly extinguished, as the invisible gas flows down to it. The gas may even be poured in the open air so as to fall in a narrow stream on the candle and extinguish it. For the same reason this poisonous gas is apt to accumulate in deep pits, wells, or mines, where it is very dangerous. A candle let down first will indicate, according as it burns brightly or dimly, or is extinguished, the purity or impurity of the air in such places, before any one descends; and this precaution should never be neglected. The gas often accumulates in the huge vats of the brewers, and has frequently caused fatal accidents there as well as in mines or pits. It is the choke-damp of miners.

Carbonic acid is liquefied by a pressure of 36 to 40 atmospheres, according as the temperature varies from 32° to about 60°. The condensed acid is very dangerous, having often, by its enormous pressure, burst very strong vessels and caused fatal results. It is best condensed by being forced by means of a very powerful forcing pump into a strong copper vessel, which, if it should at any time give way, tears instead of bursting. When allowed to escape through a small aperture, it assumes the gaseous form with almost explosive force, but is manageable, and if the current be made to circulate through a brass box, the evaporation of part produces a cold so intense as to solidify the rest. The solid acid is exactly like snow, and evaporates much more slowly than the liquid. But if mixed with ether, the mixture evaporates so rapidly, that by its means several pounds of mercury may be frozen hard in a minute or two. The liquid acid expands by heat to a remarkable degree.

Carbonic acid gas is absorbed by water to a small extent under the ordinary pressure, but under an increased pressure the quantity absorbed increases in proportion to the pressure; the water always absorbing about its own volume, whatever the pressure, but the gas being of course more and more condensed as the pressure increases. The solution sparkles, and has a pleasant acidulous taste, as observed in many mineral waters. The addition of a little carbonate of soda (or potash) causes water to absorb much more, and when this is combined with high pressure, a very large quantity is taken up, which escapes on the pressure being removed. This is the nature of soda water. Champagne is wine bottled before the fermentation is complete, and therefore charged with carbonic acid under pressure of the gas itself, which escapes with violence when the cork is drawn. All effervescing wines or other beverages are in the same way more or less charged with carbonic acid.

The solution of carbonic acid in pure water, or in water containing a little potash or soda, under the ordinary or a slightly increased pressure, occurs as a mineral water in many springs, especially in volcanic districts, even in such as, like Auvergne and the Eifel, have not been the scene of active volcanic action since the appearance of man on the earth. In the Eifel the soil is everywhere impregnated with the gas, which of course appears in all the springs. The Grotta del Cane, near Vesuvius, is a cave containing a small lake or pool, through which carbonic acid constantly bubbles, and from its weight remains near the floor of the cave, so that a dog, whose head is near the ground, falls down insensible, while men, whose heads are in pure air, perceive no effect. The animal recovers, if at once removed into pure air and thrown into the lake outside. This mode of applying the cold affusion is effectual in causing instinctive inhalations of pure air, and indicates the dashing of cold water on the face and chest of those poisoned by the gas as one of the most efficient remedies.

The solution of the gas in water reddens vegetable blues like other acids; but on standing, or after boiling, the blue colour returns, the acid being dissipated. This serves to distinguish carbonic acid from most other acids.

The same solution added to lime water renders it milky, by forming insoluble carbonate of lime, CaO, CO_2. But the addition of more carbonic acid clears all up again, forming the soluble bicarbonate, $CaO, 2\ CO_2$. Such a solution containing carbonate or bicarbonate of lime, dissolved in excess of carbonic acid, is exceedingly common in all districts where limestone occurs. The amount of lime present varies very much, but even a few grains per gallon render the water very hard. Such, indeed, is the usual cause of hardness in water, although the presence of sulphate of lime or gypsum also contributes to it in many cases. The rain dissolves carbonic acid as it passes through the air, and more in filtering through the soil, and when it now meets with chalk or limestone it dissolves it and becomes hard. Some waters contain 10 grains of carbonate of lime in the gallon, others a good deal more; very hard waters frequently 70 or 80 grains, and in some cases so much as 150 grains

Chemistry. and upwards. Such waters are useless for the purposes of washing, and generally for culinary purposes, and above all unfit for steam-boilers; for they deposit, on being boiled, a crust of carbonate of lime which is most injurious, and is often the cause of explosions. It is singular that hard waters—not, however, the hardest, but such as that of the Thames, and some still harder near Edinburgh, where from the abundance of the carboniferous limestones they are very common—are the best for the purposes of the brewer of ale or porter. On the small scale the carbonate of lime in hard water of this kind may be separated by boiling, but this is impracticable on the large scale. Professor Clark's process consists in adding to the water as much lime, dissolved in water (lime water), as it already contains in the form of bicarbonate, and more if there be an excess of carbonic acid beyond this. The added lime converts the soluble bicarbonate into the insoluble neutral carbonate, which is thus explained, $CaO, 2\,CO_2 + CaO = 2\,(CaO, CO_2)$.

The chief use of carbonic acid is to form the principal part of the food of plants, which derive from it, and therefore from the atmosphere, the whole of the immense quantity of carbon they contain. The carbon of the animal world being derived directly or indirectly from plants, for carnivorous animals feed on such as feed on plants, is also derived from the same source; and the carbon of dead animals and vegetables again takes, in the process of decay, the form of carbonic acid, in which it becomes the food of a new generation of plants and animals. The other uses of carbonic acid, as a remedy and in various beverages, are familiar, and have been already mentioned. The salts of this acid are characterized by effervescing with strong acids.

Some other compounds are frequently described as compounds of carbon and oxygen, such as oxalic, acid, mellitic acid, &c. But in fact they all contain hydrogen also, and belong to organic chemistry.

Carbon and Hydrogen.

The compounds of these two elements are extremely numerous, far more so than those of any two elements whatever. Indeed there seems hardly any limit to their number. They are all of organic *origin*, and belong to organic chemistry, under which we shall describe them more particularly. Here we shall only say, that, being formed of two combustibles, they are all eminently combustible, and are used as combustibles. They occur in all forms, solid, liquid, and gaseous; and of all different proportions of the two elements. They form various series, some of which are homologous, others polymeric. In one homologous series, that of olefiant gas, the proportion is that of 1 eq. of each, but the absolute amount varies from C_2H_2 and C_4H_4, which are gaseous, to $C_{16}H_{16}$, &c., which is liquid, and to $C_{54}H_{54}$ and $C_{60}H_{60}$, which, with many others, are solid. In another exactly parallel series, that of marsh gas, the proportion is such that there are always 2 eqs. of hydrogen more than of carbon. It begins with C_2H_4, C_4H_6, and so on to $C_{10}H_{12}$, $C_{32}H_{34}$, $C_{60}H_{62}$, &c.; those low in the scale being gaseous, those higher liquid, and higher still solid. We find similar characters in the series of methyle and ethyle, in which the hydrogen always exceeds the carbon by 1 eq.; thus we have methyle C_2H_3, ethyle C_4H_5, amyle $C_{10}H_{11}$, cetyle $C_{32}H_{33}$, melissyle $C_{60}H_{61}$, &c. As an example of another kind of series of carbo-hydrogens, we may mention certain essential or volatile oils, such as oil of lemons C_5H_4, oil of turpentine $C_{10}H_8$, another oil $C_{20}H_{16}$, &c. All these matters belong to organic chemistry, and therefore we only indicate them very briefly, that the reader may see how very peculiar is the relation of carbon to hydrogen, which is evidently connected with the fitness of these elements to constitute organic, that is, animal and vegetable compounds. Coal gas, naphtha, paraffine, and many volatile oils, belong to this group of compounds, which therefore admits of many useful applications. The fire-damp or explosive gas of mines is a mixture of some gaseous carbo-hydrogens with air.

Carbon and Nitrogen.

These elements, under certain circumstances, combine to form a very remarkable and important compound, namely, Cyanogen, C_2N or Cy, which is a compound acid radical or salt radical, entirely analogous to chlorine in its chemical relations.

Cyanogen, $C_2N = Cy = 26$, is found, as hydrocyanic acid, in oil of bitter almonds; but as that is a product of fermentation, and is not present in the dry seeds, it is doubtful whether hydrocyanic acid exist ready formed in plants. But there must be some compound of cyanogen, which, when water is added to the bitter almonds, or to the kernels of stone fruit, produces hydrocyanic acid. As urea is formed from cyanic acid and ammonia, it is probable that the animal body also contains some compound of cyanogen.

It is formed artificially when organic matter containing nitrogen is exposed to heat in close vessels. But being gaseous, it is dissipated and lost, unless some means be taken to prevent this. If potash or carbonate of potash be added, cyanide of potassium is formed, and this salt is permanent at a red heat. When water is added, however, to the heated mass, consisting chiefly of animal charcoal and cyanide of potassium, that salt is decomposed, as follows: $K, C_2N + 5\,HO = KO, 2\,CO_2 + NH_3 + H_2$; that is, bicarbonate of potash is left, and ammonia and hydrogen are given off. To obtain cyanogen in a permanent form, there must be added, either before or with the water, iron, oxide of iron, or sulphuret of iron, all of which are dissolved by cyanide of potassium. Suppose iron to be used, then $3\,(K\,Cy) + Fe + HO = (2\,K\,Cy + Fe\,Cy) + KO + H$. With oxide of iron no hydrogen is given off; and with sulphuret of iron sulphuret of potassium, KS, is formed, instead of KO; but in all these cases the compound $2\,K\,Cy + Fe\,Cy = Cy_3\,K_2\,Fe$, which is ferrocyanide of potassium, is formed. On evaporation this salt forms large and fine yellow crystals, which are very permanent, and are manufactured on the large scale, and of great purity, being much used in dyeing and calico-printing.

This salt may be viewed either as a double salt, composed of 2 eqs. K Cy with 1 eq. Fe Cy, or, as is now generally admitted, as formed of the compound radical ferrocyanogen $Cy_3\,Fe = Cfy$, which, being bibasic, takes up 2 eqs. of potassium, forming the yellow salt, Cfy, K_2. The crystals contain in addition 3 eqs. water, and are Cfy K, 3 HO.

From this salt all the compounds of cyanogen and cyanogen itself are prepared. To yield cyanogen, it is heated with bichloride of mercury, which acts on the 2 eqs. K Cy, that are present by their elements; $2\,K\,Cy + Hg\,Cl_2 = 2\,K\,Cl + Hg\,Cy_2$. This forms bicyanide of mercury, but the heat employed decomposes this salt into cyanogen and mercury.

Cyanogen is a colourless gas, collected over mercury, of a very pungent smell, inflammable and burning with a pink flame. Water absorbs it, and the solution, if kept, undergoes a spontaneous change, by which numerous compounds are formed, a kind of putrefaction. Cyanogen and water contain the four elements, carbon, hydrogen, nitrogen, and oxygen, and there are formed compounds of these, and compounds of these compounds again, so as to give rise to very complex changes. Carbonic acid, ammonia, hydrocyanic acid, cyanic acid, cyanate of ammonia, urea, formic acid, and dark brown insoluble compounds containing cyanogen, but not fully studied, are formed.

Cyanogen is very analogous to chlorine in its relations. It forms with hydrogen hydrocyanic acid, H Cy, and with

metals cyanides, corresponding to the chlorides, as K Cy and $Hg\,Cy_2$, corresponding to K Cl and $Hg\,Cl_2$. With oxygen it forms three polymeric acids, cyanic, fulminic and cyanuric acids. But it is chiefly remarkable for forming with sulphur, and also with many metals, compound radicals, such as sulphocyanogen $Cy\,S_2 = Csy$, ferrocyanogen $Cy_3\,Fe = Cfy$ and others, all of which, like cyanogen itself, form acids with hydrogen, and salts with metals.

Hydrocyanic acid, H Cy = 27, is obtained by heating ferrocyanide of potassium with sulphuric acid and water. Ferrocyanide of potassium contains $Cy_3\,K_2\,Fe$, and when the acid acts on it, there are first formed cyanide of potassium and cyanide of iron, the latter separating as an insoluble powder, 2 K Cy + Fe Cy. The Fe Cy remain unchanged; but the 2 K Cy act on sulphuric acid, thus, $2\,K\,Cy + 2\,H, SO_4 = 2\,(K, SO_4) + 2\,H\,Cy$. The acid, H Cy, being volatile, distils over with water. It is obtained pure by adding chloride of calcium, which forms a heavy oily solution with the water, above which floats the pure dry acid, and may be drawn off by a pipette. It is very volatile, lighter than water, has a peculiar oppressive smell, and is very poisonous, even when smelled at, in its pure state. Before smelling it, it should be diluted. It is the well known poison prussic acid.

It is used in a diluted form in medicine, and the medicinal acid ought to contain in 100 parts not more than 3 of the pure acid. Its strength is ascertained by converting a measured portion into cyanide of silver, which is insoluble, and is formed on the addition of nitrate of silver, $H\,Cy + Ag\,O,\ NO_5 = HO,\ NO_5 + Ag\,Cy$. As the cyanide of silver, Ag Cy, weighs very nearly five times as much as the hydrocyanic acid, H Cy, for H Cy = 27 and Ag Cy = 134, we can easily ascertain the weight of the pure acid by dividing that of the cyanide of silver by 5.

The presence of hydrocyanic acid is detected by converting it into Prussian blue, which is done by adding, first potash, then mixed sulphate of protoxide and sesquioxide of iron, leaving an excess of potash, and after a few minutes adding lastly hydrochloric acid, which dissolves all but the Prussian blue. If the quantity of hydrocyanic acid be very small, the liquid, after adding the hydrochloric acid, must be allowed to stand for 24 hours, when the blue will appear at the bottom of the vessel.

Or the hydrocyanic acid may be converted into sulphocyanide of iron, which is of a deep blood-red colour. To do this, add to the diluted acid a little sulphuret of ammonium with a little sulphur, and evaporate to dryness in a water bath. To the dry mass which now contains sulphocyanide of ammonium, add a salt of sesquioxide of iron, and the red colour will appear.

The three compounds of cyanogen and oxygen are Cy O, HO, cyanic acid; $Cy_2\,O_2$, 2 HO, fulminic acid, and $Cy_3\,O_3$, 3 HO, cyanuric acid. The first and the last are both obtained from urea, and their relation to that compound and to each other is fully detailed under the head of polymerism and isomerism in organic compounds, and the transformations resulting from them. Fulminic acid, which is bibasic, and unknown in the free state, is obtained in combination with oxide of silver or oxide of mercury, forming the fulminating silver and fulminating mercury, the latter of which is the material used for percussion caps, by dissolving the metal in nitric acid and adding alcohol, when a very complex reaction occurs, and the fulminating salt is formed.

With sulphur, cyanogen forms a new compound radical sulphocyanogen, $Cy\,S_2 = Csy$, unknown in the free state. It is obtained as sulphocyanide of potassium, by melting ferrocyanide of potassium with sulphur, when each equivalent of K Cy takes up 2 eqs. of sulphur, forming the salt $K, Cy\,S_2 = K\,Csy$. This is purified by solution in alcohol. The radical forms also an acid with hydrogen, H, Csy, hydrosulphocyanic acid. This acid and its soluble salts are recognised by striking a deep red colour with salts of sesquioxide of iron.

With the metals, cyanogen forms salts very similar to the chlorides. The cyanides of potassium, silver, and mercury can hardly be distinguished from the corresponding chlorides.

But cyanogen is remarkable for forming with certain metals remarkable compound radicals, which are monobasic, bibasic, and tribasic. Thus we have—

Platinocyanogen,........	Pt Cy	=	Cpty monobasic.
Ferrocyanogen,.........	$Fe\,Cy_3$	=	Cfy bibasic.
Ferridcyanogen,......	$Fe_2\,Cy_6$	=	2 Cfy = Cfdy tribasic.

There are also cobaltocyanogen, $Co_2\,Cy_6$ tribasic, manganocyanogen, chromocyanogen, and iridiocyanogen, and two or three different platinocyanogens. Our space forbids us to enter into minute details, but we may state that 2 eqs. of ferrocyanide of potassium, $2\,Cy_3\,Fe,\ K_2 = Cy_6\,Fe_2',\ K_4$ when acted on by chlorine yield 1 eq. chloride of potassium, K Cl, and 1 eq. ferridcyanide of potassium $Cy_6\,Fe_2,\ K_3$. This is a beautiful red salt, also manufactured on the large scale. Prussian blue, a compound of cyanogen and iron, is formed either by the action of ferrocyanide of potassium on salts of sesquioxide of iron, or of ferridcyanide on salts of protoxide of iron. It is probable that there are more blue compounds than one, and that the ferrocyanogen being bibasic, forms a different compound from that produced by the tribasic ferridcyanogen. The reaction with the ferrocyanide is probably this:—

$$3\,Cfy,\ K_2 + 2\,Fe_2\,O_3 = 6\,KO + Cy_9\,Fe_7 = Fe_4\,Cfy_3$$

and with the ferridcyanide—

$$Cfdy,\ K_3 + 3\,FeO = 3\,KO + Cy_6\,Fe_5 = Cfdy\,Fe_3$$

But there is still some doubt as to the precise composition of the different forms of Prussian blue.

The variety of compound radicals formed by cyanogen, especially with iron and platinum, and the beauty of the salts thus formed, which generally crystallize with great facility, render these compounds very interesting. But it is in its relations to organic chemistry that cyanogen is most important, and we shall see, that in the decomposition of organic compounds containing nitrogen, compounds of cyanogen are constantly appearing, as well as compounds derived from them by transformation, such as urea. Cyanogen generally combines with the compound organic positive radicals, such as methyle, ethyle, benzoyle, and others. The most important of these compounds will be noticed in their proper place.

Carbon and Chlorine.

These elements do not directly combine; but when various organic compounds are exposed to the combined action of sun-light and chlorine, they are gradually destroyed, their hydrogen combining with chlorine, and finally their carbon also. There are two chlorides of carbon—$C_4\,Cl_4$, which has been called protochloride of carbon, a colourless liquid; and $C_4\,H_6$, which has been called sesquichloride of carbon, a crystalline solid. They are of no interest except as being the ultimate products of the substitution of chlorine for hydrogen in certain organic compounds.

The compounds of carbon with bromine and iodine are less known, but appear to be analogous to the chlorides. Carbon is not known to combine with fluorine.

9. *Sulphur.*

Symbol S. Equivalent = 16.

This element is found pure as a product of volcanic action, and vast quantities of it are exported from Ætna, Lipari, &c. It occurs also frequently in combination with metals forming sulphurets; the principal ores of lead, copper, bismuth, antimony, and mercury, are sulphurets; and those of iron, cobalt, nickel, zinc, cadmium, tin, arsenic, molybdenum, and silver, also occur. In combination with oxygen it is found as sulphuric acid, in gypsum or sulphate of lime, and in the sulphates of baryta, strontia, and lead.

Sulphur combined with hydrogen, or hydrosulphuric acid, is found in some mineral waters.

Sulphur is a solid of a peculiar pale yellow colour. It crystallizes easily when melted, and is found often finely crystallized. It melts about 245°, and when heated beyond 300° becomes thick and viscid, but beyond 500° it becomes again fluid, though less so than at first. At about 600° it boils, forming a brown vapour of specific gravity about 6650, which condenses on a cold surface or in water into a light powder, called flowers of sulphur. Heated in the air, it burns with a blue flame, producing a very suffocating gas, sulphurous acid. It is insoluble in water, sparingly soluble in boiling alcohol.

It exists, as has been already mentioned, in three different solid states or allotropic modifications; one in which it forms 4-sided prisms, when melted and allowed to cool; another when dissolved by the aid of heat in sulphuret of carbon, when it forms oblique octahedrons; and the third, when heated to 500° or 600° and thrown into water, when it forms a dark brown, transparent, amorphous, viscid mass, which may be drawn into threads. It is probable that there are three corresponding liquid states, the first fluid at 240° to 300°, the second viscid, from 350° to 500°, and the third again fluid, from 500° to 600°. There are probably also three forms of the gas or vapour, of different densities; at least this seems to be the case in some of its compounds.

Sulphur has a strong affinity for oxygen, but in regard to metals and hydrogen it has equally strong affinities, being negative to them, and analogous in its relations towards metals to both oxygen and chlorine.

The uses of sulphur, as a combustible for matches, as an ingredient in gunpowder, in the manufacture of sulphuric acid, and in medicine, are well known and important.

Sulphur and Oxygen.

These elements combine in several proportions, all the compounds being acids. But two of them are of special importance, sulphurous acid and sulphuric acid. We shall first, therefore, describe these, and then briefly notice the others.

1. *Sulphurous Acid,* $\dot{S}O_2 = 32$.

This is a gas, formed whenever sulphur burns in oxygen or in air. It is colourless, transparent, of a peculiar unpleasant taste and a most suffocating smell. Its specific gravity is 2·247 nearly. It is prepared also by heating sulphuric acid with copper filings, mercury, or charcoal. In each case the sulphuric acid, SO_3, loses 1 eq. oxygen, which

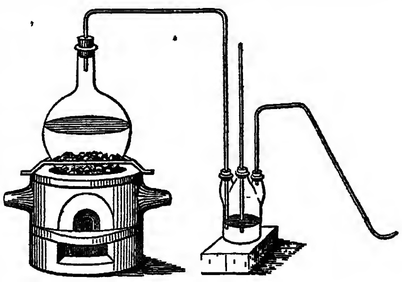


Fig 24.

unites with the metals or the carbon. In the case of copper we have, $2\,(HO, SO_3) + Cu = (Cu\,O, SO_3) + 2\,HO + SO_2$. With charcoal, $2\,(HO, SO_3) + C = 2\,SO_2 + 2HO + CO_2$. In the latter case, the gas is mixed with carbonic acid, and is therefore only proper for preparing the aqueous solution and the salts of sulphurous acid, the carbonic acid being excluded by the stronger sulphurous acid. Sulphurous acid gas must be collected over mercury—being absorbed by water, to which it communicates its suffocating odour.

The gas is easily liquefied by cold, under the ordinary pressure, and is kept in tubes hermetically sealed. It is a decided acid, forming salts with bases, and it has a peculiar action on vegetable blues, first reddening them, and then bleaching them. But the bleaching action differs from that of chlorine, for the colour is not destroyed, and may be restored, reddened of course, by stronger acids.

Sulphurous acid is characterized by its tendency to combine with a third equivalent of oxygen, and thus to be converted into sulphuric acid, which is manufactured in this manner, since sulphur does not combine directly with more than 2 eqs. of oxygen. The salts of this acid, sulphites as they are called, possess a considerable deoxidizing power, depriving many substances of oxygen, and being converted into sulphates.

Sulphurous acid is used in bleaching wool and silk, for which chlorine cannot be employed.

2. *Sulphuric Acid.*

a. *Anhydrous Acid,* $SO_3 = 40$.

Anhydrous or dry sulphuric acid is obtained by distilling the fuming or Nordhausen sulphuric acid, made by heating dried sulphate of iron. This fuming liquid is a compound or a mixture of anhydrous acid and of hydrated sulphuric acid, or oil of vitriol, which is the true active sulphuric acid; a gentle heat expels the anhydrous acid, which is very volatile, and collects in the receiver in the form of white crystals.

Anhydrous sulphuric acid is remarkable for its intense attraction for water. When thrown into water it hisses like red-hot iron, developing much heat, and forming oil of vitriol or hydrated acid. It is probably not a true acid, but readily passes into the true or hydrated form by the action of water. It melts at 68° and boils at 95°. It fumes strongly in the air, and attracts moisture with great rapidity. If a drop of water be allowed to fall into a bottle containing anhydrous sulphuric acid, there is a flash of light with explosion.

b. *Hydrated Sulphuric Acid,* HO, SO_3, or $H, SO_4 = 49$.

This, the true, active sulphuric acid, also called oil of vitriol, because it is obtained by distilling green vitriol or sulphate of iron, and has an oily consistence, is formed whenever the anhydrous acid comes in contact with water, $SO_3 + HO = HO, SO_3$. It was formerly made by distilling green vitriol or protosulphate of iron; the action of heat on that salt, dried at a moderate heat, so as to leave 1 eq. of water, is as follows: $Fe\,O, SO_3, HO = Fe\,O + HO, SO_3$. The protoxide of iron, $Fe\,O$, is oxidized into sesquioxide $Fe_2\,O_3$, at the expense of half of the sulphuric acid; thus $2\,Fe\,O + SO_3 = Fe_2\,O_3 + SO_2$; so that finally sesquioxide of iron is left, and sulphurous acid is given off with the oil of vitriol.

The modern manufacturing process is far more economical and productive. Sulphur is burned in air, with the help

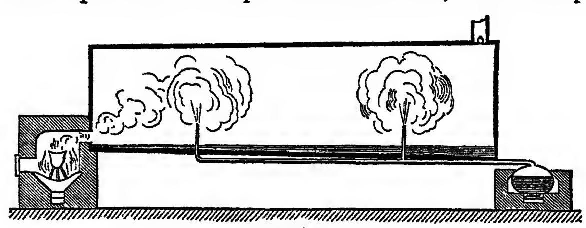


Fig. 25.

of a little nitre. The sulphurous acid gas thus formed is conducted into a large leaden chamber, where it meets with nitrous acid, obtained by the action of starch on nitric acid, and also with the vapour of water, introduced from a boiler. Water is also present on the floor of the chamber. The resulting action is rather complex. First, sulphurous acid, nitrous or hyponitrous acid, and water, combine to form the compound $2\,SO_2 + NO_4 + HO$. This compound forms crystals which fall down in a shower like snow, but are decomposed as soon as they touch the water on the floor, when the sulphurous acid is oxidized into sulphuric acid, and the nitrous or hyponitrous acid reduced to deutoxide of nitrogen; thus, $2\,SO_2, NO_4, HO = 2\,SO_3 + NO_2 + HO$. The

sulphuric acid dissolves in the water; the deutoxide of nitrogen rises into the air of the chamber, in which a continual current of air is kept up, and with the oxygen of the air again forms nitrous acid, which forms, with a fresh portion of sulphurous acid and water, the same crystalline compound as before. This is again decomposed by the water, and again deutoxide of nitrogen rises, again forms nitrous acid, and again the crystals are formed and decomposed, and so on, continuously. In this way, a comparatively small amount of deutoxide of nitrogen, supplied at first as nitrous acid, oxidizes an almost unlimited quantity of sulphurous acid, acting as a carrier of oxygen from the air to the sulphurous acid. It is only because a little of the deutoxide is unavoidably lost, being carried away with the current of effluent air, that a little nitrous acid must be added from time to time to the original supply. The regular supply of air and of steam is also essential.

After this process has been continued for some time, the water on the floor of the chamber is found so strongly charged with acid, that it no longer thoroughly decomposes the crystals. It is withdrawn and replaced by fresh water. The acid liquid, which is free from nitrous acid provided an excess of sulphurous acid has been present before drawing it off, contains only sulphuric acid and water, with perhaps a little sulphurous acid. It is boiled down in vessels of glass or of platinum, to expel superfluous water, till acid begins to rise in vapour. At this point, all the water has been expelled except the one equivalent, essential, either as water or by its elements, to the existence of the hydrated acid. The liquid now boils at nearly 600°, and has a specific gravity of 1845, and an oily consistence. When pure it is colourless, but the smallest trace of any organic matter such as wood, straw, or even dust, colours it brown. It is very acid and corrosive, and has a most powerful attraction for water, the mixture of it with water developing so much heat as to break the vessel if suddenly effected. This hydrated sulphuric acid or oil of vitriol is a true acid, and in all its relations exhibits the characters belonging to hydrochloric acid, which we have called the type of acids. Like it sulphuric acid with metals forms salts, disengaging hydrogen gas, and with metallic oxides, forms the same salts, water being separated. Hence, as formerly stated, although it contains the elements $SO_3 + HO$, and may without inconvenience be regarded as a hydrate of the anhydrous acid, it is still more probable that it is really a compound of hydrogen, H, SO_4, analogous in constitution to hydrochloric acid, HCl. All the phenomena which it exhibits with metals, oxides, &c. may be explained either way, but in the latter form its analogy with hydrochloric acid, so striking in the phenomena, becomes visible in the formula. Thus we have in the case of—

	Hydrochloric Acid.	Sulphuric Acid. 1	2	
Acids,	HCl	HO, SO_3	H, SO_4	or $H Su$
Salts,	MCl	MO, SO_3	M, SO_4	or $M Su$

The older formulæ in the second column indicate no analogy with hydrochloric acid and chlorides, but in the third and fourth columns this analogy is at once evident, especially in the fourth, where Su stands for SO_4, the hypothetical radical of sulphuric acid and sulphates. It must be borne in mind, however, that the body SO_4 is hypothetical and has not been proved to exist. Yet the assumption of it is generally agreed on, since it brings into one category hydrochloric acid and sulphuric acid with their respective congeners, otherwise separated. On this supposition the action of sulphuric acid on a metal and on a metallic oxide is as follows, which agrees perfectly with the action of hydrochloric acid:—

On a metal, $M + H, SO_4 = M, SO_4 + H$
On an oxide, $MO + H, SO_4 = M, SO_4 + HO$

In both cases, the metal simply replaces the hydrogen, and this is true of the older view also, for in that we have—

With metal, $M + HO, SO_3 = MO, SO_3 + H$
With oxide, $MO + HO, SO_3 = MO, SO_3 + HO$

We have explained this fully, because the same views apply to all hydrated acids.

Sulphuric acid forms salts with all bases, several of which occur in nature, as sulphate of lime, of baryta, of strontia, of magnesia, of lead. With 1 eq. of water it forms a hydrate, which crystallizes in cold weather. It also forms another hydrate with 2 eqs. of water, which does not crystallize so easily.

The acid is recognised by forming with baryta, whenever they meet in any mixture, the sulphate of baryta, absolutely insoluble, not only in water but also in nitric and hydrochloric acids, which dissolve many compounds of baryta insoluble in water. Any sulphate, moreover, if heated to redness with charcoal, yields, on the addition of water and acids, the odour of sulphuretted hydrogen.

The uses of sulphuric acid are numerous and important. It is employed in the manufacture of soda, bleaching powder, nitric acid, hydrochloric or muriatic acid, acetic acid, ether, alum, Epsom salt, in dissolving bone earth for agricultural purposes, in charging galvanic batteries for the electrotype and telegraph, and lastly, in medicine and pharmacy. When we consider that many other arts and manufactures depend on these—as for example, the making of glass and of soap, on the manufacture of soda—we shall see that the value of sulphuric acid cannot be over-estimated, and that every improvement in its preparation, or everything that renders it cheaper, will create new manufactures and new arts hereafter, as has already occurred. It is impossible to calculate what might be the effect, for example, of a great reduction in the price of sulphur, for which substance we are dependent on Sicily, and whose cheapness at present enables us to obtain sulphuric acid at a mere fraction of its former price. Such a reduction would not only cheapen sulphuric acid, but also soda, bleaching powder, glass, soap, and many other articles, and through these a multitude of products connected with them. A rise in the price of sulphur, or an interruption in the supply, such as was threatened some years ago, would have a most disastrous effect, through its influence on the price of sulphuric acid.

3. *Hyposulphurous Acid*, $S_2 O_2 = 48$.

This acid is hardly known in the uncombined state, as it speedily undergoes decomposition. But its salts are permanent. They are formed by boiling the salts of sulphurous acid with sulphur, when 1 eq. of sulphur is taken up by 1 eq. sulphurous acid. Thus, taking sulphite of soda, $Na O, SO_2 + S = Na O, S_2 O_2$. Hyposulphite of soda thus formed, crystallizes readily in large transparent prisms. It will be seen that this acid contains sulphur and oxygen in the proportion of 1 eq. of each. But we adopt the formula $S_2 O_2$ instead of SO, because, in the neutral salts, 1 eq. of the base is neutralized by $S_2 O_2 = 48$, and not by $SO = 24$. The acid may be viewed either as directly formed of S_2 and O_2, or as composed of sulphurous acid and sulphur, $SO_2 + S$. The latter may probably be true, as there are several acids apparently of analogous constitution.

The most remarkable character of this acid, or rather of its salts is their power of dissolving the compounds of silver which are insoluble in water and in strong acids, such as chloride, bromide, iodide, &c. of silver. The solution thus obtained has a most intensely sweet taste, followed by a metallic aftertaste. On account of this solvent power, hyposulphite of soda is much used in photography, to fix the image by removing the compound of silver unacted on by light, which if left would be acted on and destroy the pictures.

4. *Hyposulphuric Acid.* $S_2O_5 = 72$.

This acid is more permanent. It is formed when sulphurous acid is made to act on peroxide of manganese, a portion of the acid being oxidized to sulphuric acid, which with another portion of sulphurous acid forms the new acid, for $SO_3 + SO_2 = S_2O_5$. The acid thus formed combines with the protoxide of manganese. The action is as follows:—$2\ SO_2 + Mn\ O_2 = Mn\ O, S_2O_5$. From the salt of manganese, others may be obtained, and from the hyposulphate of baryta, the base being removed by sulphuric acid, the acid is obtained. It is sour and tolerably permanent, unless strongly heated, but of little interest hitherto.

There are still three acids formed of sulphur and oxygen. They all contain, like the last-named acid, 5 eqs. of oxygen, with regularly increasing quantities of sulphur, and their names and formulæ are—

5. Monosulphuretted hyposulphuric acid, $S_3O_5 = 88$
6. Bisulphuretted hyposulphuric acid, $S_4O_5 = 104$
7. Tersulphuretted hyposulphuric acid, $S_5O_5 = 120$

They all form crystallizable salts with baryta, and may be obtained from these by means of sulphuric acid, which precipitates the baryta. They are sour, and easily decomposed, yielding sulphuric acid, sulphurous acid, and sulphur. They very much resemble one another, and are of no practical interest, so that we shall not describe their preparation. It is remarkable that the third of them is polymeric with hyposulphurous acid, but the two acids are quite distinct; for not only can the acid S_5O_5 be obtained in solution, while the acid S_2O_2 is not known in a separate state, but they neutralize totally different weights of the same bases, or equal weights of the base require different weights of the two acids, in the proportion of 120 to 48.

Sulphur and Hydrogen.

These elements form two compounds, one of which is of great importance to the chemist. It is—

1. *Hydrosulphuric Acid,* $HS = 17$.

This compound, called also sulphuretted hydrogen, is a gas which sometimes occurs in volcanic districts, and is frequently found dissolved in mineral waters. It is formed during the putrefaction of organic matters containing sulphur, such as albumen in eggs, &c.

It is procured by the action of acids on sulphuret of iron; thus, with sulphuric acid, $Fe\ S + H, SO_4 = Fe, SO_4 + HS$; and with hydrochloric acid, $Fe\ S + H\ Cl = Fe\ Cl + HS$. It is also produced by the action of hydrochloric acid on tersulphuret of antimony, $Sb\ S_3 + 3\ H\ Cl = Sb\ Cl_3 + 3\ HS$. It may be collected over warm water or brine; cold water absorbs it.

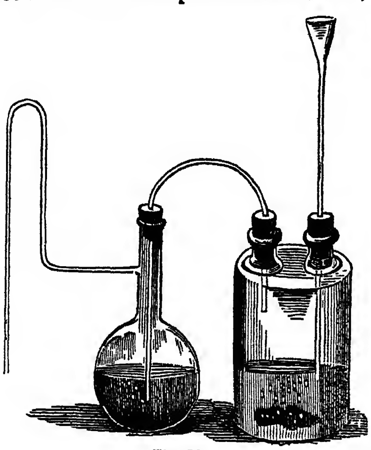


Fig. 26.

It is transparent, inflammable, burning with a pale blue flame, and depositing sulphur. It has a most offensive smell, that in fact of putrid eggs, which yield it, and this smell it communicates with its sulphureous taste to water, as in the water of Harrowgate. It also blackens the salts of lead and of many other metals, forming sulphurets of the metals. The action with a salt of lead is as follows:—if we suppose the lead to be present as oxide, the acid may be left out of view; $Pb\ O + HS = HO + Pb\ S$. It is the same whether the lead be present as chloride, $Pb\ Cl$, or as sulphate, $Pb\ O, SO_3$, or Pb, SO_4, or as carbonate, $Pb\ O, CO_2$.

It is this action of hydrosulphuric acid on metals and their salts which renders it so valuable as a test; for as the sulphurets of the heavy metals are insoluble in water, and usually of dark colours, it enables us to detect a very small quantity of those metals on the solutions of which it acts, and even to distinguish many of them by the colour of the precipitate. The salts of lead, copper, mercury, silver, gold, bismuth, and some others, form dark brown or black sulphurets; protosalts of tin give a chestnut brown; antimony, an orange-brown; persalts of tin, a dirty-yellow; arsenic and cadmium, a bright yellow, with this gas.

The solution of the gas reddens vegetable blues, but as in the case of carbonic acid, on standing or on boiling the blue colour returns.

The gas is liquefied by a powerful pressure. It is highly poisonous when inhaled, and has often caused fatal accidents in graves, when, a neighbouring coffin being perforated by the pickaxe, the gas rushes out and fills the grave striking down the gravedigger like lightning. The same thing happens in the large cloacæ of great cities. It is said that a horse whose head is in pure air, while his body is inclosed in an atmosphere containing only $\frac{1}{800}$th of its volume of the gas, is soon killed by the gas absorbed through the skin. Taken internally, it is not only safe, but a useful remedy.

2. *Bisulphuret of Hydrogen,* $HS_2 = 33$.

This compound is formed when lime and sulphur are boiled with water, till a deep yellow solution is formed. This is then poured into hydrochloric acid of moderate strength. The liquid becomes milky, and on standing deposits the bisulphuret as a heavy oily liquid, which may be withdrawn by a pipette. It undergoes spontaneous decomposition, which is hastened by the presence of metallic oxides. In these characters, and in its composition, it is analogous to the deutoxide of hydrogen. It has a pungent and offensive smell. When sealed up in one end of a bent tube, and left to itself, it is gradually resolved into sulphuric and hydrosulphuric acid, and the latter is liquefied at last by its own pressure.

There is said to be a compound of sulphur and nitrogen, $N\ S_3$, a yellowish white powder. But this is doubtful.

Sulphur and Chlorine.

When dry chlorine is passed over sulphur they readily unite and form two compounds, both liquid, volatile, and pungent. One is S_2Cl, subchloride or dichloride of sulphur, a dense yellow liquid of specific gravity 1687, boiling at 280°. The other is $S\ Cl$, protochloride of sulphur, a red liquid, of specific gravity 1620, boiling at 150°. Both decompose water, forming hydrochloric, sulphuric, and sulphurous acids.

When sulphur and iodine are heated together, they melt and form a black crystalline mass on cooling. It cannot be distilled, heat decomposing it, and its precise composition is unknown. Nothing is known of the compounds of bromine and sulphur, nor of those of fluorine with sulphur.

Sulphur and Carbon.

When the vapour of sulphur is made to pass over charcoal at a red-heat, a compound is formed which passes over and is collected in water where it sinks as a heavy liquid to the bottom. To purify it from a little sulphur that distils along with it, it is distilled again at a gentle heat. Its composition is $C\ S_2$, bisulphuret of carbon.

It is a very mobile, transparent, colourless liquid, refract ing light strongly, of a very peculiar odour, like that of decaying cabbage or horse-radish, very inflammable. Its specific gravity is 1293, and it boils at 118°.

Bisulphuret of carbon is a powerful solvent for many substances insoluble in water or alcohol; such as phosphorus, sulphur (which crystallizes beautifully from the solution), resins; and even such bodies as caoutchouc and gutta percha are softened if not dissolved by it. It is now manufactured on the large scale, and is used in making varnishes and certain preparations of caoutchouc.

10. *Selenium.*

Symbol Se. Equivalent = 39·5.

This element is so closely analogous to sulphur, that a very brief account of it will suffice. It occurs in nature chiefly as seleniuret of lead, a rare mineral. Some kinds of iron pyrites contain a little seleniuret of iron, or at all events a compound of selenium; and when sulphur made from such pyrites is converted into sulphuric acid, there is found in the leaden chambers a deposit consisting of sulphur, several metals, such as copper, lead, and arsenic, and selenium. From this deposit, or from the native seleniuret of lead, selenium is prepared. It is first dissolved in the form of selenious acid, and this is deoxidized by sulphurous acid, when the selenium separates as a deep red powder. At 392° it melts, forming a brown liquid, which boils at about 1290°, and yields a deep yellow gas. On cooling, the liquid first becomes viscid and tenacious, and finally consolidates to a nearly black solid mass, which in thin layers is translucent and red, and has a metallic lustre. When sublimed, the vapour condenses on a cold surface into a powder of a fine red, similar to the precipitated selenium.

In all its chemical relations selenium resembles sulphur, only that it is denser, its specific gravity being 4280 in the mass and 4800 in the powder; and less volatile. Its affinities are also less powerful.

Selenium appears to form three compounds with oxygen, namely, the oxide of selenium, a gas, the composition of which is not known, selenious acid $Se\,O_2$, and selenic acid $Se\,O_3$.

Heated in air, selenium burns with a pure blue flame, producing a very penetrating and peculiar odour, compared to that of putrid horse-radish. This belongs to the oxide, which has not been obtained in a state of purity. A very minute trace of selenium may be detected before the blowpipe by this character. The gas appears to be poisonous.

Selenious acid, SeO_2, is the chief product of the combustion of selenium, and if the operation is conducted in oxygen in a proper apparatus, the acid collects in the cold part of it in colourless crystals, very soluble in water. This acid is also formed when selenium is oxidized by nitric or by nitro-hydrochloric acids. Selenious acid is deprived of its oxygen by many substances, such as iron, zinc, or sulphurous acid, when the selenium is deposited as a cinnabar red powder. The vapour of the acid is yellow.

Selenic acid, $Se\,O_3$, or, in the state of hydrate, $HO, Se\,O_3 = H, Se\,O_4$, is entirely analogous to sulphuric acid in properties. It is obtained in combination with oxide of lead, by heating seleniuret of lead with nitrate of potash; or by first heating selenium with that salt, which forms seleniate of potash, and then adding to the solution of the potash salt a salt of lead, when seleniate of lead is precipitated. This salt, $Pb\,O, Se\,O_3$, is decomposed by hydrosulphuric acid as follows; $Pb\,O, Se\,O_3 + HS = Pb\,S + HO, Se\,O_3$; thus yielding the hydrated acid. The anhydrous selenic acid is unknown.

The salts of selenic acid are in form and properties so exactly similar to those of sulphuric acid, as only to be distinguishable from them by analysis.

With hydrogen, selenium forms a gaseous acid, hydroselenic acid, $H\,Se$, of a most fetid odour, and still more poisonous than hydrosulphuric acid. It is obtained, like hydrosulphuric acid, by the action of hydrochloric acid on a compound of iron with selenium. $H\,Cl + Fe\,Se = Fe\,Cl + H\,Se$. This gas is soluble in water, and acts on metallic solutions in the same way as hydrosulphuric acid, only forming seleniurets instead of sulphurets. $MO + H\,Se = HO + M\,Se$, is a general equation representing the action of hydroselenic acid on metallic protoxides.

Like sulphur, selenium combines directly with metals, when heated with them.

From its great rarity, selenium is not applied, either itself or in its compounds, to any useful purpose. It is probable, however, that some of its compounds, from their energetic action on the system, may prove valuable remedies.

The metallic lustre of compact selenium has led some to class it with metals. But it is a nonconductor of heat and electricity, and so analogous to sulphur, that these elements must be considered together. A third substance belongs to the same group by its chemical relations, namely tellurium; but that element has the conducting power as well as the lustre of metals, and it is regarded as a metal.

11. *Phosphorus.*

Symbol P. Equivalent = 32.

This element is found chiefly in the animal kingdom, in bones, as phosphoric acid united to lime and a little magnesia. But all the phosphate of lime, or bone earth of animals, is derived from their food, and consequently from the soil. In fact, all fertile soils contain this phosphate in small but essential quantity. Without it, although all the other elements of plants were present, no plant could grow. Phosphate of lime is found in minute crystals scattered through all rocks, and there are occasionally beds containing large quantities of bone earth, derived from the bones of extinct animals; as the osteolite of the Rhine, and the so-called coprolite beds in the Suffolk Crag. Phosphoric acid also occurs sparingly, combined with the oxides of lead, copper, uranium, and iron.

Phosphorus is obtained from bones, by first burning them to destroy the animal matter. The bone earth is next bruised, and digested with sulphuric acid and water till all coarse grains have disappeared, and a uniform fine powder, sulphate of lime, is formed. The water now holds in solution acid phosphate of lime. This is filtered from the sulphate, evaporated to the consistence of a syrup, mixed with charcoal, and exposed to a white heat in a retort. The charcoal deprives the phosphoric acid of oxygen, and while carbonic acid escapes, phosphorus distils over, and is collected under water. To purify it, it is melted under water and squeezed through leather. It is then, if necessary, redistilled by itself, and kept under water.

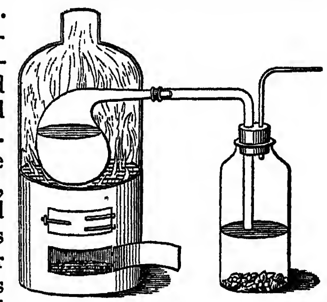


Fig. 27.

It is a solid, nearly colourless, translucent, of the consistence of wax, fusible a little above 100°, and taking fire in air at that temperature. It boils at 550°. The specific gravity of phosphorus is 1770, water = 1000. That of its vapour is 4326, air = 1000.

It is distinguished by its inflammability, which is such, that if exposed, dry, to air, in warm weather, it often takes fire spontaneously, and is therefore kept under water. When exposed to light, it becomes opaque externally, and the change spreads gradually inwards.

When heated, it burns with great splendour, whether in air or oxygen, especially in the latter; in burning, it forms phosphoric acid, which, if no moisture be present, condenses to a white powder like snow.

When phosphorus is heated for some time short of its boiling point, between 445° and 480°, it becomes dark

red, comparatively infusible, far less inflammable, and insoluble in sulphuret of carbon, which dissolves ordinary phosphorus. The red modification does not melt nor take fire, even at 480°. At about 500° it passes into ordinary phosphorus. This is a most remarkable instance of allotropic modification of an element, which in these two states exhibits properties, both physical and chemical, more different than are those of many different elements. Yet the one form passes into the other, and both yield the same compounds.

Phosphorus and Oxygen.

The affinity of phosphorus for oxygen is very strong, so that even at ordinary temperatures it is slowly oxidized in the air, becoming luminous in the dark. The temperature also rises slightly, and in summer the oxidation is thereby so much accelerated that heat enough is evolved to melt and set fire to the phosphorus. This is a true case of spontaneous combustion, and illustrates the occurrence of that phenomenon in powdered charcoal, or in porous bodies moistened with oil. At any season it may be illustrated in phosphorus, by allowing a few drops of a solution of phosphorus in bisulphuret of carbon to dry up on blotting paper, on which it leaves a film of finely divided phosphorus. This very soon begins to oxidize, vapours rise from it luminous in the dark, it gradually becomes warm, and in a few minutes bursts into flame. It has recently been proved by Schönbein that phosphorus in air first causes the formation of ozone, which is an allotropic form of oxygen, and possibly also of a hydrate of this substance, having the composition $HO_3 = O_2 + HO$. Both of these forms of ozone are much more powerful oxidizing agents than ordinary oxygen, and it appears that it is ozone which really oxidizes phosphorus, when exposed to air till the temperature rises so high as to cause combustion.

1. *Phosphorous Acid*, $PO_3 = 56$.

This acid is formed when phosphorus undergoes slow oxidation. It is best obtained pure by the action of water on terchloride of phosphorus, $P\,Cl_3 + 3\,HO = 3\,H\,Cl + PO_3$. It is very soluble and sour, and may be obtained in a mass of deliquescent crystals of the hydrated acid, PO_3, 3 HO. When heated, it yields phosphuretted hydrogen gas, while phosphoric acid is left; thus, $4\,PO_3 + 3\,HO = 3\,PO_5 + PH_3$. Phosphorous acid is not of much importance. It tends, by combining with 2 eqs. of oxygen, to form phosphoric acid.

2. *Phosphoric Acid.*

a. *Anhydrous Phosphoric Acid*, $PO_5 = 72$.

This compound is formed when phosphorus is burned in dry air or oxygen, and appears as a snow-white substance,

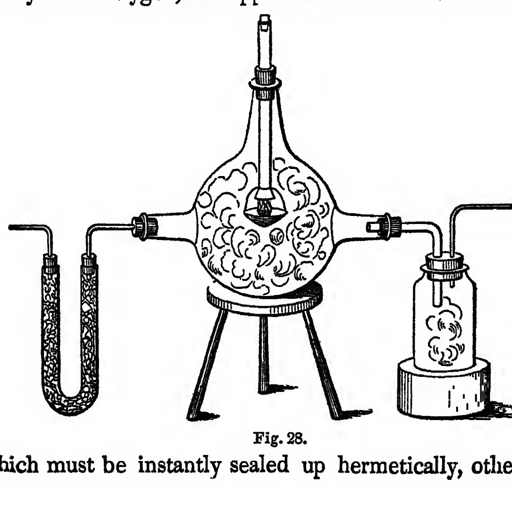


Fig. 28.

which must be instantly sealed up hermetically, otherwise it attracts moisture from the air, and deliquesces into the monobasic hydrated acid, PO_5, HO.

It is doubtful whether the anhydrous acid be really an acid. It cannot be tasted without bringing it in contact with water on the tongue, when it instantly forms the hydrated or true acid. It is used in research on account of its tendency to abstract the elements of water from many organic substances, without charring them as sulphuric acid does.

b. *Hydrated Phosphoric Acid.*

1st, *Monobasic*, PO_5, HO or PO_6, $H = 81$.

This acid is formed when the anhydrous acid acts on water. It is apt to pass into the bibasic and tribasic forms, by taking up more water, but is again obtained pure by heating to low redness, when the monobasic acid is left. It is very sour, coagulates albumen, and causes a white precipitate in nitrate of silver, the monobasic phosphate of silver, PO_5, Ag O or PO_6, Ag. It forms only one series of salts, containing one eq. of base or of metal, hence its name. Its solution passes, slowly in the cold, rapidly when heated, first into the bibasic, and then into the tribasic form.

2d, *Bibasic Phosphoric Acid*, PO_5, 2 HO or PO_7, $H_2 = 90$.

This acid is obtained by heating the solution of the tribasic or common phosphoric acid till only 2 eqs. of water are left, or by decomposing bibasic phosphate of lead or silver by hydrosulphuric acid. Its solution is not permanent, passing into the tribasic acid. But its salts are quite permanent. It does not coagulate albumen, nor precipitate nitrate of silver, unless ammonia or some base be added, when it forms a white bibasic phosphate of silver, quite different from the monobasic salt. It forms two series of salts, those with two eqs. of fixed base, such as bibasic phosphate of soda, PO_5 2 Na O or PO_7, Na_2, and those with 1 eq. of fixed base, and 1 eq. of basic water, as the acid bibasic phosphate of soda, PO_5, Na O, HO or PO_7, Na H.

3d, *Tribasic Phosphoric Acid*, PO_5, 3 HO or PO_8, $H_3 = 99$.

This is the common form of phosphoric acid, as the others, by taking up water, pass into it. It does not coagulate albumen, nor precipitate nitrate of silver, till some base is added, when it forms a lemon-yellow precipitate of tribasic phosphate of silver, PO_5, 3 Ag O or PO_8, Ag_3. It forms 3 series of salts, with 3 eqs. of fixed base, as the salt of silver just named; with 2 of fixed base and 1 of water, as in common phosphate of soda, PO_5, 2 Na O, HO or PO_8, Na_2, H; and with 1 eq. of fixed base and 2 of water, as the acid phosphate of potash, PO_5, KO, 2 HO or PO_8, K, H_2. This is the form of the acid existing in bones, and in the mineral kingdom.

It will be seen, that if we regard these acids as hydrates or compounds of water with dry acid, they all contain the same acid, and differ only in water. This is possible, for in sulphuric acid we have oil of vitriol, SO_3, HO, the hydrate SO_3, 2 HO, and the hydrate SO_3, 3 HO, all of which undoubtedly contain the same acid, and yield the same salts with bases, namely, sulphates, of which there is but one class or series.

But the three phosphoric acids differ far more than is accounted for by mere differences in the proportion of water, as in their action on albumen, and on nitrate of silver, and above all, in forming salts entirely distinct, which are monobasic, bibasic, and tribasic, that is, contain 1, 2, or 3 eqs. of base, fixed or otherwise. Nothing of all this occurs in the different hydrates of sulphuric acid, the first of which is the true acid, H, SO_4, as already explained, the other two compounds of this with water, H, SO_4 + HO and H, SO_4 + 2 HO. But this water in these two compounds is not basic, and is not replaceable by bases.

What is the cause of this difference between sulphuric

and phosphoric acid? It is not enough to say, that when the dry acid is combined with 1, 2, or 3 eqs. of water, it is disposed to take up 1, 2, or 3 eqs. of base. That is the fact to be explained, and not an explanation of it. Sulphuric acid exhibits no such tendency when combined with 2 or 3 eqs. of water, and we can hardly suppose the three phosphoric acids to contain the same acid.

Now, here the hydrogen theory of acids comes to our aid. According to it, the first hydrate is PO_6, H like nitric acid, NO_6, H. It takes 1 eq. of base to form neutral salts, because it contains 1 eq. of replaceable hydrogen, as sulphuric and nitric acids do.

The second hydrate is PO_7, H_2. Here the radical is different, and as there are 2 eqs. of replaceable hydrogen, it takes 2 eqs. of base to form neutral salts. And there are two series of these, according as half or the whole of the hydrogen is replaced by metals.

The third hydrate, in like manner, is PO_8, H_3, with a different radical, and requiring 3 eqs. of base for the 3 eqs. of replaceable hydrogen, forming also 3 series of salts, according as the hydrogen is partially or entirely replaced by metals.

On this view, the three acids must be different, whereas, on the other, they ought to be the same, as in sulphuric acid. We see also why they form different salts, and why the first can form only one series, the second two, and the third three series of salts.

Phosphoric acid as such is not much used nor of much interest, but its salts, especially those of the tribasic modification, are of the utmost and most essential importance. The earth of bones is essentially a tribasic phosphate of lime; the principal salt in the blood, to which it owes its alkaline reaction, and its peculiar power of absorbing and of giving off carbonic acid, is a tribasic phosphate of soda, with 2 eqs. of fixed base and 1 eq. of basic water, PO_5, 2 NaO, HO, or PO_8, Na_2 H, and the chief salt in the juice of flesh, and in the gastric juice, that which gives the acid reaction to these fluids, is a tribasic phosphate of potash, with 1 eq. of fixed base and 2 eqs. of basic water, PO_5, KO, 2 HO, or PO_8, K, H_2. Since these peculiar phosphates have undoubtedly each its own peculiar function to perform in the animal economy, we see how important it is to study the most minute and apparently trifling peculiarities of such a compound as tribasic phosphoric acid; although these very researches, when first made, were regarded as scientific curiosities of no practical value. No one could have conjectured that it would ever be important to know that tribasic phosphoric acid with soda tends to form a salt with 2 eqs. of fixed base, of alkaline properties, though its composition is that of an acid salt, while the same acid with potash forms by preference a salt with 1 eq. of fixed base which is strongly acid, while yet the acid can form two other compounds with each alkali. Yet we now see that such apparently insignificant facts are closely connected with the due performance of the most essential vital functions. In hundreds of cases we can substitute potash for soda, and obtain the same results, but potash cannot replace the soda of the phosphate in the blood, nor soda the potash of that in the juice of flesh.

3. *Hypophosphorous Acid*, $PO = 40$.

This acid is formed when phosphorus is boiled with bases, such as lime or potash. Phosphoric acid and phosphuretted hydrogen are formed at the same time, as will be shown under phosphuretted hydrogen, and the two acids both combine with the base. The phosphate of lime is insoluble, the hypophosphite soluble. The acid is little known, but has a tendency to absorb oxygen and pass into phosphoric acid.

Phosphorus and Hydrogen.

1. *Phosphuretted Hydrogen Gas.* $PH_3 = 35$.

This compound is formed when phosphorus is boiled with lime and water, or potash and water. The precise nature of the reaction is not ascertained, so as to enable us to represent it in an equation; but water is decomposed, and while its oxygen unites with one portion of phosphorus to form hypophosphorous acid, and apparently with another to form phosphoric acid, its hydrogen combines with a third portion, forming the new compound, which is given off in the form of a gas, not absorbed by water.

It is highly inflammable, and when prepared as above takes fire spontaneously in contact with air. But this property is owing to the presence of a minute quantity of another compound of the same elements, the liquid phosphuretted hydrogen; and when this is removed, the gas is no longer spontaneously inflammable, though still taking fire when slightly heated in air. The spontaneously inflammable gas loses that property by standing over water, when it deposits a little of a solid phosphuretted hydrogen, formed from the liquid one.

Each bubble of the spontaneously inflammable gas, as it rises through the water, takes fire, and forms a beautiful ring of white vapour (water and phosphoric acid), which expands as it ascends. Bubbles of the gas, allowed to enter a vessel of oxygen, produce each of them a slight explosion and a brilliant flash of light, but care must be taken that only one bubble at a time enters the oxygen, otherwise dangerous explosions may occur. The gas may also be prepared by the action of phosphuret of calcium on water.

When phosphuret of calcium is acted on by dilute-hydrochloric acid, or when phosphorus is boiled with an alcoholic solution of potash, the pure gas is formed, not spontaneously inflammable. All substances which destroy the liquid phosphuretted hydrogen, such as alcohol, ether, and volatile oils, deprive the spontaneously combustible gas of that property. And the addition of a minute trace of the liquid compound to the non-spontaneously inflammable gas renders it at once spontaneously inflammable.

2. *Liquid Phosphuretted Hydrogen,* $PH_2 = 34$.

When the spontaneously inflammable gas is passed through a U-shaped tube surrounded by a freezing mixture, it deposits water which freezes, and a small quantity of the liquid compound, PH_2. The gas has now lost its spontaneous inflammability. The liquid instantly takes fire in contact with air or oxygen. When kept the liquid is resolved into the gas PH_3, and a solid compound P_2 H, thus, $5\ PH_2 = 3\ PH_3 + P_2\ H$.

3. *Solid Phosphuretted Hydrogen,* $P_2\ H = 65$.

The formation of this compound from the liquid one has just been explained. It is deposited from the spontaneously inflammable gas when kept over water, as an orange-coloured film.

It should be mentioned that the gas, PH_3, has a composition analogous to that of ammonia, NH_3, and that it has also some analogy in properties. Thus it seems to be a weak base, and with hydriodic acid it forms a saline compound crystallizing in cubes, like the hydriodate of ammonia. The phosphuretted hydrogen also, like ammonia, admits of the replacement of its hydrogen by such radicals as methyle and ethyle, forming volatile bases, analogous to the volatile organic bases derived from ammonia.

With nitrogen phosphorus forms a compound, PN_2, a white solid, which resists a red heat and the action of the strongest acids.

Phosphorus and Chlorine.

1. *Terchloride of Phosphorus,* $P\ Cl_3 = 138{\cdot}5$.

When chlorine comes in contact with phosphorus, the latter takes fire, and they combine. If the phosphorus be in excess, we obtain a colourless liquid, $P\ Cl_3$. It is pungent, fuming, of specific gravity 1450. When mixed with

water it sinks to the bottom, and there is rapidly dissolved, heat being developed. The action is as follows: $PCl_3+3HO=3HCl+PO_3$. The hydrochloric acid dissolves in the water along with the phosphorous acid, but may be expelled by a gentle heat, and hydrated phosphorous acid is left.

2. *Perchloride of Phosphorus.* $PCl_5=209\cdot5$.

When the chlorine is in excess, or when chlorine is passed through the last compound, there is formed the solid perchloride, PCl_5. This also decomposes water, as follows: $PCl_5+5HO=5HCl+PO_5$, yielding, therefore, hydrochloric and phosphoric acids.

Perchloride of phosphorus has of late been employed as an agent of research in organic chemistry. By its means, certain anhydrous organic acids, previously unknown, have been obtained, and much light thrown on the constitution of organic acids.

Phosphorus combines instantly with iodine, heat and light being evolved. The compounds are of a dark red or brown colour, and solid. They decompose water exactly as the chlorides do. It is probable that there are two iodides, PI_3 and PI_5, corresponding to the chlorides, but the former alone has been analysed, and another iodide, PI_2, has also been obtained. These two compounds may be had in orange and in dark red crystals by dissolving phosphorus and iodine in bisulphuret of carbon, and applying artificial cold.

Bromine acts very violently on phosphorus, and seems to form bromides corresponding to the chlorides.

No compounds are known of phosphorus with fluorine or carbon.

With sulphur, phosphorus readily combines in several proportions. The compounds are not only highly inflammable, but liable to explode with great violence when slightly warmed, and sometimes even spontaneously. Hence they are very dangerous, and must be very cautiously experimented with. Berzelius, who examined them, narrowly escaped from some frightful explosions, occurring quite unexpectedly. Some of them are liquid, others solid; and it appears that the different allotropic states of both the elements are seen also in these compounds, several of which are isomeric. As these compounds are not fully understood, and are for the present of no practical importance, we shall not enter into details in regard to them.

12. *Boron.*

Symbol B. Equivalent = 10 9.

This element is found in nature combined with oxygen, as boracic acid, which occurs free, dissolved in the vapours of certain volcanic districts in Tuscany. The hot vapours are received in reservoirs of water, in which the acid dissolves, and the heat of the vapours is employed to evaporate the water, till at last the acid crystallizes nearly pure. In Thibet boracic acid occurs in the soil near certain lakes, combined with soda, forming the crude borax of commerce, which is purified from the peculiar fatty matter it contains by a secret process known only to the Dutch. Borax is now largely manufactured in England, from the boracic acid of Tuscany, and of the volcanic islands of the Mediterranean.

Boron is obtained by heating dry boracic acid with potassium, $4BO_3+K_3=3(KO,BO_3)+B$. Water dissolves the borate of potash, and leaves the boron as a dark brown infusible powder, which, when heated to redness in oxygen, burns and reproduces boracic acid.

Boracic Acid, $BO_3=34\cdot9$.

Obtained as above described, and purified by repeated crystallization, or from borax (biborate of soda) by the addition of sulphuric acid to a hot saturated solution, forms white scaly crystals, composed of the anhydrous acid and water, $BO_3, 3HO$. When heated the crystals melt, lose their water, and at a red heat leave the anhydrous acid perfectly fluid, which on cooling forms a transparent glass. This soon becomes opaque by attracting water from the air. The acid is very soluble in hot, sparingly soluble in cold water. It is a weak acid at ordinary temperatures, but at a red heat it expels all less fixed acids. It gives to all its compounds a peculiar tendency to melt when heated, and hence borax is much used as a flux in metallurgical operations on the small scale. Boracic acid, and the compounds of boron in general, colour flame green, and by this character the presence of boracic acid has been detected in various minerals in which it is present in small quantity, as in tourmaline and schorl, &c. Boracite and datholite contain boracic acid in larger proportion. There is no other compound of boron and oxygen.

With chlorine boron forms a gaseous compound, the terchloride, BCl_3, corresponding to boracic acid, which decomposes water, yielding boracic and hydrochloric acids, $BCl_3+3HO=3HCl+BO_3$.

With fluorine it forms a similar gas, terfluoride of boron, BF_3, which fumes strongly in moist air. Its action on water is as follows: $3BF_3+3HO=(3HF, 2BF_3)+BO_3$. The compound $3HF, 2BF_3$ is called hydrofluoboric acid.

With nitrogen boron is said to form a white solid compound, BN, which is very stable. When fused with hydrate of potash it is converted into boracic acid and ammonia, the latter being expelled, while the former combines with the potash. $BN+3KO,HO=KO,BO_3+2KO+NH_3$.

The chief uses of boracic acid are as a flux, both in itself and in the form of borax; and the latter substance is also used in medicine. Goldsmiths use borax to clean the surface of gold, silver, and other metals which are to be soldered together. Borax is sprinkled on the metal, and melted by the blowpipe, when it dissolves any oxide or other impurities, leaving a bright metallic surface.

13. *Silicon or Silicium.*

Symbol Si. Equivalent = 21·3.

Next to oxygen, this is perhaps the most abundant element. Its only oxide, silicic acid or silica, constitutes, whether free or combined, by far the greater part of all rocks and soils, excepting only the different forms of limestone, marble, and chalk, gypsum, and rock salt.

Silicon is obtained by the action of potassium on a compound of fluorine, silicon, and potassium; and appears, like boron, in the form of a dark brown powder, which, strongly heated in oxygen, burns with a brilliant light, and is converted into silicic acid. It has recently been stated that, by means of a galvanic current, silicon has been deposited on the surface of metals, and exhibits a bright metallic lustre. This requires confirmation.

Silicon and Oxygen. $SiO_3=45\cdot3$.

This, the most abundant of all minerals, occurs pure in the form of rock crystal and quartz; which is either crystallized in six-sided prisms, terminated by six-sided pyramids, or compact and massive. Many kinds of sandstone are also nearly pure silicic acid, or silica, as it is often called. With very small quantities of oxide of iron and other metals, it forms agate, calcedony, jasper, carnelian, bloodstone, and many other ornamental stones. In amethyst there is only a trace of manganese. In opal there is hardly any impurity; and flint is also very nearly pure silicic acid. The deposits and rocks known by the names of mountain meal, polishing slate, kieselguhr, &c., are also pure silicic acid, in the form of the exuviæ or shells of the diatomaceæ, microscopic organisms which abound in almost all natural waters.

Felspar, which is an ingredient of almost all rocks, is a compound of silicic acid, alumina, and potash; and there are few other minerals occurring in rocks which are not also

silicates. This is the case with mica, hornblende, talc, serpentine, hypersthene, &c.; while porphyry, slate rock, grauwacke, and many others, such as basalt, trap rocks, and lavas, are chiefly modifications of felspar. The simple minerals found crystallized in nodules and veins in all rocks, such as zeolites and the like, are also in most cases silicates.

Silicic acid exists dissolved in sea-water and in all natural waters, although in small proportion, as is proved by the existence and rapid development of the siliceous shelled diatomaceæ in all such waters. Flint has probably been originally in the form of these minute organisms, for it often contains them unaltered. Some springs, especially thermal springs, contain much dissolved silica, as, for example, the Geysers of Iceland.

Pure silicic acid is easily obtained by simply pulverizing rock crystal or white quartz. From impure quartz, or siliceous sand or minerals, it is obtained by fusion with three parts of potash, when a glass is formed, soluble in water. The addition of acids to the strong solution causes the silica to separate as a bulky jelly; if added to the very diluted solution, the silica remains dissolved; but on evaporation to a certain point gelatinizes. The jelly is dried up to a powder, and then the silica becomes absolutely insoluble in water and acids, except hydrofluoric acid. All soluble matter being washed away with the aid of acid, the silica remains as a powder, gray and translucent while moist, snow-white and opaque when dry. However finely divided, it is always gritty to the teeth. Although thus expelled from its salts at ordinary temperatures by almost all acids, at a red heat it expels in its turn all that are volatile at that temperature. With the alkalies it forms glass, soluble when the alkali is in excess, insoluble or ordinary glass when the silicic acid predominates.

The uses of silica are numerous. It is an essential constituent of plants, more especially of the gramineæ, cerealia, and rush, cane, or bamboo tribes. It is employed in the manufacture of glass, and in the form of sand, for building mortar. It is also used along with lime, with which it forms a fusible silicate, as a flux in smelting metals, especially iron. Many forms of it are valued as ornamental stones, of which the opal is the most precious, from its rarity and beauty.

With chlorine, silicon forms a volatile fuming liquid, terchloride of silicon, $Si\,Cl_3$, which decomposes water in the same way as terchloride of boron, $Si\,Cl_3 + 3\,HO = 3\,H\,Cl + Si\,O_3$.

With fluorine it forms a gaseous terfluoride, $Si\,F_3$. This acts on water like the terfluoride of boron, producing a hydrofluosilicic acid. $3\,Si\,F_3 + 3\,HO = (3\,HF, 2\,Si\,F_3) + Si\,O_3$. The hydrofluosilicic acid ($3\,HF, 2\,Si\,F_3$) forms with potash and soda insoluble double salts, as, for example, in this reaction: $3\,HF, 2\,Si\,F_3 + 3\,KO = 3\,KF, 2\,Si\,F_3 + 3\,HO$. The new salt, $3\,KF, 2\,Si\,F_3$, may be regarded as a compound of fluoride of potassium with terfluoride of silicon.

It is in consequence of the great tendency of silicic acid to form the terfluoride with hydrofluoric acid, that the latter acid corrodes glass and porcelain. But the terfluoride of silicon may be prepared in glass vessels, by heating a mixture of fluor-spar, fine sand, and sulphuric acid. The sand is dissolved and the glass escapes. The terfluoride being made to pass through water decomposes it as above explained, forming hydrofluosilicic acid and silicic acid. The latter separates as a jelly, which would soon block up the tube, if we did not protect it by causing the end of it to dip just under the surface of mercury, by which means no water reaches the tube. The liquid is strained off from the jelly, and used as a test for potash and baryta. The jelly when dry forms a fine light bulky powder of silicic acid. If the liquid and the jelly be evaporated together, the terfluoride is reproduced, and the whole disappears.

METALS.

This numerous class of elements is characterized by two properties, both of which are present in every metal. These are, the metallic lustre, and the power of conducting heat and electricity. Metals exhibit also, in general, a strong attraction for the more negative non-metallic elements, being themselves, as a class, positive. It is particularly towards oxygen, chlorine, bromine, iodine, fluorine, sulphur, and selenium, that metals show this attraction; which, however, varies remarkably in degree, from potassium and its congeners, which can with difficulty be kept in the uncombined metallic state, on the one hand, to the noble metals on the other, which frequently cannot be made directly to combine with oxygen.

Before briefly describing the more important metals, for the majority of them need only be enumerated, we shall prefix some general remarks on the physical and chemical properties of the metals, which may thus be conveniently compressed into a very small space. The most important physical properties of metals are their density, fusibility, volatility, malleability, ductility, tenacity, hardness, and colour.

Metals vary much in density; while potassium and sodium are lighter than water, and lithium and calcium not much heavier, many common metals are very heavy; as iron 7 times, silver 10, lead 11, mercury 13, gold 19, platinum 21, and iridium as much as 26 times heavier than water.

Their fusibility is equally various, for mercury melts at 71° below the freezing point of water, potassium somewhere about + 100°, tin at 440°, lead below a red heat, copper and silver at a full red heat, gold and iron at a white heat, platinum requires a heat stronger than that of any furnace, and iridium has not yet been melted.

So also with regard to volatility, mercury boils at about 600°, potassium and sodium at a red heat, arsenic and tellurium even lower, zinc and cadmium at a strong red heat, antimony perhaps at a white heat, while the remaining metals have not yet been seen in the form of vapour or gas.

Of all metals, gold is the most malleable, and may be beaten into leaves of astonishing thinness; platinum and silver come next, then palladium, copper, nickel, tin, lead, cadmium, zinc, and iron. Most of the others are brittle, or have not been tried, from the difficulty of obtaining them.

Ductility is not proportional to malleability. The most ductile metal is platinum, which yields wire so fine as to be almost invisible to the naked eye; then come gold, silver, iron, copper, tin, zinc, cadmium, and lead. The difference between malleability and ductility is strongly seen in iron, which yields very fine wire, but cannot be beaten into thin leaves.

The tenacity of metals is measured by the weight required to break a rod of equal thickness and length of different metals. Iron is the most tenacious, a fine iron wire requiring a comparatively heavy weight to break it. The other ductile metals are all more or less tenacious.

Of the common metals, gold, platinum, and lead are the softest; tin, zinc, cadmium, and silver somewhat harder; copper and iron the hardest. But the hardest of all metals is iridium, which is so very hard that it cannot be wrought by any tools.

The colour of metals is usually either white, with a tinge of some other colour in many cases, or gray. One metal, gold, is yellow, and one, copper, is red. Titanium was supposed to be of the colour of copper, but the cubic crystals formerly supposed to be titanium are now known to contain other elements, cyanogen and nitrogen, in addition to the metal. Silver is pure white; tin and sodium are yellowish-white; zinc and potassium bluish-white; bismuth reddish-white; antimony, arsenic, and iron, gray. Metals often have a different colour in the compact state and in that of powder. Gold in powder is either brown or nearly black, according to the fineness of the powder. Platinum, gray in the compact and even in the spongy state, is jet black in powder.

The chemical characters of metals are determined by their attractions for oxygen, chlorine and its congeners, and

Chemistry. sulphur. A few general remarks on the relations of these substances to metals will greatly facilitate the subsequent description of the individual metals.

The attraction of metals for oxygen, as has been already stated, varies exceedingly. Some, such as potassium and sodium, rapidly attract oxygen from the air, and are thus oxidized. Others, such as iron and copper, attract oxygen very slowly at ordinary temperatures, and only when moist, but are readily oxidized at a red heat, as is seen on the anvil of the blacksmith, where the scales which form on red-hot iron are an oxide of that metal. Others again, as silver, gold, and platinum, not only do not attract oxygen, even at a red heat, but if already combined with it, lose it when heated to redness. Mercury at a certain temperature is oxidized, but the oxide is decomposed at a temperature very little higher.

Some metals decompose water, seizing its oxygen and liberating its hydrogen, at ordinary temperatures, as potassium and sodium. Others only do so at a red heat, as iron and zinc.

There are various methods of oxidizing metals indirectly. Nitric acid oxidizes and dissolves many metals, indeed most of them. It is particularly used for oxidizing copper, mercury, silver, and antimony. Many metals, such as zinc and iron, are oxidized by dissolving them in hydrochloric or sulphuric acid, and then adding an alkali. On the common view, metals when dissolved in sulphuric acid, are first oxidized at the expense of water, and the alkali only separates the ready formed oxide by taking the acid from it. But this cannot apply to the solution of metals in hydrochloric acid, which forms chlorides; and yet alkalies added to chlorides precipitate oxides, just as with the sulphates. This is an additional argument in favour of the opinion that sulphuric acid is a compound of hydrogen, and that in its salts this hydrogen is replaced by metals.

The action of an alkali, potash, on the chloride of a metal, zinc, is as follows, $KO + Zn\,Cl = K\,Cl + Zn\,O$, and its action on sulphate of zinc on the modern view, takes the same form. $KO + Zn\,SO_4 = K, SO_4 + Zn\,O$. We have already explained the action of metals on hydrochloric and sulphuric acids, and shown that the same view may be taken of both, the phenomena being precisely the same, namely, that the metal is dissolved and hydrogen liberated.

A few metals which cannot be dissolved either by hydrochloric, sulphuric, or nitric acids, are dissolved and converted into chlorides by a mixture of nitric and hydrochloric acids, which is called nitro-hydrochloric acid, or aqua regia. It yields abundance of chlorine, which being in the nascent state combines with the metal. The action of the two acids is as follows; $H\,Cl + NO_5, HO = NO_4 + Cl + 2\,HO$. According to some, the nitrous acid and chlorine combine to form a new acid, chloronitric acid, $NO_4\,Cl$, and this is the true solvent. At all events, the result is a chloride of the metal, from which, by means of an alkali, the oxide may be formed.

Metals, having so strong an attraction for oxygen, are usually found combined with it, and the oxides of metals are the most important of their compounds. Protoxides, or oxides of the formula MO, are bases, generally powerful ones; sexquioxides $M_2\,O_3$ are weaker bases; deutoxides MO_2 are neutral, or even weak acids; teroxides, MO_3 are generally strong acids; as are also oxides of the formulæ MO_5 and MO_7. The character, therefore, of the oxide depends on the amount of oxygen in it.

The deoxidation of metallic oxides, or their reduction to the metallic state is an operation of great practical importance, most metals being obtained by this means from their ores. The methods of reduction are various.

Some oxides are reduced by heat alone, as those of silver, gold, platinum, mercury.

Most oxides may be reduced by the combined action of heat and hydrogen, or heat and carbon; the oxygen being carried off as water in the first case, and as carbonic acid gas in the second. Hydrogen is much employed in analytical reductions on the small scale, but carbon is alone used in smelting. The reduced metal is melted by the heat, and falls to the bottom of the crucible or furnace. To prevent it from being again oxidized, a flux is employed, that is, a fusible earthy or saline mixture, which covers the surface of the metal with a fluid mass, and protects it from the air. Chemistry.

Many oxides may be reduced from their solutions by means of other metals having a stronger attraction for oxygen. Thus, salts of silver are reduced by mercury, those of mercury by copper, lead, or tin; copper is reduced by zinc or iron, lead by zinc, tin by zinc. This method is often used in the laboratory. Silver, lead, and tin crystallize beautifully when thus reduced.

Many metallic oxides are also reduced by various deoxidizing agents, both from their solutions, and in the dry way with the aid of heat. Protosulphate of iron reduces gold from its solutions, as do oxalic and formic acids. Silver is reduced by formic acid, by aldehyde, and by oil of cloves. Cyanide of potassium, which combines the deoxidizing agency of carbon with that of potassium, is a most powerful reducing agent at a red heat.

Lastly, several metals are reduced, and that in a compact metallic-looking mass, although from solutions at the ordinary temperature, by the galvanic current. This constitutes the electrotype, which is chiefly applied to copper, silver, and gold. The metals thus obtained are as dense, as hard, and as malleable, as if they had been melted, rolled, and hammered.

Metals are made to combine with chlorine in various ways. Most of them if in a state of fine division combine directly with chlorine gas, generally taking fire in it. But this method is not convenient.

The chlorides of metals may be obtained by acting on the metals or on their oxides with hydrochloric acid, as already explained. As all chlorides, except two, chloride of silver and protochloride of mercury, are soluble in water, this method is much used. The insoluble chlorides are obtained by adding hydrochloric acid or a soluble chloride to any solution of the metal. Thus, hydrochloric acid or chloride of sodium, added to nitrate of silver, precipitate the chloride of silver, $H\,Cl + Ag\,O, NO_5 = HO, NO_5 + Ag\,Cl$, or $Na\,Cl + Ag\,O, NO_5 = Na\,O, NO_5 + Ag\,Cl$.

The volatile chlorides of some metals, such as aluminum, titanium, &c., which decompose water, are obtained by mixing the oxide of the metal with charcoal heated red-hot, and passing chlorine over the mixture. Aided by the attraction of chlorine for the metal, the carbon deoxidizes the oxide, which otherwise it could not do, and the chloride is deposited in the cold part of the apparatus.

When a chloride is to be reduced to the metallic state, hydrogen, aided by heat, may be used on the small scale, but carbon is of no avail.

Chlorides may also be reduced by other metals, and by various mixtures; also by the galvanic current. Chloride of silver is reduced by the action of iron or zinc; by heating to redness with lime, or by boiling with potash and sugar.

All that has been said of the formation and decomposition of chlorides applies also to bromides and iodides, and with the exception that we cannot employ fluorine itself, which is unknown, to fluorides likewise.

With sulphur, most metals combine, when heated along with it. The insoluble sulphurets may also be formed, in solutions of the metal, by the addition of hydrosulphuric acid, or of a soluble sulphuret, which act on the oxides, chlorides, &c., in the same way.

$$MO + HS = HO + MS \text{ and } M\,Cl + K\,S = K\,Cl + M\,S.$$

In some cases the sulphuret of a metal is obtained by

Chemistry.

deoxidizing the sulphate. Thus, in the case of barium or potassium, the sulphurets of which are soluble, the sulphate of the oxide is heated with charcoal or hydrogen.

$$BaO, SO_3 + C_2 = 2\,CO_2 + BaS \text{ and } KO, SO_3 + H_4 = 4\,HO + KS.$$

The sulphurets are reduced in various ways. Some are heated with a mixture of charcoal and carbonate of potash (black flux). The potassium takes the sulphur, while the carbon takes the oxygen of the potash, and the metal is reduced. Some are heated in hydrogen gas, when hydrosulphuric acid is given off, and the metal is left. Some sulphurets are reduced by being heated with other metals, as when sulphuret of mercury is reduced by heating it with iron filings. But on the large scale the usual method is to roast the ore (sulphurets being the chief ores of many metals, as lead, antimony, bismuth, copper, &c.), so as to oxidize both metal and sulphur, and dissipate a great part or the whole of the latter as sulphurous acid. The oxidized residue is then heated with charcoal as usual.

Metals also combine together, especially when heat is applied. It is remarkable that two metals heated together generally melt far more easily than they do separately. This is because the compound metal is always more fusible than the less fusible element, and often more so than the more fusible of the two. Compounds of two or more metals are called alloys, as brass, composed of copper and zinc; bronze, of copper and tin; pewter, of lead and tin; and fusible metal, of lead, tin, and bismuth. Where mercury is one of the elements, the alloy is called an amalgam.

The physical properties of alloys are those of simple metals, and there is nothing in their appearance to indicate their compound nature. In many cases, the addition of a very small proportion of one metal very greatly modifies certain properties of the other, such as fusibility, hardness, tenacity, and the like. A mere trace of arsenic renders gold brittle, and one part of zinc, tin, antimony, and other metals, added to 100, 200, or even 500 parts of iron, much increases both its fusibility and hardness. The subject of alloys is as yet only imperfectly investigated, and many valuable alloys remain to be discovered. It has been ascertained, however, that, while many metals may be fused together in any proportions, the properties for which alloys are valued are best developed when the metals are in atomic proportions, or multiples and submultiples of these.

In briefly noticing the more important metals, we shall divide them into groups, according to their natural analogies. It will be found that these groups are characterized by marked differences in the attraction for oxygen, and also in the nature of the oxides formed, while, in these and many other points, the metals of each group closely resemble each other.

GROUP I.

Metals of the Alkalies Proper.

This group consists of three metals, potassium, sodium, and lithium, which resemble each other as closely as do chlorine, bromine, and iodine. This resemblance is indeed so close that it is often difficult to distinguish between their compounds. They have all so strong an attraction for oxygen that they cannot be preserved in the metallic state unless they are protected from the contact of air, water, and other oxidized substances. They are all oxidized by exposure to air, and all decompose water at ordinary temperatures. Their protoxides are the alkalies, potash, soda, and lithia.

14. *Potassium.*

Symbol K (Kalium). Equivalent = 39 2.

This metal occurs, in the form of salts of its oxide, potash, and in that of its chloride, in the ashes of plants, especially land-plants. Chloride of potassium also occurs in those of sea-plants. Potash also occurs, combined with alumina and silicic acid, in felspar, which, as already mentioned, is one

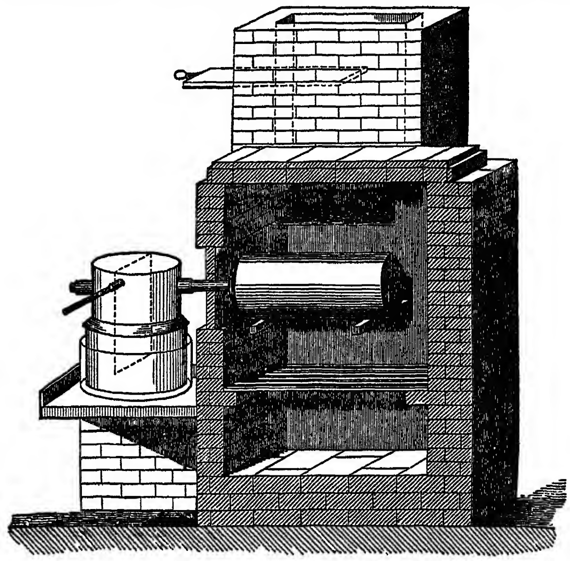


Fig. 29.

of the most abundant minerals. The metal is best obtained from the carbonate of potash, KO, CO_2, by exposing it to a white heat, mixed with charcoal, in a bottle of malleable iron. The carbon is oxidized at the expense of the potash, forming carbonic oxide gas which escapes, while the metal is volatilized and condensed in a receiver filled with naphtha, a liquid containing no oxygen. The process is not very productive, because the carbonic oxide forms, with part of the metal, a dark gray pulverulent compound, which is carried forward by the current of gas, and is apt to choke up the tube. This compound is dangerous, as it takes fire and explodes in contact with water. The metal is purified by melting it under naphtha, and pressing it through leather. If necessary it may be distilled in a small iron retort, and collected in naphtha.

Potassium has a highly metallic lustre, and a bluish-white colour. It is somewhat lighter than water, its density being 8650. It melts at 150°, and if heated takes fire, burning to oxide or potash, KO. It combines with equal energy with chlorine, bromine, iodine, sulphur, &c. Its attraction for oxygen is such that it decomposes all oxidized substances when heated with them, and many at the ordinary temperature. When thrown on the surface of water, it instantly melts, takes fire, and floats on the water, burning with a pink flame. Here the first effect is to deprive the water of oxygen, liberating hydrogen, which is set fire to by the heat evolved. The flame therefore is that of hydrogen and potassium mixed. But if the metal, inclosed in paper, or held by a pair of forceps, be plunged under the surface, no flame appears. Hydrogen gas is abundantly disengaged, and the metal even becomes red-hot under water. The oxide formed is dissolved. Exposed to air, potassium rapidly tarnishes and attracts, first oxygen, then carbonic acid and water, so that, in a short time, it is transformed into a strong solution of carbonate of potash. When heated with the oxides, chlorides, fluorides, &c., of such bodies as boron, silicon, magnesium, aluminum, &c., it deprives these substances of oxygen, and liberates the boron, silicon, and metals they contain.

Protoxide of potassium, or potash, $KO = 47{\cdot}2$. Hydrate of potash or caustic potash, $KO, HO = 56{\cdot}2$.

The anhydrous protoxide or dry potash can only be obtained by heating the metal in dry oxygen gas. When it has once been dissolved, or when obtained from a solution,

it can only be got in the form of the hydrate, which is the true alkali.

Hydrate of potash is obtained by the action of hydrate of lime on a boiling solution of carbonate of potash, when the lime takes the carbonic acid, forming an insoluble carbonate, and the free potash dissolves. The clear solution, boiled rapidly down in a clean iron or silver vessel, till it flows like oil, forms, on cooling, a hard solid mass of hydrate of potash or caustic potash, KO, HO. This 1 eq. of water cannot be expelled by heat.

Caustic potash is very soluble and deliquescent. It also attracts carbonic acid from the air, and is converted into carbonate, if not kept in tightly-stopped vessels. It is very caustic, and has a burning alkaline taste. It seems to act as a caustic from its attraction for water. It neutralizes all acids, forming salts, which are called the salts of potash. Many of them are useful, as the carbonate, nitrate, sulphate, bitartrate, oxalate, &c. The solutions of potash and of its salts, as well as of all other soluble compounds of potassium, are recognised by giving, with excess of tartaric acid, a crystalline precipitate of the bitartrate, with bichloride of platinum a yellow crystalline precipitate of the double chloride of platinum and potassium, and with perchlorate of potash a crystalline precipitate of the perchlorate.

Caustic potash is much used both in surgery and in chemistry. It precipitates the insoluble oxides of most metals. In the arts it is employed in making soap, and in a variety of other ways. The carbonate is used in the manufacture of glass, and the nitrate in that of gunpowder.

Potassium forms, in certain circumstances, not well understood, a peroxide, KO_3, which is a yellow powder of no particular interest.

Chloride of potassium, $K Cl$, is produced when hydrochloric acid acts on potash. $H Cl + KO, HO = K Cl + 2\ HO$. It crystallizes in cubes, has a bitterish saline taste, and much resembles chloride of sodium or sea-salt. This salt is found in kelp, the ashes of sea-weed, and is used in making alum.

Iodide of potassium, KI, is formed along with iodate of potash, KO, IO_5, when iodine is dissolved in solution of potash. $I_6 + 6\ KO = 5\ KI + KO, IO_5$. The mixture, when heated to redness, gives off the oxygen of the iodate, and leaves the pure iodide. $5\ KI + KO, HO = 6\ KI + O_6$. This salt is much used in medicine and also as a reagent in chemistry. It crystallizes in cubes like the chloride, and is soluble in alcohol.

The bromide and fluoride are very like the chloride and iodide, crystallizing also in cubes.

The sulphuret of potassium, KS, is formed by heating the elements together, or by heating sulphate of potash in a current of hydrogen gas. $KO, SO_3 + H_4 = 4\ HO + KS$. It is a white or yellowish powder, soluble in water. There are other sulphurets with more sulphur, especially the pentasulphuret, KS_5, which forms a solution of a deep yellow colour.

15. *Sodium.*

Symbol Na (Natrium). Equivalent = 23.

This metal is found, oxidized, as carbonate, in the ashes of sea-plants, or kelp, barilla, and varec. But it occurs chiefly as chloride of sodium constituting sea-salt and rock-salt, which are most abundant mineral compounds. Chloride of sodium is also present in small proportion in all waters, even in rain-water, and in large amount in salt springs, which are very common in many districts. It is probably also present in all soils, and in most rocks, and is a constant ingredient of the ashes of plants.

Sodium is obtained from the carbonate exactly as potassium is; only, as the metal forms no combination with carbonic oxide, the process is more productive. Like potassium, it must be collected and preserved under naphtha. It has a yellowish-white colour and bright lustre, is rather heavier than potassium, its specific gravity being 9700, and also less fusible and less volatile. It decomposes water, but does not burn on its surface, although if a few drops of water be sprinkled on a bit of sodium, the hydrogen will then take fire and set fire also to the metal, giving an intensely yellow flame. In all other respects sodium resembles potassium; but this character of giving a strong and pure yellow colour to flame is found in all the salts of sodium, and at once distinguishes them from those of potassium, which colour flame of a faint lilac, not easily observed, since the presence of a trace of sodium or of many other metals overpowers it. Potassium itself burns with a lively pink flame, but in its salts the effect is much less marked, whereas in those of sodium the effect on flame is as strong as in the metal itself.

Protoxide of sodium or soda, like potash, is best known in the form of the hydrate, or caustic soda, $Na O, HO$, which is entirely similar to caustic potash, and is prepared from the carbonate exactly in the same way. Hydrate of soda, like that of potash, is deliquescent, and also attracts carbonic acid from the air, but the carbonate of soda differs from that of potash, which is anhydrous and very deliquescent, and can hardly be made to crystallize, whereas carbonate of soda forms very large crystals, containing at least half their weight of water of crystallization and efflorescing, that is, losing water and becoming opaque and powdery in the air.

Soda is best distinguished from potash by its action on flame, and by the characters of its salts. We have seen that potash forms nearly insoluble salts with perchloric acid, bichloride of platinum, and excess of tartaric acid, to which may be added carbazotic or nitropicric acid. With all of these, and indeed with acids in general, soda forms soluble salts. There are only two salts of soda insoluble, or nearly so, namely, the silicofluoride of sodium, formed by hydrofluosilicic acid, when added to soda or its salts, and the antimoniate of soda. But potash also forms an insoluble silicofluoride; and hence the only test which can be used to distinguish soda from potash by forming a precipitate is antimoniate of potash, which of course does not act on the salts of potash. Unfortunately the solution of this test does not keep well; so that chemists generally make use of the action of sodium and its salts on the flame of alcohol, or convert the soda into certain salts which differ from the corresponding salts of potash, as has been mentioned in regard to the carbonate. The sulphate of soda is also efflorescent, and crystallizes in four-sided prisms, while that of potash is anhydrous, and forms six-sided prisms and pyramids. The nitrate of soda forms rhombic crystals, while that of potash yields six-sided prisms.

Soda is used for much the same purposes as potash; and as pure carbonate of soda is now made at a cheap rate from sea-salt, while the commercial carbonate of potash is not only dearer, but very impure, soda is generally preferred. Its chief uses are in making soap (the soaps of soda being hard, while those of potash are soft), and glass. It is also used in bleaching and calico-printing, the cloth being boiled with soda in various processes.

There is a peroxide of sodium, which seems to be a deutoxide, $Na O_2$, but is little known.

Chloride of sodium, $Na Cl$, sea-salt or rock-salt, is the most important compound of sodium. It is the type of all neutral salts, which indeed, as a class, are named from it. It has a purely saline taste, and strong antiseptic properties, fitting it for use as a condiment to food (for which purpose it is indispensable, since blood cannot be formed without salts of sodium), and for preserving meat. Chloride of potassium cannot be used for either of these purposes.

Sea-salt crystallizes in cubes, which are generally hollow.

 Rock-salt is often found in large transparent masses, which cleave readily in the boundary planes of the cube, and may thus be shaped into perfect cubic crystals. It is almost equally soluble in hot and in cold water.

In the arts, salt is used for the production of chlorine, chloride of lime or bleaching powder, and hydrochloric acid. It is also used as a manure.

The bromide, iodide, fluoride, and sulphuret of sodium, are quite analogous to those of potassium.

16. *Lithium.*

Symbol L. Equivalent = 6·5.

This metal, the third of the alkaline group, is rare, occurring only in small proportion, seldom more than 3 or 4 per cent. in a few rare minerals, such as spodumene, petalite, lithion-mica, and lepidolite. The metal is little known, but is analogous to sodium and potassium, being heavier than either, and having apparently stronger affinities.

The hydrated oxide of lithium, L O, H O, analogous to caustic potash and soda, is less soluble and less caustic, but like them attracts moisture and carbonic acid from the air. The carbonate is sparingly soluble. The sulphate, nitrate, and chloride are similar to those of potassium, except that the two last-named salts are deliquescent. Lithium and all its salts are easily recognised before the blow-pipe by the property of giving to flame a blood-red colour. It differs from potassium and sodium also in forming a sparingly soluble carbonate, and a nearly insoluble phosphate.

Lithia has not been applied to any useful purpose, being too rare. It occurs in small proportion in various waters, and possibly contributes to their action on the system. It is worth while to mention that the minerals which contain lithia, especially lithion-mica, and lepidolite, which is a kind of mica, have been found hitherto always associated with certain minerals, namely, topaz, albite, or soda-felspar, and tin ore. The occurrence, therefore, of lithia, especially along with topaz and albite, may be regarded as an indication that tin ore is not distant. The above-named minerals are found together in all the tin districts of Europe, in Cornwall, Saxony, and Sweden, and we have seen the same combination in two districts, one in Scotland, the other in Ireland; in both of which tin ore was also found, but as yet not in available quantity.

The group just described is very remarkable from the great analogy which pervades it, and from its complete parallelism with the group of chlorine, bromine, and iodine. In both, the gradation of properties is perfect, and the atomic weight of the middle elements, sodium and bromine, is, in both cases, the mean between those of the extremes. The most probable explanation of these relations is, that all these bodies are really compound, and contain in each group some common element, the variation in the amount of which causes the change of properties. In other words, these would be regarded as groups of homologous compounds, and they closely resemble such groups. But in the meantime, as we cannot prove them to be compounds, they remain elements to us.

GROUP II.

Metals of the Alkaline Earths.

The next group contains four metals, those of the alkaline earths, in which the gradation of properties seen in the first group is repeated or rather continued. In this group the protoxides are more and more sparingly soluble till the last, which is insoluble; the carbonates are insoluble in water, and the sulphates, with one exception, are either sparingly soluble or insoluble. By these characters they are readily distinguished from the metals of the first group.

17. *Barium.*

Symbol Ba. Equivalent = 68·5.

This metal, which is little known, has been obtained hitherto only by means of a powerful galvanic battery. It is much heavier than the preceding metals, its density being above that of oil of vitriol.

The protoxide of barium or baryta is found in nature, combined with carbonic acid and sulphuric acid, forming the minerals witherite and heavy spar. It occurs also in a few other minerals, chiefly silicates. To obtain the pure anhydrous oxide, Ba O, the carbonate is heated to whiteness, mixed with a little charcoal. By this means the carbonic acid is partly expelled as such, partly as carbonic oxide, and baryta is left. Or the nitrate of baryta is cautiously heated in an earthen crucible, when it melts, and gives off nitrous acid and oxygen, baryta being left. It forms a gray porous earthy mass, which, like quicklime, produces intense heat when brought in contact with water, with which it forms a fine white powder, hydrate of baryta, Ba O, HO. This is dissolved in considerable quantity by hot water, and the hot saturated solution deposits, on cooling, fine tabular crystals of another hydrate, Ba O, 10 HO. The hydrate is much less soluble in cold water than in hot, but still the solution has a strong styptic, almost caustic, alkaline taste, and attracts carbonic acid from the atmosphere, forming the insoluble carbonate. The nitrate of baryta, chloride of barium, and other salts of this base, are easily obtained from the carbonate by the action of the proper acids. But as the carbonate is much more rare than the sulphate, and as the sulphate is quite insoluble in water and acids, it must be decomposed, so as to allow of its being converted into other salts. This is effected by mixing it in fine powder with $\frac{1}{4}$th of its weight of charcoal, and heating the mixture to a strong red heat for two hours in a covered crucible, leaving a small aperture for the escape of gas. The action is as follows: $BaO, SO_3 + C_4 = 4\ CO + BaS$. The products are carbonic oxide gas and sulphuret of barium. The latter compound is dissolved by boiling water, which leaves any impurities as well as any excess of charcoal undissolved. The solution, treated with nitric acid, yields the nitrate; with hydrochloric acid, the chloride; with carbonate of potash, soda, or ammonia, the carbonate; and if boiled with oxide of copper, it yields the hydrate of baryta. The formation of the nitrate is as follows: $BaS + HO, NO_5 = HS + BaO, NO_5$. That of the chloride is $BaS + HCl = HS + BaCl$. That of the carbonate is $BaS + KO, CO_2 = KS + BaO, CO_2$, and that of the oxide is $BaS + CuO = CuS + BaO$. The oxide thus formed instantly combines with water to form the crystallized hydrate.

Baryta is characterized by the extreme insolubility of its sulphate in water and acids, and its salts are used as tests for sulphuric acid; which again is used as a test for baryta. Hydrofluosilicic acid produces, in the salts of baryta, an insoluble crystalline precipitate. Baryta differs also from the three preceding metals in forming an insoluble carbonate, and in its own sparing solubility.

Chloride of barium, prepared as above stated, crystallizes in tabular crystals, Ba Cl, 2 HO. It is much used as a test for sulphuric acid, and as a means of determining the quantity of that acid in analysis. It is also used in medicine.

The sulphuret of barium, Ba S, is soluble in water, as has just been mentioned. It is much used as a means of obtaining the other salts of baryta from the insoluble sulphate.

Baryta, and all its salts, except the sulphate, which, being insoluble in all menstrua, is inert, are very poisonous.

18. *Strontium.*

Symbol Sr. Equivalent = 43·8.

This metal is hardly known, but is very analogous to barium. The protoxide, strontia, is found as carbonate or

strontianite, and sulphate or celestine. The anhydrous oxide, $Sr O$; the hydrates, $Sr O, HO$, and $Sr O, 10 HO$; the carbonates, $Sr O, CO_2$; the nitrate, $Sr O, NO_5$; the chloride, $Sr Cl$; the sulphate, $Sr O, SO_3$, and the sulphuret, $Sr S$, are all prepared precisely as in the case of barium, and are as similar to the corresponding compounds of that metal as the salts of sodium are to those of potassium. The chief differences are, that the sulphate is not absolutely insoluble, and the hydrate rather less soluble than the corresponding compounds of baryta. The chloride is deliquescent, and strontia and all its salts give to flame a fine crimson colour. The nitrate is used, indeed, in making red fire for signals and for the theatres. There is no other useful application of strontia or its salts.

19. *Calcium.*

Symbol Ca. Equivalent = 20.

This metal also is little known. But the protoxide, $Ca O$, is the important substance quicklime. It is found, like baryta and strontia, as carbonate in marble, limestone, chalk, and calcareous spar, and as sulphate in gypsum, alabaster, and selenite. The shells of shell-fish consist chiefly of carbonate of lime, and the rocks above mentioned have been in many cases derived from the accumulation of shells and of their debris, as is proved by the frequent occurrence of chalk, limestone, and marble, entirely composed of shells.

Pure lime, $Ca O$, is obtained by heating pure marble, &c., to redness in a current of air, when the carbonic acid is expelled and quicklime is left. Quicklime is still more sparingly soluble than strontia. It combines with water with great energy, giving out much heat, and producing hydrate of lime or slaked lime, $Ca O, HO$. Hydrate of lime is very sparingly dissolved by water, forming a solution called lime-water, which has an alkaline styptic taste, neutralizes acids, and attracts carbonic acid from the air, forming the insoluble carbonate. Lime-water is a much weaker solution than strontia-water, and strontia-water than baryta-water, so that there is a regular gradation of solubility in the group.

Lime is much employed for making mortar and in agriculture. The uses of marble and limestone for building, and of chalk for various purposes in medicine, and for the preparation of effervescing drinks, are well known. The presence of lime in any solution is detected by adding first ammonia to neutralize any acid, and then oxalate of ammonia, which produces a precipitate of the insoluble oxalate of lime. Lime and its salts are also used to detect oxalic acid.

Chloride of calcium, $Ca Cl$, is formed when hydrochloric acid acts on carbonate of lime. It is very soluble, crystallizes with difficulty, and is very deliquescent. It is much used by chemists from its strong attraction for water, to deprive other substances, such as gases, ethers, and the like, of moisture; also to collect water in analysis, so that its weight may be ascertained.

20. *Magnesium.*

Symbol Mg. Equivalent = 12·2.

This metal is obtained by the action of potassium on the chloride, $Mg Cl + K = K Cl + Mg$. It is silvery white, of a brilliant lustre, and malleable. It may be kept in dry air or under water. When heated in oxygen it burns with much light, producing the protoxide or magnesia, $Mg O$.

This oxide magnesia, $Mg O$, is best obtained, like lime, by heating the carbonate. Hence it was called calcined magnesia, the carbonate being then called magnesia. Magnesia is insoluble in water, but has an earthy taste. It is quite white, while the three preceding alkaline earths are more or less gray. Hydrate of magnesia, $Mg O, HO$, is formed by precipitating the soluble salts of magnesia by caustic potash, soda, or ammonia. It is white, and resembles the anhydrous oxide, into which it is converted by a low red heat, water being expelled.

Magnesia is a strong base, and neutralizes all acids. It is distinguished from the three preceding oxides by its insolubility and by forming a soluble sulphate. It agrees with them in forming an insoluble carbonate. It is found in nature as carbonate in some localities, but chiefly in the form of the double carbonate of lime and magnesia, dolomite, or magnesian limestone. The sulphate occurs in some springs, as in Epsom and Cheltenham waters. Hence its name of Epsom salt.

Magnesia and its carbonate are much used in medicine as antacids. The sulphate is an excellent laxative.

Magnesia has a remarkable tendency to form double salts, as carbonate of lime and magnesia; sulphate of magnesia and potash (ammonia and soda may be substituted for the potash); and phosphate of ammonia and magnesia. The latter being quite insoluble, especially where an excess of ammonia is present, magnesia is detected by converting it into this double phosphate, which is done by adding first carbonate of ammonia and then phosphate of soda.

The chloride of magnesium, $Mg Cl$, is obtained by dissolving magnesia in hydrochloric acid, evaporating to dryness, and igniting after the addition of sal-ammoniac, the vapours of which protect the chloride from the action of the air, which would otherwise oxidize the metal, expelling the chlorine. The fused mass of chloride must be kept in well-stopped vessels, as it is very deliquescent. It is from this salt that magnesium is obtained, and we mention it here because, as the metal is not rapidly oxidized in the air like those which precede, and appears to be malleable, it is possible that it may be in time applied to useful purposes.

It will be observed, that while barium, strontium, and calcium form a triad, parallel to that of potassium, sodium, and lithium, and with the same gradation in properties, such as solubility, force of attraction, and atomic weight, magnesium, with some points of analogy to these, yet in other points stands by itself. It is the first metal which, although having a strong attraction for oxygen, can yet be kept unchanged in air and water, the first also whose oxide (a protoxide) is insoluble in water. But it is placed with the three preceding metals, because it differs still more from those which follow. Strictly speaking, it does not belong to the same group with the three which precede it, and which form so well-marked a triad; and we shall see that its analogies are rather with zinc, a metal belonging to a different part of the series. It is, in fact, isomorphous with zinc.

GROUP. III.

Metals of the Earths Proper.

The next group is that of the metals of the earths proper, which are five in number. Only one of these, however, is of much importance, the others being rare, and two of them exceedingly so. They form sesquioxides, which are bases, but not powerful, being expelled from their combinations by protoxides in general. These oxides are insoluble in water, and have an earthy aspect. The metals are little known, but aluminum is said to have been recently obtained on a larger scale than formerly, and to admit of useful applications.

21. *Aluminum.*

Symbol Al. Equivalent = 13·7.

This metal is obtained from the chloride by the action of potassium, and has hitherto been described as a dark-gray nearly black powder, infusible, but taking metallic lustre under the burnisher. Recently it is said to have been deposited on the surface of other metals, by means of the galvanic current, as copper is in the electrotype, in a perfectly compact metallic state, with a bright silvery lustre and co-

lour, and permanent in the air. When heated in oxygen, it burns with a brilliant light to sesquioxide. It is this sesquioxide which is so important from its abundance in nature.

Sesquioxide of Aluminum—Alumina, $Al_2O_3 = 51{\cdot}4$.

This earth is, next to silica, the most abundant solid constituent of the earth's crust. It forms a large proportion of all felspar, and felspar is a constituent of most rocks. In decayed or disintegrated felspar, which constitutes clay, alumina preponderates; and in some clays, such as pipe-clay and porcelain clay, it is nearly pure. Alumina also occurs crystallized in the sapphire and ruby, which contain only a mere trace of colouring matter, and in corundum.

Pure alumina is obtained from alum, which is a double sulphate of alumina and potash, by adding carbonate of potash, which produces a bulky gelatinous precipitate of hydrate of alumina. This is well washed with hot water. Since alumina does not combine with carbonic acid, the carbonic acid of the carbonates escapes as gas. The washed hydrate is not yet pure, retaining some potash. It is dissolved in hydrochloric acid, and reprecipitated by ammonia, again washed, dried, and ignited, when the bulky hydrate, becoming anhydrous, shrinks to a small bulk. Another method, which does not require the long and tedious washing of the hydrate, is to precipitate alum by chloride of barium, which throws down the sulphuric acid as sulphate of baryta, while chloride of potassium and hydrochlorate of alumina remain dissolved. The solution is dried up and the residue ignited, when the hydrochloric acid is expelled, and there is left a mixture of anhydrous alumina and chloride of potassium. The chloride is removed by hot water, and the alumina, which in this state is easily washed, is then dried and ignited, when it appears as a dense earthy white powder. That obtained by igniting the hydrate is translucent, and forms hard lumps.

Alumina is insoluble in water, but forms with it a plastic mass, which can be moulded into any shape, and when ignited retains the form given to it, and becomes hard, and much contracted in volume from the loss of water. When freshly precipitated the hydrate is very soluble in acids, but after ignition it dissolves in them very slowly. Its solutions have a sweetish astringent taste, and are styptic. Alumina is recognised by its being precipitated by caustic and carbonated potash, soda, and ammonia; and by its redissolving easily in an excess of caustic potash or soda, but not in ammonia. It may also be recognised by forming, with sulphuric acid and potash, a solution which, on evaporation, readily yields octahedral crystals of alum.

Alumina is useful as the chief constituent of all plastic clays, such as pipe-clay, porcelain-clay, brick-clay, and fire-clay. In these it is combined with a little silica. In the form of alum and acetate of alumina, it is much employed in dyeing and calico-printing. Alum is also used in medicine.

Alumina is the first sesquioxide we have come to, and is the type of such oxides.

Chloride of aluminum is a volatile fuming liquid, formed when chlorine gas is passed through a red-hot tube containing alumina intimately mixed with charcoal. The charcoal, aided by heat alone, cannot deoxidize alumina; but when the attraction of chlorine for the metal is added, the carbon is oxidized, and passes off as carbonic acid or carbonic oxide. $Al_2O_3 + C_3 + Cl_3 = 3\,CO + Al_2Cl_3$. The chloride is a sesquichloride. It must be carefully kept out of contact with water, which it instantly decomposes, forming hydrochlorate of alumina: $Al_2Cl_3 + 3\,HO = (Al_2O_3,\ 3\,HCl)$. This action on water is the reason why the chloride fumes in the air. Potassium decomposes it, setting free the metal as a dark-gray powder.

The other metals of this group are—22. Glucinium, $G = 26{\cdot}5$, which is found as sesquioxide in the beryl and the emerald, and is named from the sweet taste of its salts. The oxide glucina, G_2O_3, resembles alumina, but it differs from it in being soluble in carbonate of ammonia. 23. Yttrium, $Y = 32{\cdot}2$, the sesquioxide of which, or yttria, is found in two or three very rare minerals, such as gadolinite, and yttrotantalite, which occur at Ytterby, in Sweden; hence the name. Its salts are also sweetish, but it is of little importance. 24. Thorium, $Th = 59{\cdot}6$, found only in one very rare mineral, thorite, and hitherto only seen by one or two chemists; and 25. Zirconium, $Zr = 22{\cdot}4$, the sesquioxide of which, zirconia, is found in the zircon or hyacinth. It also is somewhat analogous to alumina, but is not of sufficient importance to justify us in dwelling on it more fully.

Zirconium, in some of its properties, connects this group with the next.

GROUP IV.

This group consists of metals, the oxides of which are so little known, that we cannot say with certainty that any one of them is known in a perfectly pure state. The oxides of these metals, in fact, occur generally together, and being very similar to one another, their separation is a matter of very great difficulty. We shall therefore only mention their names, for their atomic weights are for the most part still doubtful. They are, 26. Cerium; 27. Lantanium; 28. Didymium; 29. Erbium; and 30. Terbium. It is in this group that the oxides begin to be coloured. Peroxide of cerium is brown, and the salts of several of them have some degree of colour. It is now believed that the colour observed in some of the salts of yttria really depends on the presence of one or more of these metals. Zirconium has also a certain degree of analogy to tin.

GROUP V.

We shall now proceed to a group of metals of far greater importance, the first of which is iron. The metals of this group are seven in number, namely, iron and manganese, zinc and cadmium, cobalt and nickel, and tin. It will be seen that six of them are enumerated in pairs, and in fact the two metals of each pair have not only a striking analogy in many points, but also occur associated, one being seldom found without the other. In this group the attraction for oxygen is still very powerful, but the metals do not decompose water rapidly at ordinary temperatures, although they do so at a red heat. Their protoxides are powerful bases, and their sesquioxides, where they exist, are weak bases. When they form teroxides, these are strong acids. The compounds of most of them are coloured.

31. *Iron.*

Symbol Fe (Ferrum). Equivalent = 28.

This, the most valuable of all metals, is the first we have come to that is found uncombined, or in the metallic state; it occurs in that state in meteoric iron, and perhaps also in masses of terrestrial origin. There are, in different parts of the world, as in Siberia, in South America, and on the west coast of Africa, large masses of iron, declared by the native tradition to have fallen from heaven. That on the coast of Africa is almost a hill in size, the others are smaller. but yet of many tons weight, and many still smaller masses of the same kind exist. There is one of several tons weight in the court of the Government Building at Aix la Chapelle, which was found just below the surface of one of the streets, and of the fall of which no record is left. It probably fell before the city was founded. All the known masses of meteoric iron agree in character, being very hard, but malleable, and containing small quantities of nickel, cobalt, chromium, arsenic, and sulphur, with frequently a little silica. Such masses have been often seen to fall, and have been picked up while yet hot. When they fall at night, they are seen as luminous meteors, which finally explode and burst into fragments, and these, if large, bury themselves in the ground by the force of their fall. This

form of iron, however, is rare, although very interesting, from its peculiar composition, always containing the same impurities, and from the uncertainty of its origin. At one time these meteorites were supposed to come from the moon; but the prevalent opinion now is, that they are portions of planetary matter, either undergoing condensation, or else the fragments of some heavenly body that has burst or exploded, and continuing to revolve round the sun. They frequently enter our atmosphere, when they cross the earth's orbit, and then appear to take fire in it, and to be attracted to the surface. Multitudes of them pass through without falling, their centrifugal force being sufficient to resist the gravitation of the earth.

Iron is usually found oxidized; either as sesquioxide $Fe_2 O_3$, called red hematite, or black hematite, a hydrate of the same oxide; or carbonate of protoxide, FeO, CO_2 which is called clay iron ore; or magnetic oxide, or black oxide of iron, or loadstone, of which there are two kinds, $Fe_3 O_4$ and $Fe_4 O_5$. It also occurs as bisulphuret of iron, $Fe S_2$, called iron pyrites, and another sulphuret, called magnetic pyrites. The metal is obtained chiefly from hematite, magnetic oxide, and carbonate. These ores are heated with charcoal or coke, and a flux composed of sand and limestone. The reduced metal combines with a small quantity of carbon, forming a fusible compound, pig or cast-iron. This is subsequently melted in a puddling furnace, and exposed to a current of air, to burn off the carbon. As it becomes purer, it becomes also less fusible, till at last at a white heat the purified metal is only in a pasty, not a fluid state. At this stage it is hammered and rolled to expel the last traces of carbon, and then constitutes pure or malleable iron, such as is used for horse-shoes, horse-shoe nails, gun-barrels, and rails, as well as wire; for it is only when pure that it can be drawn out into fine wire.

Iron has a specific gravity of about 7800 (water = 1000). It is rather soft, especially when hot, and malleable. It is fusible only in the most intense heat of a wind furnace. Heated in a current of air, or in oxygen, to whiteness, it burns and is rapidly oxidized. At a red heat it is still oxidized on the surface; and the oxide, which is black or magnetic oxide, scales off under the hammer, and is called smithy ashes. At ordinary temperatures, if exposed to air and moisture, it is slowly oxidized, forming the brown sesquioxide, and is said to rust.

The uses of iron, in the pure metallic state, are too well known to require enumeration. The chief objection to it is that it cannot be cast nor even hammered at ordinary temperatures, so that it must be heated red-hot in order to be manufactured. Its value depends on its tenacity, a property in which it surpasses all other metals.

Iron and Oxygen.

Iron forms several oxides. Three appear to be direct compounds of iron and oxygen, and two to be composed of the others united together.

1. Protoxide of iron, FeO, is obtained by heating the carbonate or sesquioxide to a low red heat in hydrogen gas. If heated too strongly, it is reduced to the metallic state. When pure, it is of a grass-green colour, but it is apt to absorb oxygen from the air and to become sesquioxide, so that it is little known. It is a powerful base, and its salts are either bluish-green or colourless, the latter in a few cases only. These salts have an inky taste, and give a deep blue precipitate of Prussian blue with the ferridcyanide or red prussiate of potassium. Caustic alkalies precipitate a white hydrate, which instantly attracts oxygen, and passes through green to the brown sesquioxide. Carbonated alkalies give a white bulky carbonate, which also becomes green, and finally brown, being converted into sesquioxide, and losing its carbonic acid. Hydrosulphuric acid or sulphuretted hydrogen does not precipitate these salts; sulphuret of ammonium causes a black precipitate of sulphuret of iron. Infusion of galls and meconic and sulphocyanic acids have no action on pure solutions of the protoxide. That oxide and its salts are characterized by their strong tendency to pass into sesquioxide, by absorbing oxygen; and they deoxidize many substances in consequence. The carbonate occurs in many mineral springs, dissolved by excess of carbonic acid.

2. The sesquioxide or peroxide of iron $Fe_2 O_3$, is far more permanent, not having any tendency to absorb oxygen under ordinary circumstances. It is found pure in red hematite, hydrated in black hematite. To prepare it, the sulphate of the protoxide, or green vitriol, is boiled with nitric acid, some sulphuric acid being added, when it becomes sulphate of the peroxide or persulphite. The addition of an alkali throws down a bulky brown hydrate of the sesquioxide, which, being washed, dried, and ignited, leaves the sesquioxide. It is a weak base, and is expelled from its salts by all protoxides, even by protoxide of iron. Its formation from the protosulphate or green vitriol is as follows:— $2\ (FeO, SO_3) + NO_5 + SO_3 = NO_4 + (Fe_2 O_3, 3\ SO_3)$. Like alumina and other sesquioxides, it requires 3 eqs. of acid to form a neutral salt. On account of the permanence of this oxide, when we wish to test for iron, it is first converted into sesquioxide by boiling with nitric acid. Its characters are well marked. Alkalies, caustic and carbonated, throw down a brown precipitate of sesquioxide, which does not combine with carbonic acid. Ferrocyanide of potassium, or yellow prussiate, produces the deep blue precipitate of Prussian blue; the red prussiate only changes the colour of the solution to a dirty green. Infusion of galls produces ink, and sulphocyanic and meconic acids produce a deep blood-red colour. The salts of sesquioxide of iron are generally brown, and have a strong styptic inky taste.

Both oxides and their salts are used in medicine, as tonics and astringents. The salts of the peroxide are much employed in dyeing and calico-printing, as they strike either black or various shades of purple, lilac, and gray, with cochineal, logwood, and other red dyes, with which alumina gives crimson or pink colours.

The blood of animals contains iron in considerable quantity, which is found in the ashes of the blood as sesquioxide. It is present chiefly in the red globules, and indeed in the colouring matter of the globules. But it is not known whether their colour depends on the presence of iron, nor in what form of combination the iron exists. There can be no doubt that it has an important function to perform, probably connected with the absorption of oxygen in respiration; and as iron is thus essential to animal life, so it is found as a never-failing constituent of those plants on which animals feed, and that, in the form of sesquioxide, at least, it takes that form in the ashes.

3. Ferric acid, FeO_3, is formed when the sesquioxide is ignited along with potash, or with nitrate of potash. The oxide takes up oxygen, and the acid thus formed combines with the potash, forming a salt which is very soluble in water, to which it gives a deep purple colour. It does not keep, however; for on standing, oxygen is evolved, and sesquioxide is deposited. It may be preserved somewhat longer, and even obtained in dark crystalline grains, if the solution contain a large excess of potash. Ferrate of potash, KO, FeO_3, is rapidly deoxidized by contact with organic matter, such as the skin, or paper.

4. Magnetic oxide or black oxide of iron, exists in two forms, both of which may be produced artificially by precipitating a mixture of protoxide and sesquioxide in due proportion. The two magnetic oxides are $Fe_3 O_4$ and $Fe_4 O_5$. The former may be regarded as formed of 1 eq. of protoxide and 1 eq. sesquioxide, $FeO + Fe_2 O_3 = Fe_3 O_4$. The latter contains the elements of 2 eqs. protoxide, and 1 eq. sesquioxide, $2\ FeO + Fe_2 O_3 = Fe_4 O_5$. The native loadstone

or natural magnet, or magnetic iron ore, is a mixture or compound of the two. To prepare the oxide $Fe_4 O_5$ artificially, sulphate of the protoxide is divided into two equal parts, and one of these converted into sulphate of sesquioxide by boiling with nitric acid. The two portions are then mixed, and the addition of an alkali, aided by a boiling heat, throws down a black precipitate, which, when dry, is strongly magnetic, and does not attract oxygen from the air. As the two halves of the sulphate contain equal quantities of iron, the oxide thus prepared must be that which is $Fe_4 O_5 = 2\ Fe O + Fe_2\ O_3$. The oxide $Fe_3 O_4$ is prepared exactly in the same way, only two-thirds of the sulphate are converted into sesquioxide, which gives the oxide $Fe_3 O_4 = Fe O + Fe_2 O_3$. This also is black, permanent, and magnetic.

With chlorine, iron forms two chlorides. The protochloride, $Fe Cl$, is formed when iron is dissolved in hydrochloric acid. It is soluble, and has the green colour and character of a salt of protoxide. The sesquichloride, $Fe_2 Cl_3$, is formed when the sesquioxide is dissolved in hydrochloric acid, and evaporated to dryness. It forms an orange yellow mass, which is volatile at a high temperature. It is much used in medicine, in the form of an alcoholic tincture, called tincture of muriate of iron. It occurs among the volatile products of volcanic action.

The protoiodide of iron, $Fe I$, is formed, when iron and iodine, the former in excess, are placed in contact under water. Heat is developed, and a green solution of the iodide is formed. When boiled down, it leaves a dark green deliquescent mass. The iodide is decomposed by the oxygen of the air, which sets free iodine, and converts the iron into sesquioxide. The iodide is much used in medicine, and is preserved by drying it up with the addition of sugar, which covers the particles, and protects them from the air. Sugar is used in the same way to preserve the precipitated carbonate of protoxide of iron from oxidation.

Sulphur and iron unite in several proportions. The protosulphuret, $Fe S$, is formed when iron filings and sulphur are heated together, when much heat and light are developed. It is also formed when a stick of sulphur touches a white-hot rod or bar of iron. The bar is instantly perforated, and the melted sulphuret drops down. It is used in the preparation of hydrosulphuric acid. The bisulphuret $Fe S_2$, called iron pyrites or firestone, because some varieties of it absorb oxygen from the air and become hot, is a very abundant mineral. It forms cubic, octohedral, or dodecahedral crystals, of a yellowish colour and metallic lustre. When heated, it yields half its sulphur as a sublimate, but as the mineral generally contains arsenic, sulphur thus obtained is only used when better cannot be procured. Magnetic pyrites, $Fe_3 S_4$, is characterized by its magnetic properties.

With carbon, iron forms two important compounds, which, however, contain very little carbon. These are cast-iron, which contains from 2 to 4 or 5 per cent., and steel, which contains only 1 or 2 per cent. of carbon. The former is hard, fusible, and brittle, but may be cast into any shape. The latter is sufficiently fusible to be cast if required, hard and elastic, as well as tough, which properties fit it for springs and cutting instruments. Both are made by simply heating iron in contact with charcoal.

No definite compound of iron with phosphorus is known; but a very small amount of phosphorus destroys all the good qualities of iron.

32. *Manganese.*

Symbol Mn. Equivalent = 27·6.

This metal appears to accompany iron; for while the ores of iron almost always contain traces of manganese, the ores of manganese contain traces of iron or even larger quantities. The metal itself is little known, but may be got by heating to intense whiteness oxide of manganese with charcoal. It is fusible with extreme difficulty, and so brittle as to be of no use in the metallic state. In appearance it resembles iron. Its density is 8000.

The only important compounds of manganese are its oxides, especially the deutoxide or peroxide. This occurs in considerable quantity in veins and nodules, in the form of black prismatic crystals, or as a crystalline mass with a black streak. One variety of it, called wad, is earthy in aspect. It also occurs hydrated, when it is more brown, and has a brown streak. The hydrate is less valuable than the pure oxide. Peroxide of manganese is much used in the manufacture of bleaching powder, and also by chemists in preparing oxygen and chlorine. Its formula is $Mn O_2$, and it is a neutral or indifferent oxide.

Protoxide of manganese, $Mn O$, is obtained by heating the carbonate, $Mn O, CO_2$, in a current of hydrogen; it is of a grass-green colour, and unless it be very compact, attracts oxygen from the air, and passes into peroxide. It is a powerful base, and forms salts which are colourless, or have a slight pink tinge. Alkalies produce in them a white precipitate of hydrated protoxide, rapidly passing into the brown hydrated peroxide by absorption of oxygen. Carbonated alkalies cause a white precipitate of carbonate of protoxide, which in drying becomes very slightly coloured, but is not altered in composition. Sulphuret of ammonium causes a flesh-coloured precipitate of hydrated sulphuret, while bleaching solution, and ozonized air, precipitate hydrated peroxide. This action of bleaching liquor is employed in calico-printing, to give a fine bronze brown.

Sesquioxide of manganese, $Mn_2 O_3$ is left when the peroxide is heated to redness in close vessels. It is of a pale brown, and in its relations analogous to sesquioxides of aluminum and iron. It gives to glass an amethyst colour, and is believed to be the cause of the colour of the amethyst.

Red oxide of manganese, $Mn_3 O_4$, is left when any oxide is ignited in open vessels. It seems to be a compound of protoxide and sesquioxide, analogous to magnetic oxide of iron.

Manganic acid, $Mn O_3$, is formed in the same way as ferric acid; and its solution and that of its salts have a fine deep emerald green colour. Manganate of potash, $KO, Mn O_3$, is isomorphous with sulphate of potash. Its fine green solution cannot be preserved, but, like that of the ferrate, loses oxygen, while peroxide is deposited. But if diluted with hot water, the colour changes from pure green to bottle-green, olive-green, bluish-green, bluish-purple, and finally to a splendid reddish-purple, which belongs to the salt of another acid, permanganic acid.

Permanganic acid, $Mn_2 O_7$, is obtained in combination with potash, by adding hot water to the solution of the manganate. When the change is complete, a brown precipitate of hydrated peroxide settles, and the clear red solution, evaporated to a small bulk, yields beautiful bronze-coloured crystals of the permanganate, which have a metallic lustre; from the intensity of their purple colour, one small crystal will give to a quart of water a fine deep purple tint. This salt is much more permanent than the green manganate, but is rapidly deoxidized by all organic substances. In fact, it is a most powerful oxidizing agent, and produces peculiar results, from the nature of its composition, and the presence of an alkali. It is used in organic research. Its formula is $KO, Mn_2 O_7$, and its formation from the green manganate is as follows: $3\ (KO, Mn\ O_3) = Mn\ O_2 + 2\ KO + (KO, Mn_2\ O_7)$, so that the liquid becomes alkaline from free potash, and peroxide is separated. The action of this salt on sugar will serve as an example of its action on organic substances, by which acids are generally formed which combine with the potash. We shall suppose the sugar to be dry grape sugar, $C_{12} H_{12} O_{12}$.

$$C_{12}H_{12}O_{12}+6\,(KO, Mn_2O_7) = 12\,MnO_2+12\,HO+6\,(KO, C_2O_3)$$

One eq. of sugar, with 6 eqs. of the salt, yield 12 eqs. of peroxide, 12 of water, and 6 of oxalate of potash. This proves that no part of the carbon in sugar can be in the form of carbonic acid, as some have supposed. For we get all the carbon as oxalic acid; and as that acid contains less oxygen than carbonic acid, it is impossible that it can have been formed from carbonic acid by means of a powerful oxidizing agency.

There are two chlorides of manganese, the protochloride $Mn\,Cl$, and the perchloride $Mn_2\,Cl_7$, corresponding to permanganic acid. The protochloride, from which all the salts of manganese are obtained, is obtained pure from the solution made in preparing chlorine by the action of hydrochloric acid on the peroxide. This solution contains protochloride of manganese, and sesquichloride of iron. One part of it is precipitated by carbonate of soda, and the washed precipitate, consisting of carbonate of protoxide of manganese with sesquioxide of iron, is added to the remaining solution and boiled. The protoxide in the precipitate expels the iron from the solution, so that, if the proportion of the solution precipitated has been rightly calculated, the whole manganese is now found in the liquid, and all the iron in the precipitate. It is best to manage it so that a little manganese remains in the precipitate, for in that case no iron can remain in the liquid, provided the iron has been in the state of sesquichloride or sesquioxide. This very beautiful process, in which one part of an impure solution is made to purify the whole, itself included, depends on the fact that protoxides, even in the form of insoluble carbonates, expel sesquioxides from their solutions. The solution must first be rendered neutral by evaporation to dryness, for free acid would prevent the result. A solution of protochloride of manganese is thus obtained quite free from iron, and containing only traces of copper, cobalt, and nickel. The first is separated by hydrosulphuric acid; the two others by a few drops of sulphuret of ammonium. From the pure chloride, which forms pink crystals, all the salts of manganese may easily be prepared.

The perchloride is volatile, and its vapour is of a greenish-yellow colour. It has not been much studied, but it is said to decompose the vapour of water, producing a purple cloud of minute particles of permanganic acid, along with hydrochloric acid.

Protosulphuret of manganese, $Mn\,S$, is formed as a flesh-coloured hydrate, when sulphuret of ammonium is added to the salts of protoxide of manganese. This appearance is quite characteristic of the pure salts of manganese.

It is worthy of notice, that while 1 eq. of manganese is isomorphous with 1 eq. of sulphur in the manganate of potash, isomorphous with sulphate of potash, 2 eqs. of manganese are isomorphous with 1 eq. of chlorine in the permanganate, isomorphous with perchlorate. The four salts are as follow:—Sulphate of potash, KO, SO_3. Perchlorate of potash, $KO, Cl\,O_7$. Manganate of potash, $KO, Mn\,O_3$. Permanganate of potash, $KO, Mn_2\,O_7$. This seems to indicate that our equivalent of chlorine ought to be halved, as it is on the Continent, when the formula of the perchlorate would be, KO, Cl_2O_7. Such a change, however, would imply the halving of the equivalents of bromine, iodine, hydrogen, and many metals; and although it may ultimately be adopted, at present it would cause confusion.

Iron and manganese form a group of two, with many points of analogy, and remarkable in this, that their atomic weights are almost if not exactly the same. We have now to examine two similar pairs.

The first of these includes zinc and cadmium. These metals are usually found, like the two last, together, and the analogy between them is very strong. Both are obtained from the chief ore of zinc, calamine, or silicate of oxide of zinc, and both are volatile at a red heat.

33. *Zinc.*

Symbol Zn. Equivalent = 32·6.

The ore is heated with charcoal in crucibles closed above, from which a tube leads downwards, and conveys the vapours to the condensing vessel where they are collected in water. The vapours which first come burn, if set fire to, with a peculiar brown flame, and deposit an impure oxide, containing nearly all the cadmium, which is more volatile than zinc.

When this brown blaze, as it is called, is over, the pure vapour of zinc is collected in water, where it forms metallic masses. Since the discovery of cadmium, the brown blaze is no longer burnt but collected separately in water if the cadmium be required; or the oxide may be used to obtain that metal. The above process is called distillation per descensum.

Zinc is a crystalline, easily-fusible metal, of a bluish-white colour, specific gravity about 7000. It melts at a low red heat, and if heated more strongly is converted into vapour, which takes fire and burns with a greenish-white flame, producing the oxide, a large part of which is carried upwards by the heated current, and deposited in light white flocks, called Lana Philosophorum. The oxide remaining in the crucible, when washed from any particles of metal, is pure, and is not in itself volatile. The metal is not malleable when cold, but is broken, although not very easily, by the hammer. At 300° it may be rolled into plates or sheets, which are used instead of sheet lead.

There is only one oxide of zinc, the protoxide, $Zn\,O$, which is prepared by burning the metal, or precipitated as a hydrate by the alkalies, an excess of which redissolves it. The best way is to precipitate it as carbonate, and to ignite that salt, when the oxide is left. While hot, it is yellow, but becomes white on cooling. It is distinguished from alumina in solutions by its ready solubility in excess of ammonia. Its salts are colourless and generally isomorphous with those of magnesia. The sulphate of zinc is so like that of magnesia, that its density alone distinguishes the two salts, unless we apply chemical tests. Solutions of zinc give, when quite neutral, a white precipitate of hydrated sulphuret with hydrosulphuric acid, but in acid solutions this test does not act. Sulphuret of ammonium produces, in neutral solutions, the same compound more abundantly. Ferrocyanide of potassium causes a white precipitate, and the action of caustic and carbonated alkalies has been already mentioned. The salts of zinc have a styptic metallic taste. The sulphate, acetate, and carbonate, as well as the oxide, are used in medicine. The sulphate is astringent, and in large doses emetic and poisonous. It is much used as a collyrium.

There is only one chloride, the protochloride, $Zn\,Cl$, formed when zinc is dissolved in hydrochloric acid. It forms a crystalline deliquescent mass, which, in solution, is used to preserve anatomical preparations, and to prevent decay in wood, according to Sir W. Burnett's method.

The iodide, $Zn\,I$, is made by the action of an excess of zinc on iodine under water, when the compound dissolves. It is used in medicine.

The sulphuret, $Zn\,S$, or zinc blende, is a common mineral in Cornwall and other mining districts. It forms dense black crystals, and when converted into oxide by roasting, yields the metal when heated with charcoal. The white hydrated sulphuret, formed in solutions of zinc by sulphuret of ammonium, when heated, loses water, and becomes black.

Zinc is much used in the form of sheets and pipes, not having the poisonous properties of lead. It is also a constituent of brass and of German silver. One of its chief uses now is the formation of galvanic batteries, in which plates of zinc are placed alternately with those of copper, or of platinized silver. For the purposes of the electric telegraph and the electrotype zinc is therefore most valuable.

Carbonate of zinc prepared by a peculiar process has lately been introduced under the name zinc white, as a substitute for the poisonous white lead.

34. *Cadmium.*

Symbol Cd. Equivalent = 56.

The preparation of this metal from the common ore of zinc, of which it constitutes from 1 or 2 to 10, 12, or even 15 per cent., has been described under zinc. Cadmium also occurs in very small quantity as sulphuret, or cadmium blende, in fine orange crystals, of an octahedral form, first observed in trap rock in the west of Scotland by Lord Greenock, and hence called, as a mineral, Greenockite. In this rare ore no zinc is present.

Cadmium has a darker gray colour than zinc, and is very fusible and malleable. Its specific gravity is 8700. It is more volatile than zinc, and very combustible at a high temperature. Like zinc it forms but one oxide CdO, chloride $CdCl$, sulphuret CdS, &c. Its salts, like those of zinc, are astringent, styptic, and emetic. Sulphate of cadmium is an excellent collyrium. Cadmium is reduced to the metallic state from its solutions by zinc, and this furnishes a beautiful method for its purification. The oxide of the brown blaze of zinc works contains much zinc and some cadmium. It is dissolved in hydrochloric acid or sulphuric acid, and the acid solution in a platinum vessel acted on by a piece of zinc. The reduced cadmium adheres to the platinum, and after being washed may be dissolved off by hydrochloric acid. Another character of its salts is, that their acid solutions give with hydrosulphuric acid a fine orange yellow precipitate of sulphuret of cadmium. In this point it agrees with arsenious acid; but there is no difficulty in distinguishing between a basic oxide, such as oxide of cadmium, which forms an insoluble carbonate and is itself insoluble in water, and a soluble acid like arsenious or arsenic acid.

Zinc and cadmium form a pair of closely analogous metals, and the atomic weight of cadmium is not far from double that of zinc. It is probable that both metals will be used to coat the surface of other metals as we coat copper with tin; for already lead has been successfully coated with both, and even iron has been coated with zinc, under the name of galvanized iron. The two metals in question have the advantage of not being poisonous, as lead and copper are.

The next pair is even more remarkable for the analogy between them. The metals are cobalt and nickel. Like the metals of the two preceding pairs they are found associated, the ores of the one always containing more or less of the other. They are both as infusible as iron and manganese, and have more analogy to them than to zinc and cadmium. Indeed, there is a curious relation between them; for while cobalt and nickel are found in meteoric iron, and are like iron naturally magnetic, iron is always found in the ores of nickel and cobalt, often in large proportion. Again, there are traces of cobalt and nickel in the ores of manganese, except in a very few instances. Lastly, the atomic weight of all four metals is nearly the same, varying only from 27·6 to 29·6.

35. *Cobalt.*

Symbol Co. Equivalent = 29·5.

The metal is found chiefly as arseniuret, along with arseniurets of iron and nickel; also as sulphuret. It is best purified from arsenic by melting with sulphur and alkalies, when it is converted into sulphuret; or the arseniuret is dissolved in nitric acid, and the arsenic precipitated as sulphuret by hydrosulphuric acid, which does not precipitate cobalt, nickel, or iron in acid solutions; but this latter process is very tedious. When a solution is obtained free from arsenic it is boiled with nitric acid to convert the iron into sesquioxide. Excess of alkali is then added, and the precipitate, consisting of protoxides of cobalt and nickel, and sesquioxide of iron, is acted on by oxalic acid, which forms with the two first insoluble salts, with the last a soluble one. The iron is thus entirely removed by washing, and a pale pink powder is left, a mixed oxalate of cobalt and nickel, the former predominating. When the ore of nickel (arseniuret) is treated in the same way, the mixed oxalate is pale green, the nickel predominating. This powder is dissolved in liquor ammoniæ, and the dark red solution exposed to the air in a loosely-covered jar. As the excess of ammonia is dissipated, a green salt is deposited, oxalate of nickel and ammonia, while the colour of the liquid becomes a pure wine red, and it contains now only a similar but soluble double oxalate of cobalt and ammonia. This is dried up and ignited, or boiled with caustic potash, and yields pure black sesquioxide of cobalt. If the metal is wanted, this oxide is dissolved in hydrochloric acid, precipitated by a fixed alkali, and reconverted into oxalate, which is now of a pure pink colour, and when ignited in a covered crucible with a small aperture for gas, leaves the pure metal either spongy, or if the heat be high enough, melted into a button. The action of heat on the oxalate is as follows, $CoO, C_2O_3 = 2\ CO_2 + Co$. The oxalate of nickel and ammonia is ignited, and leaves oxide of nickel, from which the metal may be prepared exactly as cobalt is.

Cobalt is gray, brittle, very infusible—specific gravity 8500. Its protoxide CoO is a powerful base, has an ash-gray colour, and forms salts, which are either pink, crimson, or blue. Its solutions are pink, and give with alkalies a lilac hydrate, changing to brown; a permanent lilac carbonate with carbonated alkalies, and a black sulphuret with sulphuret of ammonium. Salts of cobalt, ignited with alumina, give it a fine smalt-blue colour. In fact smalt or zaffre is the silicate of oxide of cobalt, named zaffre (or sapphire originally, Italian *zaffir*) from its colour. It is got by roasting the ores of cobalt with sand, and is much used to give the blue colour to chinaware, and also to be added in small quantity to paper to improve its colour. There are several oxides of cobalt, but the protoxide is the most important.

The protochloride, $CoCl$, forms beautiful deep red crystals, which, when heated, melt to a deep rich blue liquid. Traces made on paper with a very dilute solution of this salt are invisible when dry, their pink colour being very pale. But on being warmed they turn blue and become visible, again disappearing on cooling, moisture being absorbed. This is one of the oldest and best known sympathetic inks, and has this advantage that the characters may be made to appear and disappear any number of times, provided the heat applied be not too strong.

36. *Nickel.*

Symbol Ni. Equivalent = 29·6.

The preparation of this metal has been given under cobalt. It is about as difficult to melt as iron, is of specific gravity 8800, has a whiter colour, and is malleable and magnetic, so that needles for the compass may be made of it, and these do not rust as steel is apt to do. But the metal is principally used as the chief ingredient in German silver. The more nickel this alloy contains, up to a certain point, the more it resembles silver in colour and lustre, as well as in permanence. The other ingredients are zinc and copper.

Protoxide of nickel, NiO, is a powerful base, its salts are all green, and their colour is complementary to that of the corresponding salts of cobalt. Its solutions are easily recognised by their colours, and by the pale apple-green hydrate and carbonate produced by caustic and carbonated alkalies. Ammonia in excess redissolves the precipitated hydrate, forming a sapphire-blue solution. Sulphuret of ammonium causes a black precipitate of the sulphuret NiS. From salts of copper, which are redissolved by ammonia, with a deep

violet-blue, and precipitated black by sulphuret of ammonium, those of nickel are distinguished by not being precipitated, if free acid be present, by hydrosulphuric acid, and by the action of ferrocyanide of potassium which gives with copper a chestnut-brown precipitate. The colour of the solution of copper too is generally blue.

Nickel forms a peroxide which is not of much interest, nor are the other compounds of nickel very important. The astonishing analogy between nickel and cobalt in so many points, while they differ in the colour of their compounds, as well as the fact that they always occur associated, and that they seem to accompany iron, not only in the mineral kingdom, but also in meteoric iron, and that both are magnetic, seem to indicate some hidden relations of an interesting kind.

37. *Tin.*

Symbol Sn (Stannum). Equivalent = 59.

This metal is the last of the present group, and stands here by itself, although it has many points of analogy with zirconium, and perhaps titanium, in its compounds.

Tin occurs chiefly as deutoxide or peroxide, sometimes called stannic acid, from its weak acid properties, in the form of rounded or water-worn crystals, called tinstone, or stream tin, being found in the beds of streams in tin districts. It is easily reduced by heating with charcoal, the metal being very fusible. Tin also occurs as tin blende or sulphuret, which is roasted and then heated with charcoal.

The metal has a yellowish-white colour and bright lustre, and melts at 440°. Its specific gravity is 7290. It is a most valuable metal, being used to make pipes and sheets or leaves, also to coat iron plate, forming tinned iron, commonly called tin-plate, and to form with copper the various kinds of bronze and bell metal; with lead, pewter and solder.

When heated to whiteness in air, it burns into oxide. and may also be easily oxidized by nitric acid. It forms two oxides—the protoxide $Sn\,O$, a somewhat weak base, and the deutoxide $Sn\,O_2$, which has rather weak acid properties. Peroxide of tin, or stannic acid, seems to exist in two forms; in one it dissolves easily in acids, in the other it is insoluble. The latter is supposed to have 5 times the equivalent of the former, and to be $Sn_5\,O_{10}$.

There are two chlorides corresponding to the two oxides, $Sn\,Cl$ and $Sn\,Cl_2$, both of which are much used in dyeing and calico-printing to brighten the colours. It is only by means of tin that cochineal is made to yield the fine colour given to scarlet cloth. The protochloride of tin crystallizes very readily. The perchloride is a volatile fuming liquid, but is commonly prepared in aqueous solutions by dissolving tin in nitro-hydrochloric acid. The protochloride is formed when tin is heated with hydrochloric acid, hydrogen being disengaged.

Iodide of potassium strikes a deep red colour with salts of tin, from the formation of an iodide.

There are two sulphurets of tin. The protosulphuret $Sn\,S$, is dark brown or black. The bisulphuret has a dirty yellow colour, and some degree of metallic lustre; it used to be called aurum musivum. These sulphurets are precipitated from the solutions of tin by hydrosulphuric acid.

Tin is thrown down in beautiful metallic crystals, from its solutions, by zinc.

GROUP VI.

Acidifiable Metals.

The next group of metals is characterized by a remarkable tendency to form acids with oxygen, and by the absence of basic protoxides. They are eleven in number, but only three of them are of practical importance, and one or two of the others are hardly known. Most of the acids of this class of metals are teroxides, and most of the metals form volatile chlorides.

38. *Chromium.*

Symbol Cr. Equivalent = 26·7.

This metal, which is in some points analogous to iron and manganese, connects this group with the last. It is chiefly found in two forms, as chromic acid, combined with oxide of lead, in the beautiful and scarce red lead ore of the Ural, and as sesquioxide, combined with sesquioxide of iron in the more abundant chrome iron ore. The metal is little known. It is very infusible, hard, and brittle. Specific gravity about 6000.

It forms two oxides—the sesquioxide or green oxide, $Cr_2\,O_3$, and the orange-red chromic acid, $Cr\,O_3$. The former, like other sesquioxides, is a weak base. It is obtained from bichromate of potash, by heating it with carbonate of soda and sal-ammoniac, when the acid is deprived of half its oxygen by the hydrogen of the ammonia. Water dissolves the saline matter from the residue, and leaves the sesquioxide of a fine deep green. It is precipitated from its solutions as a bluish-green bulky hydrate. Like all sesquioxides, it has a great tendency to form double salts, and in fact may be substituted for alumina in alum without altering the form of the salt. Chrome alum, as it is called, is of a dark reddish-purple by transmitted light, black by reflected light, green in powder and in solution, of a mixed green and red by day-light, pure red by candle-light. Another beautiful double salt, the oxalate of chromium and potash, is azure-blue by transmitted sun-light, red by transmitted candle-light, black by reflected light. The remarkable action of these salts on light has been described by Brewster.

Chromic acid, $Cr\,O_3$, is formed when chrome iron ore is heated with nitre. The sesquioxide, being oxidized, forms the acid, which unites with the potash of the nitre, forming a lemon-yellow neutral chromate, $KO,\ Cr\,O_3$. The strong solution of this salt, mixed with nitric acid, loses half its potash, and deposits beautiful orange red crystals of the bichromate of potash, $KO,\ 2\ Cr\,O_3$. Both these salts are much used in calico-printing. To obtain the acid pure, a cold saturated solution of bichromate is mixed with oil of vitriol; and the mixture, on cooling, for heat is developed, deposits beautiful red acicular crystals of the acid. These are drained on a fire-brick, excluding the air, and when dry, sealed up in a tube. If any sulphuric acid or bisulphate of potash adhere to them, they may be purified by dissolving them in a little hot water, adding some sulphuric acid, and recrystallizing.

Chromic acid is very soluble in water, even deliquescent. It oxidizes organic substances, such as alcohol or ether, with flame. One very convenient method of using it as an oxidizing agent is to heat the organic substance with bichromate of potash and sulphuric acid, when the action is more gentle. In all cases the acid is reduced to sesquioxide.

The salts of chromic acid are remarkable for their fine colours, which are yellow, orange, and red. The chromates of potash (neutral), baryta, zinc, and lead (neutral), are of various shades of yellow. The bichromate of potash is orange. The dichromate of lead and the chromate of mercury are orange-red, and that of silver is deep red. The chromates of lead are used as pigments, and also formed on the cloth in calico-printing. The sesquioxide is used to give the beautiful green now so often seen on fine porcelain.

The chromates of potash are poisonous, and the workmen who make or use them suffer from ulcers on the hands of a peculiar kind. The solutions of these salts are antiseptic in a high degree. They may also be used like nitre to give to cotton or cloth the property of burning as in moxas.

There are two chlorides of chromium, a sesquichloride, which is of a peach-blossom colour, but forms a green solution and a volatile chloride, either a terchloride $Cr\,Cl_3$ or $Cr_2\,Cl_7$. But the latter is not well known. There is an oxychloride which is a volatile liquid of a dark red colour, acting violently on combustible substances, which is $Cr\,O_2$

Cl, that is, chromic acid, in which 1 eq. of oxygen is replaced by chlorine, or else $2\ Cr\,O_3 + Cr\,Cl_3$, a compound of 2 eqs. of chromic acid with 1 eq. of terchloride. The proportions are the same, the latter being 3 times the former.

39. *Vanadium.*

Symbol V. Equivalent = 68·6.

This very rare metal is found as vanadic acid $V\,O_3$, combined with oxide of lead, and also in small proportions in some of the ores of iron. It forms three oxides, a protoxide $V\,O$, a deutoxide $V\,O_2$, and vanadic acid $V\,O_3$, which is analogous to chromic acid. The acid has a reddish orange colour, is sparingly soluble in water, and when fused forms on cooling very large crystals even from a small quantity. It is easily deoxidized and yields the deutoxide, which is a weak base, and forms blue salts. The protoxide is black, and is not known to form salts. Vanadium forms two chlorides, a bichloride $V\,Cl_2$, and a volatile terchloride $V\,Cl_3$. Vanadium is too rare to be applied to any useful purpose.

40. *Molybdenum.*

Symbol Mo. Equivalent = 46.

This metal occurs as molybdic acid, combined with oxide of lead, and also as tersulphuret of molybdenum. The metal is little known. Molybdic acid, $Mo\,O_3$, corresponds to chromic acid. Its only use is as a test for phosphoric acid, with which, when heated in solution with it, it forms a peculiar yellow precipitate. It is used in the form of molybdate of ammonia.

Like chromium, molybdenum forms a volatile terchloride and an oxychloride. But we need not dwell on this metal here. There is an oxide, with less oxygen than the acid, which has a fine blue colour.

41. *Tungsten.*

Symbol W (Wolfram). Equivalent = 95.

This metal is of no great interest. It is found as tungstic acid, combined with lime, or with oxides of iron and manganese, the former being the mineral tungsten, the latter wolfram.

Tungstic acid, $W\,O_3$, is a nearly insoluble yellow powder. Like molybdenum, it forms, with less oxygen than in the acid, a blue oxide like indigo. This appears to be a compound of the acid with another inferior oxide, oxide of tungsten, which is black. Tungsten, too, forms a volatile terchloride, and an oxychloride.

42. *Titanium.*

Symbol Ti. Equivalent = 25.

This metal also occurs as titanic acid in the mineral rutile. According to some, the formula of the acid is $Ti\,O_3$, while others make the acid $Ti\,O_2$. From its analogy to oxide of tin, it is probable that the latter formula is correct. Like peroxide of tin, it exists in two forms, one of which is brown and insoluble in acids; the other white and soluble in hydrochloric acid. The white variety is used to form an enamel for artificial teeth. It was at one time thought that the copper-coloured cubic crystals occasionally found in the slag of iron furnaces, were metallic titanium; but these have been shown to contain nitrogen and cyanogen besides. This metal, like the two preceding, forms a volatile chloride. There appear to be two oxides, the sesquioxide and the acid, and two chlorides, sesquichloride and bichloride, corresponding to these. The solutions of titanic acid in acids are decomposed by boiling, the titanic acid being deposited; and when the acid is fused with alkalies, the fused titanate is decomposed by water, leaving an acid salt with large excess of acid.

The composition and properties of the acid and of the bichloride show a great analogy with tin; but these metals are easily distinguished, since the compounds of tin, heated on charcoal before the blowpipe, readily yield metallic tin.

43. *Columbium.*

Symbol Ta (Tantalum). Equivalent = 92 ?

This metal occurs in the form of columbic acid, $Ta\,O_3$, in a few very rare minerals. Its properties are but imperfectly known; and it has recently been found to be associated with two other analogous metals, namely, 44. Niobium, and 45. Pelopium, which are still less known, but appear also to form acids with oxygen.

46. *Antimony.*

Symbol Sb (Stibium). Equivalent = 129.

This metal occurs as sulphuret, and as double sulphuret of antimony and silver; also as bournonite, a triple sulphuret of lead, copper, and antimony. It is obtained from the sulphuret by heating it with iron filings, or with carbonate of soda, after roasting it. The metal is fusible at a moderate red heat, of a gray colour and very bright lustre; specific gravity 6800. At a white heat it is converted into vapour, and burns in air. It forms two distinct oxides, and these combine to form a third.

Teroxide of antimony, $Sb\,O_3$, is a weak base. It is obtained by pouring the terchloride into water, when an oxychloride is formed. This is boiled with excess of carbonate of soda, and leaves the teroxide as a grayish-white powder. It has a great tendency to form double salts, such as tartar emetic, which is a tartrate of antimony and potash. Its solutions give with hydrosulphuric acid a characteristic brownish-orange precipitate of hydrated tersulphuret.

Antimonic acid, $Sb\,O_5$, is obtained by the action of nitric acid on the metal; it resembles the teroxide in appearance, but has weak acid properties. Both oxides are used in medicine.

There is another oxide, sometimes called quadroxide, but which appears to be $Sb_2\,O_8 = Sb\,O_3,\ Sb\,O_5$, an antimoniate of the teroxide. It is formed by heating the antimonic acid.

Antimony forms with hydrogen a gaseous compound, probably $Sb\,H_3$, analogous to phosphuretted hydrogen. It is not yet known in a state of purity, but only mixed with hydrogen. It is formed when hydrogen is disengaged in a solution containing antimony. The mixed gas burns with a yellow flame, giving off fumes of oxide, and which deposit metallic spots of antimony on glass or porcelain held in the flame. In these characters, antimony agrees with arsenic, and, indeed, it may be said to form with phosphorus and arsenic a group of three, like some of those we have already seen.

There are two chlorides of antimony, the terchloride, $Sb\,Cl_3$, and the perchloride, $Sb\,Cl_5$, both volatile; the former semi-solid at ordinary temperatures, and hence called butter of antimony. Mixed with water, it deposits an oxychloride, $Sb\,Cl_3 + 2\ Sb\,O_3$, called powder of algaroth, which is used in preparing the oxide as well as tartar emetic. The terchloride is formed by the action of hydrochloric acid on the tersulphuret.

There are also two sulphurets, the tersulphuret $Sb\,S_3$, and persulphuret $Sb\,S_5$; the former is the ore of antimony, and is dissolved by hydrochloric acid, yielding the terchloride and hydrosulphuric acid gas, $Sb\,S_3 + 3\ H\,Cl = Sb\,Cl_3 + 3\ HS$.

The compounds of antimony are much employed in medicine; and the metal is a chief ingredient in the alloy used for types, in which it is combined with lead and a little tin, and in some alloys with tin used for various purposes.

47. *Arsenic.*

Symbol As. Equivalent = 75.

This metal is found chiefly combined with sulphur, and also

with metals, such as cobalt and nickel. It likewise occurs as arsenic acid, As O_5, combined with various oxides. When the minerals containing it are roasted, part of it is sublimed in the metallic state, and part as arsenious acid As O_3, which is consequently obtained in very large quantities from the ores of cobalt and nickel. To obtain the metal from this acid, it is simply heated with charcoal, when the metal sublimes and forms a bright metallic crust. Its density is 5800. Under the ordinary pressure, it is converted into vapour before reaching its melting point. Its vapour has a strong garlic odour, and is very poisonous. It burns when heated in air, forming arsenious acid, which also sublimes as a white crystalline powder.

Arsenious acid, As O_3, is volatile; its vapour has no smell, unless when heated on charcoal, when it is reduced to the metallic state, and it is the metallic vapour the smell of which is then observed. It is sparingly soluble in water, and its solution gives, with excess of lime-water, a white precipitate of arsenite of lime; with ammoniaco-sulphate of copper, a grass-green precipitate of arsenite of copper, or Scheele's green; with ammoniaco-nitrate of silver, a lemon-yellow precipitate of arsenite of silver; and with hydrosulphuric acid, a bright yellow sulphuret, As S_3. By these characters this substance when pure is easily recognised; and from its very poisonous nature, and the facility of procuring it, poisoning by its means is so frequent, that it has to be sought for oftener than any other poison.

The best antidote to it is the administration of a large quantity of moist hydrated sesquioxide of iron, which has the property of forming with it an insoluble and inert arsenite of iron. Calcined magnesia has a similar effect.

When arsenious acid has to be sought for in mixed fluids, the above tests are inapplicable, except the last, which may be used to separate the arsenic from the mixed fluid, after adding an acid and filtering. The impure sulphuret thus obtained is decomposed by heating it with a mixture of charcoal and carbonate of potash, or with cyanide of potassium, and the metal sublimed. It is recognised by its volatility and the odour of its vapour, but it may also be oxidized and the tests applied. Even when the acid is pure, we ought always to reduce at least a part of it to metal, as the most characteristic property. Only antimony at all resembles it in this particular, but we shall see presently that these two metals are easily distinguished.

Where the quantity of arsenic present is very small, the method of Marsh, in which it is converted into arseniuretted hydrogen, must be employed as the most delicate and the most certain. We shall describe this presently, under the head of arseniuretted hydrogen.

Arsenic acid, As O_5, corresponds to phosphoric acid as arsenious acid does to phosphorous acid. It is formed by heating arsenious acid with nitric or nitro-hydrochloric acid. It is very soluble, very acid, and very poisonous. Its salts are exactly similar to and isomorphous with those of phosphoric acid.

When hydrogen is disengaged in a solution containing arsenious acid, there is formed arseniuretted hydrogen, As H_3, mixed with hydrogen. The gas is obtained purer, but still mixed with some hydrogen, by the action of hydrochloric acid on an alloy of tin and arsenic. It has a most offensive alliaceous smell, and burns when heated in air, with a pale flame, producing arsenious acid and water. It is extremely poisonous, and several chemists have lost their lives from incautiously inhaling a little of it.

When this gas, even mixed with a large excess of hydrogen, is passed through a tube, part of which is red-hot, it is entirely decomposed, and a ring of metallic arsenic is deposited just beyond the hot part of the tube. On this property is founded Marsh's process for detecting arsenic.

The suspected liquid is added to diluted sulphuric acid, and zinc is introduced. The gas is then passed through a narrow tube, and a slow but constant current of it is kept up. As soon as all the air is expelled from the tube, a part of it is heated to redness, and if there be but a trace of

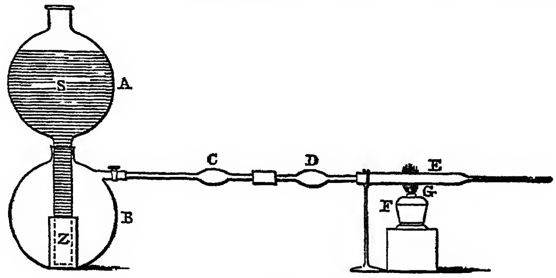


Fig. 30.

arsenic present, a ring soon appears. Or the gas may be burned at the end of the tube without heating it in the tube, and a cold piece of glass or porcelain held in the flame, which, if arsenic be present, will deposit metallic stains of that metal. The former method is the best, as the whole arsenic may in time be collected in one ring. Under similar circumstances, antimony also forms a ring of metal, but the arsenical ring is sublimed by a moderate heat, and if air be present is changed into arsenious acid, easily recognised by its octahedral crystals, its volatility, and by other tests. The antimony is with difficulty volatilized, and if oxidized, the oxide remains, and is not crystalline. Nitric acid dissolves the arsenic, but not the antimony.

This method of detecting arsenic is so delicate, that by its means arsenic is found where it was not before suspected. We often find it in the commercial sulphuric acid, hydrochloric acid, and zinc, the very substances we use in the process. Hence, before introducing the suspected fluid, we must always try the acid and zinc first for a time. If no ring appear, and if, on adding the suspected liquid, the ring be at once formed, we may safely conclude that the arsenic comes from that liquid. But without this precaution, we dare not make any such statement.

There is only one chloride of arsenic, a terchloride, As Cl_3, which is volatile.

There are three sulphurets of arsenic. Realgar, which is reddish-brown, As S_2; orpiment, which is yellow, As S_3; and the persulphuret, which is pale yellow, As S_5. The two former are found in nature.

The reader has no doubt remarked the analogy between the chemical relations of antimony and arsenic and those of phosphorus. Indeed, no two elements are so analogous in this respect as arsenic and phosphorus, save that one is metallic, the other not. There is a resemblance, however, even in physical properties for the odour of phosphorus closely resembles that of arsenic. These three elements, in spite of one being non-metallic, form a group distinguished by forming oxides with 3 and 5 eqs. of oxygen, and gaseous compounds of a fetid odour with 3 eqs. of hydrogen.

48. *Tellurium.*

Symbol Te. Equivalent = 64·2.

This metal forms one of another remarkable group of three, the two others being non-metallic, namely, sulphur and selenium. This case and the preceding, show that there is no essential and absolute division between metals and non-metallic bodies.

Tellurium is found, but very rarely, combined with gold, silver, lead, and bismuth, in the Transylvanian mines. In appearance it resembles antimony, and its specific gravity is 6260. With oxygen it forms two acids, tellurous acid, Te O_2, and telluric acid, Te O_3, corresponding to sulphurous and sulphuric acids.

With hydrogen, it forms a gaseous compound, H Te, corresponding to hydrosulphuric acid, and resembling it in its properties and its action on metallic solutions.

Tellurium is volatilized by an intense white heat. It is chiefly interesting from its analogy to sulphur and selenium; but its rarity prevents it from being applied to useful purposes, although it seems likely to have a powerful action on the animal system.

GROUP VII.

This group has no peculiar character, from which it can be properly named, but is intermediate between group 5 and the next or last group, that, namely, of the noble metals. The number of metals in it is five, namely, bismuth, uranium, copper, lead, and mercury. Their attraction for oxygen is less than that of the metals of group 5, but still considerable. The oxides of one of them, mercury, are reduced by heat alone, thus connecting these metals with the noble metals. The protoxides, and in some cases higher oxides, are basic.

49. *Bismuth.*

Symbol Bi. Equivalent = 71 ? or 106 ?

This metal is found in the metallic state, and as sulphuret, also combined with tellurium. It is obtained entirely from the native metal, which, being very fusible, is separated from its gangue or matrix by fusion. It contains a little sulphuret, also sulphurets of other metals and arseniurets, but is easily purified by heating with $\frac{1}{8}$th of its weight of nitre. The sulphur, arsenic, and other metals are oxidized and combine with the potash, as does also a little bismuth; the rest forms a pure button of metal below the saline mass. Bismuth is very crystalline, and may be obtained in fine crystals by melting a mass of it, and when it is half solidified, breaking the crust and pouring out the liquid part. The hollow mass is found lined with fine hollow rhombohedral crystals, not far removed from the cube in their angles. Its colour is reddish-white; its specific gravity 9900. It melts at about 507°, and expands in solidifying. It is volatile at a very intense heat.

Bismuth forms two oxides: 1. A basic oxide, which is thought by some to be a protoxide, $Bi\,O$, in which case the equivalent of the metal is 71; but which others regard as a sesquioxide, Bi_2O_3, which makes the equivalent of the metal 106. It is a weak base, and its salts are decomposed by water, which dissolves very acid salts, leaving insoluble subsalts. This is particularly the case with the nitrate, which, diluted with water, deposits a fine white crystalline powder of subnitrate, used as a white paint for the face. It is, however, very liable to be blackened by hydrosulphuric acid and other analogous compounds of sulphur. The salts of bismuth are recognised by the action of water and that of hydrosulphuric acid.

2. A peroxide, which has weak acid properties, and is also called bismuthic acid. It has a light red colour, and has not been much studied. If the basic oxide be Bi_2O_3, the acid is Bi_2O_5; but if the former be $Bi\,O$, the latter is probably $Bi\,O_2$. There seems to be an intermediate oxide, a compound of the acid with the base.

Chloride of bismuth is volatile, and, taking the larger equivalent, its formula is Bi_2Cl_3. It dissolves in hydrochloric acid, but the solution is decomposed by water, which throws down an oxychloride, $Bi_2\,Cl_3 + 2\,(Bi_2O_3,\,3\,HO)$. This powder is pearl white, used like the subnitrate as a cosmetic.

Sulphuret of bismuth, Bi_2S_3, occurs in nature, and is isomorphous with sulphuret of antimony.

Bismuth forms with lead and tin alloys of remarkable fusibility. That with 1 part of lead, 1 of tin, and 2 of bismuth, melts at 201°; that with 5 parts of lead, 3 of tin, and 8 of bismuth, melts at 209°. These alloys are used for taking casts for electrotyping, and for various other purposes.

50. *Uranium.*

Symbol U. Equivalent = 217·2.

This metal is found as an oxide, combined with oxides of iron, lead, copper, and other metals, along with silica, in the mineral pitchblende; and also as a phosphate of uranium and lime, in uranite. The pitchblende is acted on by nitric acid, and the solution purified from lead, copper, and arsenic, by hydrosulphuric acid. The nitrate of uranium is then crystallized. This salt, which forms beautiful yellow crystals with green reflection, when heated leaves an oxide. This, mixed with charcoal, and heated in a current of chlorine, gives a volatile protochloride, U Cl, in dark green crystals. These, heated with potassium, yield the metal as a black powder, parts of which, by the heat evolved, are brought into a compact state, and exhibit a silvery lustre. Heated in air, it burns vividly, producing the oxide. It is permanent at ordinary temperatures, and appears to be in some degree malleable. It only decomposes water at a high temperature.

Uranium forms two oxides, both basic, a protoxide, U O, and a sesquioxide, $U_2\,O_3$. The former is dark brown, and forms green salts; the latter is yellow, and forms beautiful yellow salts. From the circumstance that the salts of the sesquioxide differ in the amount of acid from those of all other sesquioxides—the sulphate, for example, being $U_2\,O_3,\,SO_3$, and not like that of alumina, $Al_2O_3,\,3\,SO_3$—it is supposed that the sesquioxide is really a protoxide, not of uranium, but of uranyle, $U_2\,O_2$. On this supposition, the salts of the sesquioxide are no longer anomalous. These salts give yellow precipitates with the alkalies, which are compounds of the sesquioxide with the alkalies, for that oxide has both weak acid and weak basic properties. Ferrocyanide of potassium produces in the salts of sesquioxide of uranium a fine rich brown precipitate.

The chloride, U Cl, has been already mentioned. There is an oxychloride $U_2\,O_2\,Cl$, which may be regarded as the protochloride of uranyle. When heated with potassium it leaves not the metal but the protoxide, UO, or uranyle $U_2\,O_2$, which was long supposed to be the metal, and appears, in fact, to play the part of a metal.

Oxide of uranium is now much used to give to glass the beautiful yellow colour, with green reflection, so much admired in the Bohemian glass.

51. *Copper.*

Symbol Cu. Equivalent = 31·7.

This valuable metal occasionally occurs native, but its chief ores are the mixed sulphurets of iron and copper or copper pyrites, the carbonate or blue copper ore, and the compound of carbonate and hydrate called green malachite. The latter are easily reduced by heating with charcoal; the former is roasted so as to oxidize it and dissipate the sulphur, and the roasted ore is then heated with charcoal. This process is repeated, and at last pure copper is obtained. Another ore of copper, very easily worked, is the red oxide or suboxide. Lastly, in mines where sulphuret of copper is present, it is oxidized by the air into sulphate of protoxide, which is dissolved by the water filtering through the rocks. This water, where the sulphate is observed, is collected in reservoirs, and the copper precipitated by fragments of iron. The copper thus obtained is very pure, and has only to be melted.

Copper has a bright red colour and high lustre, of specific gravity from 8780 to 8960. It melts at a strong red heat, and at a white heat gives vapours which burn with a green flame. It is very malleable and ductile, and has much tenacity.

Copper is rapidly tarnished and covered with a green rust

or verdigris, in moist air. At a red heat it is rapidly converted into the black protoxide.

Protoxide of copper, $Cu\ O$, is black, and forms with acids blue or green salts, with water a blue hydrate. It is a pretty strong base. Its solutions are known by their colour, by the action of a rod of iron which is quickly covered with precipitated copper, and by the action of ammonia which first causes a pale blue precipitate of subsalt or hydrate, and when added in excess, redissolves this, forming a deep violet-blue solution. Potash and soda throw down the blue hydrate, which, when boiled, loses water and becomes black. Hydrosulphuric acid gives a black precipitate of sulphuret, and ferrocyanide of potassium gives, in acid solutions, a chestnut-brown precipitate. The last is a most delicate and characteristic test, and by its means traces of copper have been found in most soils, as well as in plants, and in animal and vegetable food. Copper vessels are rapidly corroded by cold vegetable acids, but the same acids may be boiled in them without corroding the metal. As the salts of copper are very poisonous, this must be carefully attended to. Preserves of acid fruits, such as red currants, &c., are constantly boiled in vessels of copper, but must not be allowed to cool in them. Copper is sometimes improperly added to pickles to improve their green colour. Its presence is easily detected in the acid liquor by the ferrocyanide, or by introducing the blade of a knife. Several of the salts of copper are used in medicine. Sulphate of copper, or blue vitriol, is an escharotic externally, and an emetic in small doses given internally. The violet-coloured ammoniaco-sulphate of copper is used in epilepsy, and also as a test for arsenious acid.

Suboxide of copper, $Cu_2\ O$, is red and crystallizes in octahedrons. It is found in nature, and may be formed by heating the protoxide with copper filings, or by adding to a solution of sulphate of copper sugar and potash, till the precipitate at first formed is redissolved. On boiling, the suboxide is deposited as a fine deep red crystalline powder. It forms colourless salts, and a colourless solution in ammonia, but the latter solution absorbs oxygen from the air, and becomes violet-blue. The oxide gives to glass, when melted with it, a fine red colour.

Copper seems to form two oxides with more oxygen than the protoxide, a deutoxide and an acid. But these are very little known.

There are two chlorides of copper; the subchloride or dichloride $Cu_2\ Cl$, and the protochloride $Cu\ Cl$. The former is white and sparingly soluble. The latter is green and very soluble. It is formed by dissolving the protoxide in hydrochloric acid.

There are also two sulphurets corresponding to the two oxides and chlorides. The disulphuret, $Cu_2\ S$, is formed by melting together copper and sulphur. It is fusible and crystalline. The protosulphuret, $Cu\ S$, is the black precipitate produced in salts of copper by hydrosulphuric acid. $H\ S + Cu\ O,\ S\ O_3 = H\ O,\ S\ O_3 + Cu\ S$. It rapidly attracts oxygen from the air, and is converted into sulphate. Copper pyrites consists of the disulphuret, combined with sesquisulphuret of iron, and mixed moreover with iron pyrites, or bisulphate of iron. From this mineral the greater part of the copper of commerce is obtained.

Copper forms many valuable alloys. With zinc or zinc and a little tin or lead, it forms brass; with tin it gives bronze, bell metal, gong metal, and gun metal, according to the proportions. In the bronze used for medals, a trace of zinc is added.

52. *Lead.*

Symbol Pb (Plumbum). Equivalent = 103·7.

This valuable metal occurs in various forms, but the only ores which are wrought are galena or sulphuret of lead, $Pb\ S$, and carbonate of lead, $Pb\ O,\ CO_2$. The latter is simply heated with charcoal. The former is roasted, when sulphurous acid is given off, and oxide of lead, $Pb\ O$, and sulphate of lead, $Pb\ O,\ SO_3$, are formed. A part of the ore is left unchanged; and on increasing the heat, a most remarkable reaction takes place between the unaltered ore and the oxide and sulphate. The reaction with the oxide is this: $Pb\ S + 2\ Pb\ O = SO_2 + Pb_3$. With the sulphate it is this: $Pb\ S + Pb\ O, SO_3 = 2\ SO_2 + Pb_2$. In both cases, metallic lead and sulphurous acid are the only products. When the ore is less pure, it is first roasted and then heated with iron, which removes the sulphur. The lead thus obtained frequently contains silver in sufficient quantity to repay its extraction.

Lead is a metal of a dark-gray colour and high lustre, quickly tarnished in air, but only superficially at ordinary temperatures. It is very soft, malleable, and ductile, but has little tenacity. Its specific gravity is 1144. It is easily melted, and when hot is rapidly oxidized, forming protoxide. The uses of lead are well known.

With oxygen lead forms three compounds, a suboxide $Pb_2\ O$, a protoxide $Pb\ O$, and a deutoxide having feeble acid properties, peroxide of lead or plumbic acid.

The protoxide, $Pb\ O$, is formed when lead is heated rather beyond its melting point. It is a yellow powder called massicot. This, heated more strongly, melts, and on cooling forms a crystalline brownish-yellow mass, called litharge. Heated for a long time in air, massicot takes up oxygen and forms the red oxide or minium, a compound of plumbic acid with the protoxide. The protoxide is a strong base, isomorphous with baryta and lime. Its salts have a sweet taste, and are poisonous, more especially the carbonate. They are recognised by the following tests. Alkalies throw down a white hydrate, soluble in excess; carbonated alkalies a white carbonate; hydrosulphuric acid a black sulphuret; sulphuric acid and sulphates a white insoluble sulphate; and iodide of potassium a bright yellow crystalline iodide. The most important of its salts are the carbonate or white lead, the nitrate, the acetates, which are used in calico-printing, the latter also extensively in medicine, and the chromate, valued for its fine yellow colour.

Plumbic acid or peroxide of lead is obtained by acting on red lead with nitric acid. Red lead is $Pb_3\ O_4 = 2\ Pb\ O,\ Pb\ O_2$ and also $Pb_4\ O_5 = 3\ Pb\ O,\ Pb\ O_2$. The acid dissolves out the protoxide, and leaves the plumbic acid as a puce-coloured dense powder. It combines with bases, and even forms crystallizable salts with some of them.

With chlorine, lead forms but one compound, a protochloride, $Pb\ Cl$. It is formed as a sparingly soluble white crystalline powder when hydrochloric acid or soluble chlorides are added to the salts of lead. The chloride, melted with the oxide, forms several oxychlorides, which are used as yellow pigments, under the names of mineral yellow, Turner's yellow, &c.

There is but one iodide, $Pb\ I$, formed when iodide of potassium is added to a salt of lead. It is a bright yellow sparingly soluble powder, generally formed of minute scales, which dissolves in boiling water, forming a colourless solution. On cooling, large and beautiful scales of a golden lustre are deposited. They are regular hexagons.

There is also but one sulphuret, $Pb\ S$, formed as a black powder when hydrosulphuric acid or a soluble sulphuret acts on salts of lead. It is the same substance with galena, the ore of lead, which forms cubic crystals of a metallic lustre, but very brittle.

Lead forms with antimony the alloy used for type metal; with tin it forms pewter and various kinds of solder.

53. *Mercury.*

Symbol Hg (Hydrargyrum). Equivalent = 200.

This metal is found native, and in the form of bisul-

phuret or cinnabar. The latter substance, when heated in iron bottles with iron filings, yields metallic mercury. The metal is liquid at all temperatures from $-39°$ to about $600°$, which is its boiling point. Below $-39°$ it is solid. It has a bluish-white colour and bright lustre. Its specific gravity is about 1300. When heated to about its boiling point, in air, it absorbs oxygen, and forms the red oxide or deutoxide, which is again decomposed by a temperature somewhat higher.

Mercury forms two oxides, a protoxide and a deutoxide. The protoxide, HgO, is obtained by the action of potash on calomel, which is the protochloride, $HgCl + KO = KCl + HgO$. It has an ash-gray colour, and by the action of light is resolved slowly into deutoxide and metal, $2\,HgO = HgO_2 + Hg$. It is a base, and its salts give a dark gray or black precipitate with alkalies, a white one of calomel with hydrochloric acid or soluble chlorides, and a dirty greenish-yellow protoiodide with iodide of potassium. They are reduced to the metallic state by copper and by other metals; also by protochloride of tin, which first forms calomel and then reduces it.

The peroxide or deutoxide, HgO_2, is also a base. It is obtained by heating the nitrate of either oxide till the acid is entirely expelled, taking care not to decompose the oxides. It is a very dark red, nearly black while hot, and light red when cold. The same oxide is formed slowly when mercury is kept at its boiling point in a vessel with a long neck, in which the vapours are condensed and fall back. Prepared in this way it is of a darker red, and is called oxidum hydrargyri rubrum per se, while that from the nitrate is called oxidum hydrargyri rubrum per acidum nitricum. The latter generally contains some subnitrate, and is more active as an escharotic. It is much used also in the form of ointment. Its salts give a yellow precipitate of hydrated peroxide with potash; a white with ammonia, which is a compound containing amide; and a fine scarlet periodide with iodide of potassium. Both the salts of protoxide and those of peroxide give a black precipitate with hydrosulphuric acid, which in the latter case is the bisulphuret, in the former a mixture of bisulphuret with the metal. The salts of the peroxide are reduced by the same reagents as those of the protoxide; by copper and other metals, by protochloride of tin, and by formic acid.

Mercury forms two chlorides; calomel, which is the protochloride, $HgCl$, a white, insoluble, heavy powder, formed by the action of hydrochloric acid or chloride of sodium on salts of the protoxide; and corrosive sublimate or bichloride, $HgCl_2$, which is formed when hydrochloric acid acts on the peroxide, $2\,HCl + HgO_2 = 2\,HO + HgCl_2$. It is a crystalline heavy substance, soluble in water, and very poisonous. The chlorides are also formed by subliming a mixture of sulphate of peroxide with common salt, which gives a sublimate of bichloride, and, if metallic mercury be added, calomel. Both are volatile, and calomel, whichever way prepared, always contains at first some bichloride. To render it fit for medical use, this must be removed by repeated boiling with water, as long as potash causes a yellow precipitate in the filtered liquid. Both chlorides are much used in medicine, calomel being the milder, and corrosive sublimate the more active of the two.

There are two bromides and two iodides, corresponding to the two chlorides. The iodides are formed by the action of iodide of potassium on the salts of the two oxides. The protoiodide, HgI, is of a dirty yellowish green, insoluble, and is resolved by light into periodide and metal, $2\,HgI = HgI_2 + Hg$. The periodide is of a beautiful scarlet, and insoluble, or nearly so. A moderate heat renders it lemon-yellow, and the yellow form is instantly reconverted into the red by friction, or by the touch of a hard point. In the latter case, the part touched becomes red, and the red colour spreads from it through the mass. The change of colour is owing to a change of position in the molecules, or a change of crystalline form. Both iodides are used in medicine, and the periodide also as a pigment.

Mercury rubbed with 1 eq. sulphur, forms a black powder called ethiops mineral, which is a mixture of the metal with the bisulphuret. With 2 eqs. of sulphur it forms the bisulphuret, which is also produced by the action of hydrosulphuric acid on salts of the peroxide. It is black when thus prepared; but if sublimed becomes dark red, and when finely powdered this acquires the colour of vermilion, which is a form of the bisulphuret.

The compounds of mercury with other metals are called amalgams. They are sometimes liquid, oftener semisolid. Amalgam of silver occurs native in crystals. Amalgam of tin is used for silvering the backs of mirrors, and an amalgam of tin and zinc for rubbing the cushion of electrical machines.

GROUP VIII.

The Noble Metals.

The metals of this group are so called, because, from their small attraction for oxygen, they do not tarnish in the air, nor even in the fire. Hence their use for ornamental purposes, and for coinage. They are eight in number, namely, silver, gold, platinum, and five rarer metals associated with platinum.

54. *Silver.*

Symbol Ag (Argentum). Equivalent = 108.

This beautiful metal is found native; also combined with sulphur, arsenic, and antimony, with tellurium, and with chlorine. It occurs also frequently in small but available quantity in galena or lead ore. Native silver, when disseminated in the rock, is extracted by amalgamation with mercury.

Silver has a pure white colour and brilliant lustre. Its specific gravity is about 10,500. It melts at a strong red or white heat, and is quite unaltered in the fire. By the intense heat of the galvanic battery it is volatilized. It is very malleable and ductile, and has considerable tenacity. It is rather soft, and therefore copper is added to form standard silver, which is hard, and wears better. Spanish dollars consist of pure silver, with only a trace of gold, which is present more or less in all silver.

Silver appears to form three oxides; a suboxide, Ag_2O, little known; the protoxide, AgO, a strong base, and a deutoxide or peroxide, AgO_2. The protoxide alone is of interest. It is obtained by adding potash to nitrate of silver, as a brown hydrate, which, when gently heated, loses water, and leaves the protoxide as an olive-coloured powder. Its salts are recognised by the brown precipitate produced by potash, which like nearly all compounds of silver dissolves in ammonia, by the curdy white chloride produced by hydrochloric acid or soluble chlorides, and by the black sulphuret thrown down by hydrosulphuric acid. The metal is reduced by copper, zinc, and iron, and even by mercury.

There is only one chloride, $AgCl$, which appears as a curdy white substance, insoluble in water and acids, soluble in ammonia, when hydrochloric acid or chloride of sodium is added to the salts of silver. It is fusible, and on cooling forms a semitransparent mass, called horn silver. It is blackened by light, a character common to all the compounds of silver, especially the chloride, iodide, bromide, &c.; on this property is founded the daguerreotype. The chloride, moistened with diluted acid, is reduced by zinc or iron; or it may be boiled with potash and sugar, or ignited to whiteness with lime and a little charcoal, when a button of silver is obtained.

The bromide and iodide resemble the chloride, but the iodide is yellowish and sparingly soluble in ammonia.

The sulphuret is black. It is found in nature both pure

and combined with arseniuret and antimoniuret of silver, also in galena with sulphuret of lead.

The chief uses of silver are for coinage and for plate. Nitrate of silver is used as a caustic and also internally, and the chloride, iodide, and bromide, are the substances used in photography in the form of a film on the surface of silver, paper, or other substances.

The compounds of silver possess the remarkable property of dissolving in hyposulphite of soda, even when insoluble in water and acids, and this property is made use of in photography to fix the images by removing the unaltered chloride, &c. of silver.

55. *Gold.*

Symbol Au (Aurum). Equivalent = 99·6.

This metal is found native, as in the gold fields of California, Australia, and others. It is very widely distributed, but often in quantity too small to pay for its extraction. The sand of the Rhine and of most rivers contains traces of it. It is also found combined with tellurium, and alloyed with silver and palladium. Many kinds of pyrites contain gold enough to pay for the working, and it has also been found in galena.

Gold is distinguished by its yellow colour, bright lustre, and great density. Its specific gravity is 19,500. It is the most malleable of all metals, and also highly ductile. It melts in a white heat.

Gold does not combine directly with oxygen, and is dissolved by no single acid, but only by a mixture of nitric and hydrochloric acids, called aqua regia, or nitro-hydrochloric acid. This forms a chloride from which alkalies precipitate the oxide, which is a teroxide, $Au\,O_3$, as a brownish-yellow powder, which loses its oxygen when exposed to a moderate heat. It has weak acid properties, and is sometimes called auric acid. There is a suboxide of a violet colour, little known.

The terchloride of gold, $Au\,Cl_3$, is by far the most important compound. It is formed, as above stated, by means of aqua regia. It is reduced to the metallic state by protosulphate of iron, by formic acid and formiates, by oxalic acid, and by various metals. With the chlorides of the positive metals terchloride of gold forms crystallizable double chlorides.

The compounds of gold with sulphur are little known. Hydrosulphuric appears to form, in solution of the terchloride, a bisulphuret, which is black.

56. *Platinum.*

Symbol Pt. Equivalent = 98·7.

This metal is also found native, but combined or mixed with five other metals, namely iridium, rhodium, palladium, ruthenium, and osmium, all of which occur in very small quantity in the native platinum which is found in grains. Aqua regia dissolves the whole, except the black scales of an alloy of iridium and osmium, and a few particles of iridium. The solution is mixed with sal-ammoniac, and the bichloride of platinum which has been formed combines with that salt, chloride of ammonium, to form a nearly insoluble double chloride, $Pt\,Cl_2, NH_4\,Cl$, which is deposited as a bright yellow powder. If much iridium be present, the salt is coloured reddish from the presence of the corresponding double chloride of iridium. The washed salt is dried and ignited, when it leaves spongy platinum. By repeating the process the iridium is got rid of in the mother liquid. The spongy metal is made into a paste with water in a wooden mortar, and this paste gradually but powerfully compressed till it assumes a metallic aspect. It is then heated red-hot and hammered gently, and this is repeated till it becomes of full density. It has a grayish-white colour, a high lustre, and a specific gravity of 21,500.

It forms two oxides, a protoxide and a deutoxide, which are feeble bases, and little studied. Its most important compound is the bichloride, $Pt\,Cl_2$. This, with the chlorides of the positive metals, forms crystallizable and permanent double chlorides. Those of potassium and ammonium are nearly insoluble, and the latter, as above stated, yields pure spongy platinum when heated. That of sodium is soluble even in alcohol, and forms fine large crystals. In consequence of this property bichloride of platinum is used to absorb the ammonia formed from the nitrogen of organic compounds, and thus to determine the quantity of that nitrogen.

When the bichloride, which is an orange-coloured soluble salt, is heated to a certain point, it loses half its chlorine, and leaves a protochloride, as a green powder, insoluble in water, but soluble in hydrochloric acid. This chloride also forms double chlorides with the chlorides of the positive metals. With ammonia it gives rise to a remarkable series of bases containing platinum, nitrogen, hydrogen, and in some cases chlorine. These resemble organic bases.

The other metals found along with platinum are extracted from the mother liquid after the precipitation of the platinum by sal-ammoniac, by a very tedious and complex series of operations. Iridium and osmium are also obtained from an alloy of these metals left undissolved by the acid. They all resemble platinum, iridium the most, then rhodium, ruthenium, palladium, and osmium. Their chlorides are the chief compounds, except in the case of osmium, which forms with oxygen a remarkable crystallized and volatile acid, osmic acid, $Os\,O_4$. These chlorides form double chlorides with potassium, ammonium, sodium, &c., analogous to those of platinum. The salts of rhodium are rose-coloured, those of iridium of various colours, those of palladium brown, and those of ruthenium reddish. All these metals are very infusible, and unaltered in the fire, like platinum. But they are so scarce, except palladium, which is malleable, and is used by dentists instead of gold, that they can hardly be applied to useful purposes. Iridium, or rather an alloy of it with a little platinum, as found in the ore, in small grains, is used for the points of gold pens, and from its extreme hardness does not perceptibly wear. Iridium is also the heaviest of metals, its specific gravity being 26,000. We shall not enter into further detail in regard to these very scarce metals.

Having concluded this brief notice of the elementary bodies, and of their chief binary compounds, the reader is now acquainted with the fundamental facts of chemistry. There is, however, an important class of compounds which we have only noticed incidentally, namely the salts, and although we cannot describe them in detail, we may offer some general remarks which will facilitate the study of them.

One division of saline compounds has been described in the place they naturally occupy, namely, those salts called haloid salts, formed of a metal united to such bodies as chlorine, bromine, &c. These, in fact, are true typical salts, for the very substance from which the name of the class is taken, common or sea salt, is one of them, being the chloride of sodium. In one sense, every body having similar properties may be called a salt; every body which is crystalline, more or less soluble, sapid, and neutral. Accordingly at an early period the term salt was extended to such bodies in general, and even after the true nature of common salt was known (for it had long been viewed as a compound of hydrochloric acid and soda) those bodies which really consisted of an acid and a base, both generally oxidized, such as sulphate of soda, nitrate of potash, and the like, were still regarded as salts, and even considered as the only true salts, on the theory that a true salt was a neutral compound of an acid and a base. This theory, in the end, actually excluded common salt from the class of salts; and therefore two kinds of salts were admitted; oxygen salts, of which sulphate of soda, $Na\,O,\ SO_3$, is a type; and haloid salts, of which common salt, $Na\,Cl$, is the

type. We have already shown how, by the progress of chemical discovery, we have been enabled to reduce to one series the two classes of acids, namely, oxygen acids, such as sulphuric acid, HO, SO_3, and hydrogen acids, such as hydrochloric acid, HCl. This is done by regarding the hydrogen in the former as being combined, not first with oxygen to form water, and the water with the dry acid, but as united with a radical, SO_4, differing from chlorine only in being certainly compound. Although this particular radical, SO_4, be not yet known in a separate form, many such compound radicals are known, and play exactly the part of chlorine. Of these cyanogen, $C_2N = Cy$, is the type. On this view, therefore, while hydrochloric acid can only be HCl, sulphuric acid, represented as H, SO_4, or more simply, making $SO_4 = Su$, by HSu, becomes as perfectly analogous to it in formula as it is in properties.

Now, if we adopt this view of acids, or at least of all such acids as cannot exist in an active state without hydrogen, formerly supposed to be present as water, we must apply the same view to the salts of those acids. For when hydrochloric acid acts on a base, such as soda, two phenomena are constantly observed—the formation of a neutral salt and the separation of water. This is perfectly obvious from the equation (M representing any metal), $HCl + MO = MCl + HO$. But when sulphuric acid acts on the same bases the phenomena are absolutely the same; a neutral salt is formed, and water separated. And this we express by the equation, $H, SO_4 + MO = M, SO_4 + HO$.

Here, then, we see the first great principle to be admitted concerning salts. They represent hydrogen acids, in which the hydrogen is replaced by a metal, and therefore acids (that is, hydrogen acids, which includes what used to be called hydrated acids) and salts form in reality but one series, the general formula of which is XR; R being any negative acid radical or salt radical, for the terms are synonymous, and X standing for the positive element, which may be either hydrogen or a metal. So that acids, in this view, are salts of hydrogen, and salts are salts of metals. Hydrogen, indeed, is possibly or even probably the gas of a very volatile metal, whose salts are peculiar in this, that they possess those characters which we call acid. The analogy between neutral salts and acids, nay, even between neutral salts, acids, and bases, or alkalies, did not escape the first scientific chemists, although they knew nothing of the true constitution of any of them. In all works published towards the end of the last century, acids, alkalies, and neutral salts are all included under the head of saline substances. This view, founded on acute observation, was for a time displaced by the limited notion of a salt being a compound of an acid and an alkali, which, as we have seen, actually excluded common salt from the class of salts, as soon as it was shown to contain neither oxygen nor hydrogen, and consequently not to be, as was supposed, a compound of hydrochloric acid with soda. But the progress of science has shown that as oxygen can no longer be called the acidifying principle, since hydrogen is better entitled to the name, so all acids, bases, and salts really belong to one series, that represented by XR. Water may be taken as the type of all such compounds, and while its oxygen may be replaced by chlorine, bromine, iodine, fluorine, sulphur, selenium, cyanogen, the radicals, SO_4 (in sulphuric acid), NO_6 (in nitric acid), &c. &c., its hydrogen may be replaced by any metal, or by such compound radicals as can play the part of metals, as cyanogen and SO_4 play that of chlorine. In organic chemistry there are, as we shall see, many such radicals, of which ethyle, $C_4H_5 = Ae$, is a good example.

Such being the nature of salts in general, it is easy to see how neutral salts are formed when acids and bases act on each other. They were formerly supposed to combine directly, but we now know that if the acid be a hydrogen acid, or a hydrated acid, and the base an oxide, this is not the case, but that water is always formed, as in the general equation, $HR + MO = MR + HO$. We have just stated how this applies to sulphuric acid, HO, SO_3, or rather, H, SO_4. But when anhydrous sulphuric acid acts on an anhydrous base, the reaction is different; no hydrogen being present, no water can be formed, but yet the same neutral salt is formed, as, to take the case of sulphuric acid and soda, both anhydrous, in the equation, $NaO + SO_3 = Na, SO_4$. Here, instead of simply uniting together, the acid and base react on each other; the oxygen of the base is transferred to the acid, producing the radical, SO_4, and with this the metal unites.

The salts of ammonia come into the same category as those of metallic protoxides. For, as has been already explained, in every salt of ammonia, NH_3, with an oxygen acid, there is found, besides the ammonia and anhydrous acid, invariably 1 eq. of water, HO, or rather its elements. The salt, NH_3, SO_3, if it exist at all, is not sulphate of ammonia. That salt contains the elements, NH_3, HO, SO_3, which, on the old view, are arranged as NH_4O, SO_3, sulphate of oxide of ammonium, and on the new as NH_4, SO_4, or, making ammonium, $NH_4 = Am$, it is written Am, SO_4, perfectly corresponding to K, SO_4, sulphate of potash, which it resembles very closely in properties. When ammonia, NH_3, acts on hydrogen acids, such as hydrochloric acid, is was formerly supposed to combine directly with the acid, and the resulting salt, sal-ammoniac or hydrochlorate of ammonia, was written NH_3, HCl. It is now believed that here also ammonium is formed by the hydrogen of the acid combining with the ammonia, and that the compound metal thus formed combines with the residual chlorine, just as potassium would do; so that the result is $NH_3 + HCl = NH_4, Cl = AmCl$, and the salt is now called, accordingly, chloride of ammonium, being perfectly analogous in all respects to chloride of potassium or sodium. In other words, as cyanogen or SO_4 may replace the oxygen of water or the chlorine of sea-salt, so ethyle, $C_4H_5 = Ae$, and ammonium, $NH_4 = Am$, can replace the hydrogen in water and the metal in salt, being, in fact, compound metals.

On the views above explained, neutral salts become exceedingly simple, and the law of their formation very easily remembered, while water, acids, and bases all fall into the same category.

Besides neutral salts, there are acid or supersalts, and alkaline or subsalts. The former, in the case of such acids as sulphuric acid, may be regarded as compounds of the acid with a neutral salt. Thus acid sulphate, or bisulphate of potash is $KO, HO, 2SO_3 = K, SO_4 + H, SO_4 = \left.\begin{matrix}K\\H\end{matrix}\right\} \begin{matrix}SO_4\\SO_4\end{matrix}$. The latter are compounds of the neutral salt with an additional quantity of the base, as, for example, subnitrate or basic nitrate of lead, which is $2PbO, HO, NO_5 = PbO, NO_5 + PbO, HO = Pb, NO_6 + PbO, HO$.

There is, however, another kind of acid salts, namely, those of polybasic acids. Of such acids, phosphoric acid is an excellent type, in two of its three modifications, the bibasic and tribasic phosphoric acids. Polybasic acids, especially bibasic ones, are very frequent in organic chemistry. Of the organic bibasic acids, oxalic acid is the type.

A bibasic acid is one which, to form a neutral salt, requires 2 eqs. of base. Bibasic phosphoric acid is $PO_5, 2HO$, or rather H_2, PO_7, the 2 eqs. of hydrogen being replaceable by metals. The neutral bibasic phosphate of silver is Ag_2, PO_7. But if only 1 eq. of hydrogen be replaced by a metal, we have the acid only half neutralized, or an acid salt, as the acid bibasic phosphate of silver, which would be $\left.\begin{matrix}Ag\\H\end{matrix}\right\} PO_7$, or that of potash, which is $\left.\begin{matrix}K\\H\end{matrix}\right\} PO_7$.

The same is true of tribasic acids, which form three series of salts with the same base, according as 1, 2, or 3 eqs. of

hydrogen are replaced by the metal. Tribasic phosphoric acid is PO_5, 3 $HO = H_3, PO_8$; and it forms with soda, three salts, namely, the acid salt $\left.\begin{matrix}Na\\H_2\end{matrix}\right\}PO_8$, the acid salt $\left.\begin{matrix}Na_2\\H\end{matrix}\right\}PO_8$, and the neutral salt Na_3, PO_8. The two latter are alkaline in reaction on test paper, although acid and neutral in composition; but, in fact, all three, as well as the two salts of the bibasic acid, are, strictly speaking, neutral salts in composition, since they all contain the same number, whether two or three, according to the acid, of basic equivalent, whether metal or hydrogen. Accordingly, all the three salts of soda with the tribasic acid, form, with salts of silver, the same yellow precipitate of neutral tribasic phosphate of silver, Ag_3, PO_8. Oxalic acid is $C_4 O_6$, 2 $HO = H_2, C_4 O_8$, and it forms a neutral oxalate of potash, $K_2, C_4 O_8$; an acid oxalate of potash called binoxalate, $\left.\begin{matrix}K\\H\end{matrix}\right\}C_4 O_8$, and a double acid oxalate of potash, called quadroxalate, $\left.\begin{matrix}K\\H\end{matrix}\right\}C_4 O_8 + H_2, C_4 O_8$.

With regard to salts considered individually, they may be studied either under the head of all the salts of one acid radical with different bases, or all those of one base with different acid radicals. On the former plan they are arranged as sulphates, nitrates, phosphates, chlorides, bromides, &c.; on the other as the salts of potassium, sodium, ammonium, iron, lead, silver, &c. There are conveniences belonging to both systems, but our space will not permit us to enter into either. We can only point out that all the salts of one radical, all the sulphates, or all the chlorides exhibit the characters of that radical. Thus all the soluble sulphates form an insoluble precipitate of sulphate of baryta when mixed with salts of that base. All the chlorides are in like manner precipitated by salts of silver. All the nitrates deflagrate with red-hot charcoal, &c. Nor are we confined to one character; for all the sulphates, for example, when ignited with charcoal, yield sulphurets, and the smell of hydrosulphuric acid is perceived when acids are added to the ignited mass. This is because they all contain sulphur.

Again, all the salts of one metal or base exhibit the chemical characters of that metal. Thus all the salts of sesquioxide of iron give Prussian blue with ferrocyanide of potassium. All the salts of silver give the insoluble chloride on the addition of hydrochloric acid or solution of salt.

Now, as we have in all cases given the characters by which acids and radicals, metals and bases, may be recognised, the chemical characters of any salt may be known by referring to those of its elements. We may merely state here that the most valuable and important salts, most of which have been noticed incidentally under the head of their acids or their bases, are the sulphates, especially those of lime, magnesia, baryta, soda, potash, alumina and potash, iron, zinc, copper, and ammonia; the nitrates of potash, soda, strontia, lead, mercury, and silver; the carbonates of lime, magnesia, potash, soda, ammonia, iron, zinc, lead, &c.; the phosphates of soda, potash, lime, of magnesia and ammonia; the chlorate of potash, the chromates of potash and of lead; and many salts of organic acids not yet described, as oxalates of lime and of ammonia, acetates of potash, soda, alumina, iron, zinc, and lead; and tartrates of potash, potash and soda, and potash and antimony. The haloid salts, such as chloride of sodium, iodide of potassium, fluoride of calcium, &c., have been described in their proper place.

ORGANIC CHEMISTRY.

We must now turn to the chemistry of organized bodies, animal and vegetable, and of the unorganized or structureless products of animal or vegetable life, both of which classes of compounds are called organic.

As formerly explained, the elements of organic bodies are the same as those which constitute the inorganic world, save that the relative proportions are different, and that few comparatively of the elements can enter into the composition of organic compounds. The chief mass of such compounds is formed of only four elements, carbon, hydrogen, nitrogen, and oxygen; frequently of carbon, hydrogen, and oxygen alone; sometimes of carbon and hydrogen only. In every case of an organized structure, however, or of any substance capable of being formed into such a structure or tissue, there are not only the four elements just mentioned, but also sulphur, and several mineral salts in small proportion, but equally essential with the rest. These salts are phosphates, chlorides, alkalies, probably introduced as carbonates, oxide of iron, and frequently iodides and fluorides. Where these saline matters are absent—that is, where the substance, on being burned, leaves no ashes—it is invariably destitute of organized structure, and frequently either crystallized or liquid, both these forms being incompatible with organization.

Organic substances then are characterized by the small number of their elements, and, since they are themselves exceedingly numerous, by the great variety of proportions in which the same elements are united. By far the greater number of organic compounds are only products of organic life, and not themselves organized; and these consist either of the four elements which may be called organic, carbon, hydrogen, nitrogen, and oxygen, or of carbon, hydrogen, and oxygen, without mineral matter or ashes. Such compounds are the vegetable acids, sugar, gum, oils and fats, the vegetable bases, colouring matters, resins, and the like, in plants, and in animals such compounds as fats and oils, bile, urea, animal acids, and bases, &c. To these must be added the innumerable compounds derived from them by various chemical processes. The few organized tissues, and the substances of which these may be formed, are such bodies as bone, muscle, nerve, membranes, woody tissue, albumen, fibrine, caseine, gelatine, chondrine, and the like.

Now, all such organic substances, organized or not, agree in containing a large amount of carbon; and as this is combined with the elements we have named, oxygen, hydrogen, nitrogen, and in some cases sulphur, the action of heat on them, with or without the access of air, is peculiarly characteristic, and enables us at once to recognise organic compounds. Heated in close vessels, they blacken, give off water, oily matter, and combustible gases, and leave behind a black mass, composed of carbon and ashes, if there be ashes present. Heated in the open air, they are oxidized, the whole of their hydrogen being given off as water, their carbon as carbonic acid, their nitrogen as ammonia or as nitrogen gas, while the ashes alone remain. In the first case, which is called the destructive distillation of organic matter, the oxygen present is chiefly taken up by hydrogen to form water, while the carbon enters into new combinations with hydrogen and oxygen, or with hydrogen alone, or with nitrogen; and as all the compounds thus formed are gaseous, the carbon is carried off, as far as the quantity of the other elements admits of, but a large part is always left as charcoal, for want of other elements to combine with it. All organic bodies, therefore, are charred by heating when air is excluded, as in a retort or in the bottom of a tube, and burn when heated with a full supply of air. These characters depend on the nature of the elements they contain, and above all, on the presence of so large a proportion of carbon.

Organic bodies differ from the inorganic in their comparatively complex formulæ. Thus, in inorganic chemistry we constantly meet with such formulæ as those of water, HO, hydrochloric acid HCl, potash KO, sulphuric acid SO_3 or HO, SO_3, and the like. But the simplest organic

compounds are more complex than this. Formic acid is $C_2H_2O_4$, oxalic acid $C_4H_2O_8$, acetic acid $C_4H_4O_4$, and these are by far the simplest organic compounds. Benzoic acid is $C_{14}H_6O_4$, urea is $C_2H_4N_2O_2$, sugar is $C_{12}H_{12}O_{12}$, quinine is $C_{20}H_{12}NO_2$; and while many organic compounds are equally or more complex, some of them, especially those which are capable of forming blood and tissues, contain hundreds of atoms in a single molecule. This peculiar complexity of constitution, while but a small number of elements are employed, is a very marked character of organic compounds, and one consequence of it is, that they are much more easily decomposed by heat or by chemical means than inorganic substances, while the products of their decomposition are singularly varied. In fact, when so many atoms are present, and the elements are capable of uniting two and two or three together, in an endless variety of proportions less complex than the compound acted on, the results may be modified almost *ad infinitum* by altering the circumstances, such as temperature, or the reagents employed, which may be oxygen, or different oxidizing agencies of various energy, or acids, or bases, or chlorine, or any two or more combined, or any of the various modes of deoxidation, or of removing hydrogen, and so on; when such are the conditions, it is easy to see that the results must be infinitely more varied than they can possibly be in the case of inorganic compounds, the composition of which is in general so little complicated. This capability of undergoing numerous decompositions or transformations under the influence of the known chemical agencies is another characteristic feature of organic compounds; and there are causes of change which are almost peculiar to organic substances, such as the action of what are called ferments, and the power we have of replacing one or more atoms of one of the elements of such compounds, generally the hydrogen, by its equivalent of other elements, or even of compound radicals, or groups acting the part of elements. We may say, then, that organic compounds are complex in their constitution, and in consequence peculiarly liable to transformations and decompositions of various kinds—a character which renders them eminently fitted for the functions they have to perform in plants and animals. And while this is true of organic compounds generally, it is especially true, as was formerly hinted, of those which contain nitrogen, from the fact that that element has nearly equal affinities for the three elements which accompany it, and a great tendency also to combine with two or with all three of them in various proportions. Those organic bodies, and they are numerous, which undergo spontaneous transformations, are always compounds containing nitrogen.

Another peculiarity of organic compounds is this, that all their chief elements are either gaseous in themselves, or have a strong tendency to form gaseous or volatile compounds; so that the ultimate result of the transformations of the most complex of them, aided by the atmosphere, is their entire conversion (the ashes alone excepted) into the least complex gaseous forms; and they are sent into the air in those forms, which are, carbonic acid, CO_2; water, HO; ammonia, NH_3; hydrosulphuric acid gas, HS; and sulphuric acid, HO, SO_3. The decay of a dead animal or of a dead tree produces these very substances; and the whole mass of both, excepting the ashes, is dissipated in these forms, chiefly by the action of the atmospheric oxygen, aided by their own tendency to change. In this way, not only is the accumulation of dead organic matter prevented, but its disappearance is, as we shall see, the regular and unfailing source of food to the new generation of plants, and to the animals which feed on them. There are no elements known to us which are capable of undergoing these successive changes, except those which we find in organic matter.

Such are the characters which distinguish organic from inorganic compounds; and it will be seen that, while in both classes the same laws of combination prevail, the peculiarities of the former depend on the peculiar nature of their principal elements.

The number of natural organic compounds is so great, and that of the compounds derived from them artificially is so much greater, that we cannot pretend to describe them all. We can only state such general laws as are deducible from what is known, and indicate the groups or series into which organic substances naturally fall. We shall find that they have a peculiar tendency to form groups of analogous constitution and properties, and that these groups exhibit a repetition, on a larger scale, of what we have already seen among elementary bodies. There are, no doubt, many organic compounds which as yet appear to stand alone; and this renders a satisfactory classification for the present unattainable. But this is entirely due to the imperfection of our knowledge, and the rapid daily progress of organic chemistry is constantly opening up new views, which enable us to include in the known series more and more compounds every day. This progress also demonstrates that the natural groups of organic compounds are formed on the same principles as those of inorganic substances; that the types, so to speak, are the same, while the differences do not affect essential or fundamental points, and the general analogy is unmistakeable.

COMPOUND ORGANIC RADICALS.

Organic chemistry has been defined as the chemistry of compound radicals, as opposed to inorganic chemistry—that of elementary or simple radicals. But since we have come to admit in the latter such compound radicals as SO_4 in sulphuric acid and sulphates, NO_6 in nitric acid and nitrates, and many others, this definition cannot be maintained. We might say, indeed, that organic chemistry was that of such compound radicals as contain carbon. It is probable that all organic compounds contain at least one such radical (except in the case of ammonia and its derivatives, amide and ammonium, if considered organic), and that this is the cause of their complexity.

A compound organic radical is a group which plays the part of an element, and enters as a whole into combination with either elements or other compound radicals. Only a few of the organic radicals admitted by chemists are known in the separate state, but some are known with certainty; and where this is not the case, yet the assumption of the existence of such a radical often simplifies, in an extraordinary degree, the understanding of a whole series of connected substances, and reduces them to a form as easily remembered as in the case of a metal or a negative radical, such as chlorine.

Among organic radicals we find the same diversity of character as among elementary bodies. Some are negative, resembling chlorine, &c., in their relations; others positive, resembling hydrogen or metals; some, again, are more analogous to combustible bodies like carbon and sulphur; and some cannot be referred exactly to any of these categories, but partake of more than one. These differences of negative and positive, however, are, as the reader knows, differences of degree; so that all radicals, compound as well as simple, may be arranged in a series, in which each is positive to the next on one side, and negative to the next on the other. Among the elements this is well known; of the organic radicals, too few are yet known to enable us to establish such a series, save in a very fragmentary manner.

Of strongly negative organic radicals, analogous to chlorine, cyanogen is the type, and the analogy is here truly surprising. Thus we have—

With Chlorine, Cl.	*With Cyanogen*, $C_2N = Cy$.
Hydrochloric acid, H Cl	Hydrocyanic acid, H Cy
Hypochlorous acid, Cl O	Cyanic acid, Cy O
Chloride of potassium, K Cl	Cyanide of potassium, K Cy
Bichloride of mercury, Hg Cl_2	Bicyanide of mercury, Hg Cy_2

There are other negative radicals, chiefly derived from cyanogen, such as ferrocyanogen, $C_6 N_3 Fe = Cy_3 Fe = Cfy$, sulphocyanogen, $C_2 N S_2 = Cy S_2 = Csy$, and various others, which exhibit a general resemblance to chlorine in their relations, forming acids with hydrogen and salts with metals.

Of such positive radicals as are analogous to hydrogen and metals, and can, indeed, replace them, the simplest and the type is methyle, $C_2 H_3 = Me$. Let us compare it with potassium. We have—

With Potassium, K.	*With Methyle*, $C_2 H_3 = Me$.
Protoxide, basic, KO	Protoxide, basic, Me O
Hydrated protoxide, KO, HO	Hydrated protoxide, Me O, HO
Chloride, K Cl	Chloride, Me Cl
Iodide, KI	Iodide, Me I
Sulphuret, KS	Sulphuret, Me S
Cyanide, K Cy	Cyanide, Me Cy
Nitrute, K, NO_6	Nitrate, Me, NO_6
Carbonate, KO, CO_2	Carbonate, Me O, CO_2
Acetate, KO, $C_4 H_3 O_3$	Acetate, Me O, $C_4 H_3 O_3$

This list might be extended to a great length, and the analogy would hold good. It is easy to see how much the assumption of the radical methyle simplifies its compounds, the formulæ of which, written at full length, no one could be expected to remember, many of them being very like each other. Thus the carbonate is $C_3 H_3 O_3$; the cyanide, $C_4 H_3 N$; the hydrated oxide, $C_2 H_4 O_2$; and the acetate, $C_6 H_6 O_4$.

There are very many radicals of this class, and all more complex than methyle, but all equally simple when considered as radicals, each having its own symbol. Thus, we have ethyle, $C_4 H_5 = Ae$; amyle, $C_{10} H_{11} = Ayl$; cetyle, $C_{32} H_{33} = Ct$; phenyle, $C_{12} H_5 = Ph$; and many others.

Of the radicals analogous to sulphur or carbon, benzoyle is a type. Its formula is $C_{14} H_5 O_2$; its symbol Bz; and we have it, as well as sulphur, in combination with—

	Sulphur.	Benzoyle.
Hydrogen............	HS	H Bz
Oxygen............	SO_3, HO	Bz O, HO
Chlorine	S Cl	Bz Cl

The analogy is not so close here as in the other cases, but the principle is the same. There are a good many radicals of this type, all forming with hydrogen volatile oils, with oxygen volatile acids. Acetyle, $C_4 H_3$, or rather formyle, $C_2 H$, is the type of another allied group of radicals, which form with hydrogen volatile oily products, and with oxygen volatile acids of an oily character.

Such are the general characters of some of the best known groups of organic radicals, and it is precisely the compounds connected with these which are best known, and the study of which is most simplified by the admission of these radicals.

ISOMERISM IN ORGANIC COMPOUNDS.

Another remarkable feature in organic compounds is the frequent occurrence of isomerism or polymerism. This is the natural result of the large number of atoms generally present, which of course admits of a great variety in their arrangement, giving rise to isomeric compounds; while the absolute number also varies, being double, or treble, or manifold in one compound of what it is in another, thus producing polymeric compounds. It is obvious that in either case the transformation of one compound into the other must be comparatively easy, since nothing is necessary to be added nor taken away.

As examples of isomerism, that is, of bodies with the same proportion of elements and the same absolute quantity, which makes the atomic weight or equivalent the same, we may mention cyanate of ammonia (of oxide of ammonium), and urea. The former is $Am O, Cy O = NH_4 O, C_2 NO$. In the latter the rational formula is not known with certainty, but the empirical formula is $C_2 H_4 N_2 O_2$, which, it will be seen, is the same, absolutely and relatively, as the other. Again, acetate of oxide of ethyle is $Ae O, Ae O_3 = C_4 H_5 O, C_4 H_3 O_3 = C_8 H_8 O_4$, while butyric acid is $C_8 H_7 O_3, HO = C_8 H_8 O_4$. These two substances are totally different, and we are able to express the difference in the rational formulæ, which shows the first to be a neutral salt of oxide of ethyle, the second a hydrated acid. A still more striking case of isomerism is that of the following substances, in several of which the rational formula is unknown, but all of which have the same atomic weight, and entirely different properties :—

Substance.	Empirical Formula.	Rational Formula.
Alanine; a base	$C_6 H_7 NO_4$	$C_6 H_6 NO_3$, HO ?
Sarcosine; a base	$C_6 H_7 NO_4$	$C_6 H_6 NO_3$, HO ?
Carbamate of oxide of ethyle...	$C_6 H_7 NO_4$	$C_4 H_5 O, C_2 H_2 NO_3$
Hyponitrite of oxide of propyle	$C_6 H_7 NO_4$	$C_6 H_7 O, NO_3$

Here we have at all events three totally distinct rational formulæ, and in regard to the two first substances it is not that they have the same rational formula, but that we do not yet know the difference, which, as both seem to be hydrated bases but of distinct properties, must of course be in the arrangement of the anhydrous base $C_6 H_6 NO_3$. There must be a difference, and we might even from analogy conjecture several modes of explaining the difference of properties, but nothing is certainly known of it. It is quite probable that several more substances having the same composition and atomic weight may still be added to this list. These examples of strict isomerism will suffice. As to polymerism, we have an example of it, connected with the four substances just mentioned; for lactamide, a body quite different from all four, has the empirical formula $C_{12} H_{14} N_2 O_8$, exactly double of theirs. Its rational formula is probably $C_{12} H_{10} O_8, 2 NH_2$, which represents the neutral amide of lactic acid, a bibasic acid. We have also an example of polymerism, connected with acetic ether and butyric acid, the empirical formula of which is $C_8 H_8 O_4$. That of aldehyde is $C_4 H_4 O_2$ or exactly one-half, while its rational formula is $C_4 H_3 O, HO$, that is, hydrated protoxide of acetyle. Besides this, we have metaldehyde and elaldehyde, polymeric with aldehyde, the precise equivalent of which is doubtful. There are also the three acids, formed of cyanogen and oxygen, namely:—

Cyanic acid	Cy O, HO	=	$C_2 NO$, HO
Fulminic acid	$Cy_2 O_2$, 2 HO	=	$C_4 N_2 O_2$, 2 HO
Cyanuric acid...........	$Cy_3 O_3$, 3 HO	=	$C_6 N_3 O_6$, 3 HO

Many other examples might be given, both of isomerism and of polymerism; but those already given are sufficient to illustrate the principle. There is, indeed, a remarkable class of compounds, namely, the volatile bases, homologous with ammonia, and in which the hydrogen of that substance is partially or entirely replaced by radicals of the ethyle series, which exhibit isomerism carried to an extraordinary point, as will be more particularly explained under the head of these bases. Suffice it here to say, that we may easily form two volatile bases similar in properties, but quite distinct, of the formula $C_4 H_7 N$; three such bases of the formula $C_6 H_9 N$; four of the formula $C_8 H_{11} N$; six of $C_{10} H_{13} N$; and so on, the number regularly increasing with the amount of carbon, so that with 20 eqs. of carbon we may have 16 volatile bases, all of the same empirical formula $C_{20} H_{23} N$, and yet all distinct, and each having its own well ascertained rational formula. Nor does this stop here, for with every 2 eqs. of carbon by which the formula is augmented, the number of possible isomeric (not polymeric) volatile bases is increased by two. This will give the reader some notion of the extraordinary fertility of organic chemistry, and of the important part performed by isomerism in the transformation of organic compounds. It is but the other day that these volatile bases were discovered, and already some dozens of them are known.

The examples of isomeric and polymeric transformation are very numerous, and there can be no doubt that this is a principle constantly in action in living organisms, animal or vegetable. The artificial formation of urea is a striking instance. The cyanate of oxide of ammonium, which we

have just seen to be isomeric with urea, spontaneously changes into that substance when its solution is left to itself, and rapidly if warmed. Urea, when heated, is transformed or resolved into ammonia, and hydrated cyanuric acid, polymeric with cyanic acid. That is to say, 3 eqs. of urea yield three of ammonia and 1 of cyanuric acid, $3\ (C_2 H_4 N_2 O_2) = 3\ NH_3 + Cy_3 O_3,\ 3\ HO$. Again, this very cyanuric acid, when heated, is resolved into 3 eqs. of cyanic acid. $Cy_3 O_3,\ 3\ HO = 3\ (Cy O, HO)$. Cyanic acid, left to itself, is transformed into cyamelide, a body polymeric with it, possibly having twice its equivalent, $2\ (Cy\ O, HO) = C_4 H_2 N_2 O_4$. Cyamelide, when heated, is resolved, like cyanuric acid, into cyanic acid again, $C_4 H_2 N_2 O_4 = 2(Cy\ O, HO)$. If we now add ammonia, we obtain cyanate of oxide of ammonium, and this can be made again to pass through the whole series of metamorphoses just mentioned. Hydrobenzamide, by boiling with potash, is transformed into the base amarine, isomeric or perhaps polymeric with it. Furfuramide, in the same way, is transformed into the base furfurine, which has exactly double its equivalent. Every case of fermentation, strictly so called, is one of isomeric or polymeric transmutation; not, however, generally into one, but into two or more compounds. Dry grape sugar $C_{12} H_{12} O_{12}$ yields, in the vinous fermentation 2 eqs. of alcohol and 4 of carbonic acid, $C_{12} H_{12} O_{12} = 2\ (C_4 H_6 O_2) + 4\ CO_2$. The same substance, in the lactic fermentation, yields the isomeric lactic acid, $C_{12} H_{12} G_{12} = C_{12} H_{10} O_{10},\ 2\ HO$. Lactic acid, in the butyric fermentation, is resolved into butyric acid, carbonic acid, and hydrogen, $C_{12} H_{10} O_{10},\ 2\ HO = C_8 H_7 O_3, HO + 4\ CO_2 + H_4$. It is easy to see how very important a principle this is, in reference to the vital changes which constitute organic life, animal or vegetable. It is in some such way that the food of plants and animals is assimilated, and becomes converted into those substances of which the animal and vegetable frames are composed. It is more particularly in the animal body, however, that isomeric transformations prevail, because the food of animals is complex, and therefore liable to transformation, and adapted to undergo it. We can even, in some measure, imitate artificially the change by which some parts of the food of animals are dissolved into blood. For we can so treat fibrine as to obtain from it a solution of albumen, much resembling the serum of blood; and albumen is either isomeric with fibrine or very nearly so.

ORGANIC TYPES. SUBSTITUTION.

We have seen that great advantage is gained by admitting the existence of organic compound radicals. There is, however, another kind of organic group, which has not the properties of radicals. These are named types, the meaning of which is, that the atoms are grouped together in a certain mode, on which the properties of the compound so entirely depend, that, provided this grouping or arrangement be retained, great changes may be made in regard to the individual elements, without changing the general character of the compound. This leads us to the very remarkable and important law of substitution, which has become so fertile in discoveries of late years. Some writers have imagined that the notion of types was incompatible with that of radicals, but this is not the case. Every radical, nay, every compound of a radical, may also be a type, and we shall find that both ideas are useful in enabling us to classify our knowledge.

The fundamental idea of a type may be found in inorganic chemistry. Hydrochloric acid, $H\,Cl$, is a type, and so is common salt, $Na\,Cl$. All compounds, which, like hydrochloric acid, consist of 1 eq. hydrogen and 1 eq. of a powerful negative radical, are acids. All those which consist of 1 eq. of metal and 1 eq. of negative radical, are salts. We can substitute for the chlorine in either, bromine, iodine, cyanogen, or sulphur, and the compound will still have the original character of an acid or a salt. And in the case of salt, we may substitute for the sodium, potassium, ammonium, barium, iron, lead, silver, &c., and still the result is a salt. In fact, every compound is, or represents, a type, and every chemical change is a substitution. But in inorganic chemistry, the only substitutions which do not destroy the type are those of like for like, of chlorine for iodine, &c., or of one metal for another. It cannot well be otherwise, from the simplicity of inorganic formulæ.

But in organic chemistry, where the formulæ, and consequently the molecules, are so much more complex, the type acquires a new significance. The elements of all organic compounds being the same, and often in the same amount and proportion, the *arrangement* or relative position of the atoms comes to be a matter of the utmost importance, as fixing the character of the group, that is, of the type. A certain mode of arrangement gives acid properties; another, the properties of a base; a third, those of an oil; a fourth, those of an ether, and so on. And so powerful is the influence of arrangement in these complex molecules, that substitution is no longer confined to replacing like by like, but extends to the replacement of an element by its equivalent of another, not only not analogous to it, but actually opposite to it.

Naphthaline is $C_{20} H_8$. The character of the type is, that it is volatile and combustible. Now, we may remove 1 eq. of hydrogen, and replace it, not by anything analogous to hydrogen, but by 1 eq. of chlorine, forming the body $C_{20} \left.\begin{matrix} H_7 \\ Cl \end{matrix}\right\}$; chlonaphtase, which has the same general characters. We may go on replacing the hydrogen, atom by atom, by chlorine, and yet the type will remain unaltered. That is, the properties of naphthaline depend chiefly on the way in which the atoms are grouped, and, provided the grouping be unchanged, it does not appear to signify much whether the 8 atoms attached to the 20 of carbon be all hydrogen, or partly hydrogen and partly chlorine. In like manner, bromine may be substituted for the hydrogen, and yet we know that, in general, chlorine and bromine are strongly opposed to hydrogen, being negative, while it is positive. Here, then, we have negative atoms playing the part of positive ones, and this is the peculiar feature of that kind of substitution in organic compounds which we are now considering. And since the negative character of such bodies as chlorine and bromine is thus, as it were, sunk, nay, changed almost to its opposite, it is evident that in naphthaline the nature of the compound molecule must depend far more on the arrangement or grouping, than on the original nature of the atoms it contains. Even the last atom of hydrogen in naphthaline may be thus replaced by chlorine, yielding the body $C_{20} Cl_8$, which has still the general characters of the type. The peculiarity of this form of substitution (for we must remember that almost all chemical changes consist in substitution of one element for another, as when the oxide of a metal, MO, is converted into the chloride, $M\,Cl$, or the sulphuret, $M\,S$, or the cyanide, $M\,Cy$, or the sulphate, M_4, SO, &c. &c., where chlorine, sulphur, cyanogen, and $S\,O_4$, are successively substituted for oxygen) is still better seen in the action of nitric acid or naphthaline. The first effect is that 1 eq. of hydrogen is oxidized into water; but the oxygen being taken from nitric acid, NO_5, leaves nitrous acid, NO_4, and this complex atom at once takes the place of the hydrogen removed, forming the compound $C_{20} \left.\begin{matrix} H_7 \\ NO_4 \end{matrix}\right\}$, which has still the typical characters, although the place of 1 eq. of hydrogen is now occupied by a compound, containing 4 eqs. of oxygen; the body of all others most opposite to hydrogen. And this is so far from being a solitary case, that a large proportion of organic compounds, whether acid, basic, or neutral, form analogous compounds, in which hydrogen is replaced by the same number of atoms of nitrous acid, of chlorine, and of bromine, the general character of the compound remaining the same.

Chemistry. Many examples might be given. Acetic acid, $C_4 H_3 O_3, HO$, acted on by chlorine, yields chloracetic acid $C_4 Cl_3 O_3, HO$. Aniline, a base, $Cy_2 H_7 N$, acted on by bromine, yields the base bromaniline, $C_{12} \left.\begin{matrix} H_6 \\ Br \end{matrix}\right\} N$. The neutral oil, benzole, $C_{12} H_6$, yields, with nitric acid, the oil nitrobenzole, $C_{12} \left.\begin{matrix} H_5 \\ NO_4 \end{matrix}\right\}$.

It is easy to see that in this way a very large number of new compounds may be obtained, and, in fact, such are every day discovered, the experimenter being guided by the laws we have explained. It must be noticed, however, that although the type, generally speaking, is not altered by such substitutions, as we have just seen that the substitution-products from an acid, a base, and a neutral oil, are acid, basic, and oily and neutral, yet the negative energy of the elements substituted for hydrogen is not altogether lost or sunk. For, although we have from aniline, a base, basic substitution products, such as chloraniline, bromaniline, and nitraniline, in all of which 1 eq. of hydrogen is replaced successively by 1 eq. of chlorine, bromine, and nitrous acid, yet when 2 eqs. of hydrogen are thus replaced, the basic properties are much weakened, and when 3 eqs. have been replaced, as in trichloraniline and tribromaniline, these properties are gone, and the compound is neutral. But the very fact that, in this form, 3 eqs. of chlorine, one of which neutralizes the most basic metals, are just sufficient to destroy the basic character of 1 eq. of a feeble base, proves how much the negative character of chlorine, bromine, or nitrous acid is affected by the peculiar position they are made to occupy in the compound molecule, which only allows their negative character to appear to a small extent, when their quantity reaches a certain point.

Such are the general facts concerning types, and the peculiar form of substitution we have endeavoured to explain, by which the type is not materially changed, although hydrogen be replaced by its opposites. These facts are so far from being inconsistent with the existence of compound radicals, that these radicals are themselves, as types, equally capable of this form of substitution with any other compounds. Indeed, in the case of aniline, which is itself a substitution product of another kind, where hydrogen is replaced, not by its opposites, but by its homologues, as we shall presently explain, it is the radical phenyle, $C_{12} H_5$, contained in it, that undergoes the substitution of chlorine, bromine, and nitrous acid for hydrogen.

This leads us to consider that other form of substitution, also peculiar to organic compounds, to which we have just alluded, and to its results, namely, the formation of what are called homologous series, involving principles which, in reference to the classification and understanding of organic compounds, and to their artificial formation, are of far greater practical value than any we have yet expounded. Indeed, we can now see that the progress of science must inevitably reduce the whole of organic chemistry, in which, we must remember, only the same three or four elements are perpetually met with, to a collection of homologous series, in which every compound will have its natural place, indicative at once of its origin, its immediate derivation, and its properties both physical and chemical. This is so much the case, that the student, if he have a clear conception of the nature and relations of the series we call homologous, will have a far better idea of organic chemistry than he could have without this, even if we had space to describe the innumerable organic compounds, which, without this guiding principle, would form, as they have long done, a perfect chaos of isolated facts, which no memory could retain, and to which it would be impossible to give a rational or connected form. For this reason, we shall give a full explanation of this part of the subject, referring the reader to larger works for the voluminous details concerning individual compounds which are altogether inconsistent with our space.

Although we cannot yet include nearly all organic compounds in the series we are about to describe, yet a large number of the more important may be thus included, and thus a catalogue of the known homologous series will form the skeleton, as it were, or groundwork of an arrangement, in which all the parts may be seen to be mutually related. Those substances which do not themselves naturally fall into any of the series will be mentioned as groups, according to their natural affinities, and it will be found that they are in most cases related to the series of which we speak, through some of the products of their decomposition or transformation. Chemistry.

Lastly, after giving a brief account of those substances which cannot yet be included in the homologous series, we shall explain the changes which occur in living organisms, so far as these are known.

HOMOLOGOUS SERIES.

1. These series have gradually, and of late rapidly, developed themselves from the researches of modern chemists. They arise from a kind of substitution, the commonest of all in organic chemistry, in which hydrogen is replaced by certain compound radicals, which, being themselves homologous, of course give rise to homologous series, when substituted for hydrogen in various compounds. The origin of these homologous series of radicals themselves is more obscure; but, whatever that origin may be, these radicals are so related to each other as to constitute what may be called the chief or fundamental homologous series. Of these, more than one are known, but we shall select the best known and most important, which is that of the methylic or ethylic radicals, so called because methyle and ethyle are the two first radicals of the series. Let us consider these two. Methyle is $C_2 H_3$; ethyle is $C_4 H_5$; and they are, in all respects, closely analogous to one another, and, as has been already stated, to hydrogen and metals. Now what is the difference between them? $C_4 H_5 - C_2 H_3 = C_2 H_2$. Consequently the difference is $C_2 H_2$ or $2\,CH$. So that, by adding $C_2 H_2$ to the formula of methyle, we obtain that of ethyle. To ascertain the true starting point, let us, after subtracting $C_2 H_2$ from ethyle, which leaves $C_2 H_3$ or methyle, subtract the same amount, $C_2 H_2$, from methyle itself, $C_2 H_3 - C_2 H_2 = H$. Therefore hydrogen is the origin or point of departure of this series of radicals, and we have already seen that they are analogous to hydrogen. On the other hand, let us add to the formula of ethyle, once more $C_2 H_2$, and we have $C_4 H_5 + C_2 H_2 = C_6 H_7$, which is the formula of propyle. Another addition of $C_2 H_2$ to propyle gives $C_8 H_9$, which is butyle, and again the addition of $C_2 H_2$ to butyle gives $C_{10} H_{11}$ = amyle, and so on. Such is the nature of this first or fundamental homologous series, and all other homologous series yet known are formed on the same principle of the addition of $C_2 H_2$, neither less nor more, at each step, the starting point alone being different. There is every reason to believe that this first series extends from methyle (or from hydrogen), $C_2 H_3$ to melissyle $C_{60} H_{61}$, although only a few of the radicals, members of this series, are yet known in a separate form.

The first thing to be noticed is, that all the members of the series, being derived from H by the addition of $C_2 H_2$ in successive steps, contain, and must contain, invariably 1 eq. of hydrogen more than of carbon. Secondly, for the same reason, the number of equivalents of carbon is in all an even number, or divisible by 2, while that of the equivalents of hydrogen is odd. These facts are expressed by giving to the series the general formula, $C_n H_{n+1}$, in which n signifies 2, or a multiple of 2 by a whole number. The general formula may also be written $C_{2n} H_{(2n)+1}$. But the former is the simpler mode. The formula $C_n H_{n+1}$ includes all the radicals of this, the methylic or ethylic series. In this, as in all similar homologous series, the compounds

lowest in the scale, that is, with least carbon and hydrogen, are the least dense, the most volatile, and have the strongest affinities; and these properties vary in proportion to the amount of $C_2 H_2$ added, according to a regular law. The density of the vapour or gas increases, and the boiling point rises with perfect regularity, as we rise on the scale. Methyle and ethyle are gases like hydrogen, at ordinary temperatures; but while methyle requires 20 atmospheres to liquefy it, ethyle is condensed by 2 atmospheres, and the condensed liquid boils under the ordinary pressure at 23° or 9° below the freezing point. Propyle and butyle are oily liquids, the latter boiling at 226°, and amyle is an oily liquid boiling at 311°. Higher in the scale, the radicals are solid, but fusible and volatile; and the higher we go, the higher are the melting and boiling points. This at least is found to be the case in all other homologous series, and is no doubt true in this, although as yet all the radicals high in the scale are not known in the separate state.

2. Such is the first or fundamental homologous series of radicals, homologous with, and analogous to, hydrogen. Now these radicals, in the second aud more common form of substitution seen in organic compounds, are substituted for hydrogen, atom for atom, in various compounds, and thus give origin to as many homologous series as there are different compounds in which hydrogen can be replaced by these radicals. Hydrogen, H, is the starting point of the radicals; and water, H O, is the starting point of their protoxides, so that we have—

Hydrogen	H	Water	HO
Methyle	$C_2 H_3$	Oxide of methyle	$C_2 H_3 O$
Ethyle	$C_4 H_5$	Oxide of ethyle	$C_4 H_5 O$
Propyle	$C_6 H_7$	Oxide of propyle	$C_6 H_7 O$
Butyle	$C_8 H_9$	Oxide of butyle	$C_8 H_9 O$
Amyle	$C_{10} H_{11}$	Oxide of amyle	$C_{10} H_{11} O$

and so on, the two series running absolutely parallel. The five protoxides just named are all known, as well as a good many higher in the scale. They are in fact what are called the ethers, oxide of ethyle being common ether. Oxide of methyle or methylic ether is a gas at ordinary temperatures, and the others named are liquids less volatile than ether, while higher in the scale they are solids, as oxide of cetyle, $C_{32} H_{33} O$, which is a crystalline solid, like fat or wax. The general formula of this series is $C_n H_{n+1} O$.

3. The third homologous series is that of the hydrated protoxides of the radicals, or the alcohols; of which the starting point may be said to be 2 eqs. of water H O, H O, which we may suppose to exist, since water can play the part both of acid and base, both negative and positive, and may possibly form double molecules of hydrate of water. At all events we have only to add $C_2 H_2$ to the first equivalent of water, in successive quantities, to obtain the series of the alcohols, which are—that is, the first 5 of them—

Water	HO, HO	
Hydrated oxide of methyle	$C_2 H_3 O$, HO	Methylic alcohol.
... ... ethyle	$C_4 H_5 O$, HO	Ethylic or common do.
... ... propyle	$C_6 H_7 O$, HO	Propylic alcohol.
... ... butyle	$C_8 H_9 O$, HO	Butylic alcohol.
... ... amyle	$C_{10} H_{11} O$, HO	Amylic alcohol.

The whole of these alcohols are formed in the peculiar fermentation of sugar, called the vinous or alcoholic fermentation, and all but the first can only be produced in this way, so far as is yet known. When sugar dissolved is placed in contact with yeast, fermentation ensues, and at a certain temperature, if the sugar be pure, only ethylic alcohol and carbonic acid are produced. Dry grape sugar is the substance which ferments. Its formula is $C_{12} H_{12} O_{12}$, and in fermentation, $C_{12} H_{12} O_{12}$ yield 4 CO_2 and 2 ($C_4 H_6 O_2$). But when impurities are present, other analogous fermentations, though to a less extent, accompany this one; and in the fermentation of the juice of the grape, but especially of the expressed residue or mark of the grape, and also in that of infusion of grain or of malt, the four other alcohols here named, and one or two others next above them in the scale, are formed. We do not know exactly what are the products of the fermentations which produce them, but they must differ from those of the vinous fermentation. Thus, 3 eqs. of sugar $C_{36} H_{36} O_{36}$ may yield 4 eqs. of propylic alcohol 4 ($C_6 H_8 O_2$), 4 eqs. of water, 4 H O, and 12 of carbonic acid, 12 $C O_2$. Again, 5 eqs. of sugar may yield 4 of amylic alcohol, 12 of water, and 20 of carbonic acid. But the changes may be more complex. All that we know is, that in some circumstances not yet fully investigated, 5 or 6 different alcohols are formed from sugar. The amylic alcohol was discovered in the alcohol from potatoes and grain a good many years ago, and since then in that from the grape. In the latter, the methylic, propylic, butylic, and caproic alcohols have very recently been detected. Methylic alcohol is obtained, however, chiefly from the distillation of wood, and is often called pyroxilic spirit.

The propylic and butylic alcohols are perfectly analogous to the rest, and intermediate in properties between common alcohol and amylic alcohol, or oil of potato spirit, which has long been known. This series exemplifies admirably the nature of a homologous series. The physical properties of the alcohols are graduated in exact proportion to the increased amount of carbon and hydrogen. Thus, the boiling point rises about 34° for each step or addition of $C_2 H_2$; so that knowing the boiling point of one alcohol, we can calculate that of all the rest. This was done with respect to the two newly discovered alcohols before they were obtained, and the result agreed perfectly with the calculation. A good many alcohols are known higher in the scale. Spermaceti yields one of them, cetylic alcohol $C_{32} H_{33} O$, HO, and two others have been obtained from wax, namely cerotic or ceric alcohol $C_{54} H_{55} O$, HO, and melissic alcohol $C_{60} H_{61} O$, HO. These three are crystalline, fusible, volatile solids, but have a high boiling point. General formula $C_n H_{n+1}$, O, HO.

It is unnecessary to repeat in each case the statement, which holds good in all, that the physical properties and chemical affinities, in a homologous series, vary with the amount of carbon and hydrogen; the density and boiling point rising and the affinity diminishing as the carbon and hydrogen increase.

4. The fourth series is that of the hydurets of the radicals of the first series, or positive radicals. The general formula is $C_n H_{n+1}$, $H = C_n H_{n+2}$. The first is $C_2 H_3$, H or $C_2 H_4$, hyduret of methyle. This is marsh gas, sometimes written $C H_2$. But $C H_2$ is polymeric only with the true hyduret. The next is hyduret of ethyle, $C_4 H_5$, $H = C_4 H_6$. This series consists of gases, liquids, and solids, and it is believed that some kinds of naphtha, and some kinds of paraffine, belong to it. Naphtha may be $C_{10} H_{12}$, $C_{16} H_{18}$, $C_{20} H_{22}$, and the like, and paraffine may be in some cases, $C_{54} H_{56}$ and $C_{60} H_{62}$. At all events wax yields paraffine, and the substances in wax contain, as we have seen, C_{84} and C_{60}. Marsh gas, $C_4 H_6$, or perhaps $C_2 H_4$, or a mixture of both, is pro duced by the decay of dead vegetable matter at the bottom of stagnant water; also in coal mines. It is formed artificially in various processes.

5, 6, 7, 8. It will be seen that these four series are closely related together, the first containing the positive radicals, while the others contain compounds of those radicals. But these radicals form many compounds, and each compound of any one radical, as methyle or ethyle, indicates another homologous series. We have seen the oxide, the hydrated oxide, and the hyduret, each belonging to such a series. Now, the chloride of methyle is one of a fifth series, the general formula of which is $C_n H_{n+1}$, Cl. The iodide belongs to a sixth, of the general formula $C_n H_{n+1}$, I; the bromide to a seventh; formula $C_n H_{n+1}$, Br. All these, at least in the lower part of the scale, are volatile ethereal liquids, and become no doubt solid higher up. These series are exactly parallel to those already mentioned. An eighth series consists of the cyanides, which are remarkable as con-

taining two compound radicals, but otherwise are quite analogous to the rest. These cyanides are interesting from their being either identical or isomeric with the compounds of another series, the nitryles, connected with a second series of radicals, the negative radicals, to be presently mentioned. The cyanides are also interesting, since from them it is possible to reproduce the corresponding alcohols; and in this way we may be able to obtain certain alcohols which could not otherwise be procured.

9, 10. A ninth homologous series is that of the sulphurets of the positive radicals, which, in the lower part of the scale, are ethereal liquids, with an insupportable garlic odour; general formula $C_n H_{n+1}$, S. A tenth series consists of compounds of the sulphurets with hydrosulphuric acid, of the general formula $C_n H_{n+1}, S + HS$. Of these the types are methylo-mercaptan and ethylo-mercaptan, or simply mercaptan, so called from its strong action on oxide of mercury. These two compounds are $C_2 H_3 S$, H S and $C_4 H_5 S$, H S, while the corresponding sulphurets are $C_2 H_3 S$ and $C_4 H_5 S$. The mercaptans have also a strong and offensive garlic odour. It will be seen that the sulphurets are the oxides or ethers in which sulphur has taken the place of oxygen, and the mercaptans are the hydrated oxides or alcohols, in which the same substitution has taken place; for we have—

Ethers.	Sulphurets.	Alcohols.	Mercaptans.
$C_2 H_3 O$	$C_2 H_3 S$	$C_2 H_3 O$, HO	$C_2 H_3 S$, HS
$C_4 H_5 O$	$C_4 H_5 S$	$C_4 H_5 O$, HO	$C_4 H_5 S$, HS
$C_6 H_7 O$	$C_6 H_7 S$ &c. &c.	$C_6 H_7 O$, HO	$C_6 H_7 S$, HS, &c.

The two series might be extended as far as any of the others.

11. We now come to another group of homologous series, still containing the same radicals, namely the salts of their oxides, or compounds of the oxides with oxygen acids, or, as they are called, the compound ethers. The ethers are capable of uniting with almost all acids, such as sulphuric, nitric, hyponitrous, carbonic, oxalic, acetic, benzoic, and in fact all organic acids. It is evident that the compounds of each acid with the ethers form a homologous series. We shall merely give as an example of the neutral compound ethers, an eleventh series, the carbonates of the oxides of the second series. Their general formula is $C_n H_{n+1}, O, CO_2 = C_{n+1} H_{n+1} O_3$. Those of methyle and ethyle are volatile ethereal liquids, as are indeed the whole class of compound ethers when low in the scale.

12, 13, 14. A twelfth series is that of the acid sulphates of the oxides of the second series. General formula $C_n H_{n+1}$, O, HO, 2 SO_3. These are formed when the alcohols are acted on by excess of sulphuric acid. They are strongly acid, and, when neutralized by fixed bases, form what may be considered either as double salts, or salts of acids containing the ethers along with sulphuric acid. The two first of these acid sulphates are $C_2 H_3 O$, HO, 2 SO_3, called sulphomethylic acid, or double sulphate of water and oxide of methyle; and $C_4 H_5 O$, HO, 2 SO_3, sulphoethylic—or sulphovinic acid, or double sulphate of water and oxide of ethyle. The rest of the series are perfectly analogous to these. When these two, or any of the others are neutralized with potash, which replaces the water, we obtain the sulphomethylate and sulphoethylate of potash, or double sulphates of potash and oxide of methyle or ethyle, which, in fact, belong to a thirteenth homologous series, since every base forms a new series with these acids. The two acids, with their potash and lime salts, may be thus compared:—

Acids.	Potash Salts.	Lime Salts.
$C_2 H_3 O$, HO, 2 SO_3	$C_2 H_3 O$, KO, 2 SO_3	$C_2 H_3 O$, CaO, 2 SO_3
$C_4 H_5 O$, HO, 2 SO_3	$C_4 H_5 O$, KO, 2 SO_3	$C_4 H_5 O$, CaO, 2 SO_3

The lime salts, of course, form a fourteenth series, and here, as in the case of the neutral compound ethers, there is no limit to the number of series, but that of the acids and bases capable of uniting with the oxides of series 2, and the acids of series 12.

15. The next, or fifteenth homologous series that we shall specify, is not only in itself a very remarkable one, but at the same time the source of an infinite number of additional series. It still contains the same positive radicals which have been present in all the series hitherto named. In this one they are combined with amide, NH_2, and the result is, a series of volatile bases formerly alluded to, homologous with ammonia, which is their starting point, as hydrogen is of the radicals; (for ammonia is amide + hydrogen). They are in the highest degree analogous to ammonia, which is the true type of the volatile organic bases. Their general formula is $C_n H_{n+1}$, NH_2, and therefore they contain no oxygen. The formula may also be written $C_n H_{n+3}$, N, which makes it easy to remember, that the hydrogen in all of them exceeds the carbon by 3 eqs., and that there is 1 eq. of nitrogen, and no oxygen. The following are a few of those in the lower part of the scale. We have added a third column to show the analogy with ammonia more clearly, in which the radicals, as well as the amide, are represented by their abbreviated symbols:—

Ammonia,	$H_3 N$	=	NH_2, H	=	Ad H
Methylamine,	$C_2 H_5 N$	=	NH_2, $C_2 H_3$	=	Ad Me
Ethylamine,	$C_4 H_7 N$	=	NH_2, $C_4 H_5$	=	Ad Ae
Propylamine,	$C_6 H_9 N$	=	NH_2, $C_6 H_7$	=	Ad Pr
Butylamine,	$C_8 H_{11} N$	=	NH_2, $C_8 H_9$	=	Ad Bu
Amylamine,	$C_{10} H_{13} N$	=	NH_2, $C_{10} H_{11}$	=	Ad Ayl

and so on throughout the whole series of radicals.

No series is more striking than this. Its discovery was predicted by Liebig exactly ten years before it was made, and the properties of the compounds belonging to it plainly indicated. The analogy to ammonia is so perfect, that the base nearest to ammonia, methylamine, can hardly be distinguished from it. It is, like ammonia, a gas, absorbed in large quantity by water, of a pungent smell, almost identical with that of ammonia; it forms white fumes with hydrochloric acid, and its salts exactly resemble those of ammonia. It occurs in various decompositions, and in putrefaction, along with ammonia, and it has been frequently taken for ammonia and described as such before its true nature was known. Ethylamine is only a degree less like ammonia, being at ordinary temperatures a very volatile liquid, the smell of which, while analogous to that of ammonia, yet differs from it. It also has been often overlooked from this resemblance. As in all other series, the compounds higher in the scale are less and less volatile and more oily, and at a certain point become solid and crystalline. Not only do these bases form as many new homologous series as there are acids to combine with them, but with them all the reactions of ammonia may be repeated, giving rise to new compounds. Thus, ammonia forms four or five new bases with platinum; so do these volatile bases, methylamine and ethylamine, so that each of these four or five platinum bases represents a new series, and each of their salts with acids represents another. Thus not only do the sulphates of methylamine, &c., form a series, but the sulphate of each of the four or five platinum bases of ammonia does so likewise. And so of all the other salts. The bases of the series are called amide bases.

16. The sixteenth is also one of volatile bases, but not containing amide. Ammonia is still the type, but in this case it is viewed as composed of NH, H_2, or of imide NH, with 2 eqs. of hydrogen. The homologous bases of this series consist of imide with 2 eqs. of methyle, or of ethyle, &c.; or of imide with 1 eq. of methyle and 1 of ethyle, or 1 eq. of ethyle, and 1 of propyle, &c. &c. The following list contains a few of them:—

Ammonia,	$H_3 N$	=	NH, H_2	=	Id, H_2
Dimethylamine,	$C_4 H_7 N$	=	NH, 2 ($C_2 H_3$)	=	Id, Me_2
Diethylamine,	$C_8 H_{11} N$	=	NH, 2 ($C_4 H_5$)	=	Id, Ae_2
Dipropylamine,	$C_{12} H_{15} N$	=	NH, 2 ($C_6 H_7$)	=	Id, Pr_2
Methylethylamine,	$C_6 H_9 N$	=	NH, $C_2 H_3$, $C_4 H_5$	=	Id, Me Ae
Ethylopropylamine,	$C_{10} H_{13} N$	=	NH, $C_4 H_5$, $C_6 H_7$	=	Id, Ae Pr

and so on. These bases are very much similar to the others. They are called imide bases, and their general formula is $NH, 2 (C_n H_{n+1})$. It will be seen by the first column, that several of them are isomeric with amide bases, but the second and third columns, which give the rational formulæ, show that they are distinct in constitution as they are in properties, although analogous. It must be observed that the general formula of this series $NH, 2 (C_n H_{n+1})$, may also be written $(C_n H_{n+3}) N$, which is the same as that of the preceding series in its second form. The same general form also $(C_n H_{n+3}) N$, includes also the next series, although it also may be expressed so as to show the difference.

17. The seventeenth series is again one of volatile bases, of the type of ammonia, and of the general formula $(C_n H_{n+3}) N$, agreeing in this with the two preceding series, as has just been stated. But the more precise formula here is that which is taken from ammonia, viewed, not as amide + 1 eq. hydrogen, nor as imide + 2 eqs. hydrogen, but as nitrogen + 3 eqs. hydrogen, $N + H_3$. This being the type, in these bases the whole 3 eqs. of hydrogen are replaced by methyle, or by ethyle, &c., or partly by one and partly by another of the radicals of series 1. The following are some of them. Their general formula, strictly stated, is $N + 3 (C_n H_{n+1})$

Ammonia	$H_3 N$	=	$N + H_3$	=	$N H_3$
Trimethylamine	$C_6 H_9 N$	=	$N + 3 (C_2 H_3)$	=	$N Me_3$
Triethylamine	$C_{12} H_{15} N$	=	$N + 3 (C_4 H_5)$	=	$N Ae_3$
Triamylamine	$C_{30} H_{33} N$	=	$N + 3 (C_{10} H_{11}$	=	$N Ayl_3$
Methylodiethylamine	$C_{10} H_{13} N$	=	$N + C_2 H_3 + 2 (C_4 H_5)$	=	$N Me Ae_2$
Ethylodiamylamine	$C_{24} H_{27} N$	=	$N + C_4 H_5 + 2 (C_{10} H_{11})$	=	$N Ae Ayl_2$
Methylethylamylamine	$C_{16} H_{19} N$	=	$N + C_2 H_3 + C_4 H_5 + C_{10} H_{11}$	=	$N Me Ae Ayl$

Even among the few here given, it will be seen that three are isomeric with bases in the last table, and two of these also with two bases in the first table, series 15. But the rational formulæ in the last two columns show that they differ in constitution, as they do also in properties. The bases of this series are called nitryle bases.

The three series just mentioned, of all of which ammonia is the type, include all the known *volatile* organic bases, natural or artificial, that is, all such as are not decomposed but volatilized, unchanged by a due application of heat. An amide base is easily converted into an imide base by the action of the iodide of one of the radicals of series 1, and an imide base is converted by the same means into a nitryle base. And all of them may be derived from ammonia by the action, in successive steps, of such an iodide. Let us take iodide of ethyle, $Ae I$. The first action is $NH_3 + Ae I = NH_2 Ae, HI$. That is, the iodine takes 1 eq. of hydrogen, forming hydriodic acid, while the ethyle replaces that eq. of hydrogen, forming the amide base, ethylamine, which combines with the hydriodic acid. The next step is the action of iodide of ethyle on ethylamine, $NH_2 Ae + Ae I = NH Ae_2, HI$; the result is, hydriodate of diethylamine. And in the third stage, when iodide of ethyle acts on diethylamine, we obtain the hydriodate of triethylamine, $NH Ae_2 + Ae I = N Ae_3, H I$. Nothing can show more plainly that all these bases are simply ammonia, the hydrogen of which is replaced, in part or in whole, by positive radicals of series 1. It is also evident, that since there are only 3 eqs. of hydrogen in ammonia, we cannot push further the substitution of these radicals for hydrogen, after we have replaced the whole 3 equivalents. If we attempt to do so, we find that we obtain indeed new bases, but of a different type, being no longer volatile, but decomposed by heat, and containing oxygen. The explanation of this is very interesting. We cannot indeed replace more than three atoms of hydrogen in ammonia by our radicals, but we can add to the 3 eqs. of radical a fourth, and no more, or, in other words, we can replace the fourth eq. of hydrogen also in *ammonium*, which contains 4 eqs. of hydrogen. This leads to the formation of the next series.

18. The eighteenth series is a most remarkable and interesting one, of fixed bases, that is, bases which cannot be volatilized without decomposition, and which no longer are of the type ammonia, but, in composition, of the type of hydrated oxide of ammonium; and as that body is unknown in a separate form, we can compare them to nothing so well as to hydrated oxide of potassium, or caustic potash, to which they are in a most astonishing degree analogous. To illustrate their formation, let us suppose iodide of ethyle to act on triethylamine. Here there is no more hydrogen left to be replaced, for all 3 eqs. are already replaced, and all the hydrogen present is in the form of ethyle. The action is $N Ae_3 + Ae I = N Ae_4 I$. The ethyle of the iodide unites with triethylamine to form a compound metal, tetrethylium, $N Ae_4$, analogous to ammonium, NH_4, and this metal unites with the iodine, forming the iodide of tetrethylium, $N Ae_4 I$, exactly similar to iodide of ammonium, $NH_4 I$. To obtain the base, this iodide, which is a crystallizable salt, is acted on by oxide of silver and water. The action is, $N Ae_4 I + Ag O + HO = Ag I + N Ae_4 O, HO$; and the results are, iodide of silver and hydrated oxide of tetrethylium. The latter is obtained as a crystalline mass by evaporation *in vacuo*.

In composition, it corresponds to the hydrated oxides of ammonium and potassium. We have—

Hydrated oxide of ammonium...	$NH_4 O, HO$	=	$Am O, HO$
... ... potassium... ..			KO, HO
... .. tetrethylium..	$NAe_4 O, HO$	=	$Tth O, HO$

($Tth = NAe_4$, tetrethylium). Hydrated oxide of ammonium is not known, as, when we attempt to separate it from the salts of ammonium, it is instantly resolved into ammonia and water. $NH_4 O, HO = NH_3 + 2 HO$. The reason of this would seem to be, that the attraction of the oxygen of the oxide for the fourth eq. of hydrogen is so strong as to detach it, that eq. being of course held by a feebler force than the others. If, however, this hydrated oxide could exist in a separate form—and possibly we may some day succeed in obtaining it, perhaps under the influence of intense cold—it would certainly resemble caustic potash, and the hydrated oxide of tetrethylium. The latter can exist in a separate form, just because the attraction of oxygen for the fourth eq. of ethyle is very much less than for hydrogen; that is, at ordinary temperatures; for at higher temperatures hydrated oxide of tetrethylium undergoes precisely the same change as that of ammonium at ordinary temperatures, being converted into ethylamine, corresponding to ammonia, and hydrated oxide of ethyle, corresponding to 2 eqs. of water. $NAe_4 O, HO = NAe_3, + Ae O, HO$. It is on this account that we conjecture that under intense cold the ammonium compound might be permanent. The action of heat on this hydrated oxide of tetrethylium is characteristic of this whole series of bases.

In properties, hydrated oxide of tetrethylium is so very like caustic potash, that were it not for the action of heat, it might, in solution, be confounded with it. It has a caustic alkaline taste, feels soapy to the fingers, as potash does, attracts water and carbonic acid from the atmosphere, precipitates the salts of metals as potash does, converts oils into soaps when boiled with them, and forms insoluble or sparingly soluble salts, with bichloride of platinum and other tests, exactly as potash does. The chief difference is, that besides the caustic alkaline taste, it has a bitter taste; and this is true of the whole class of bases to which it belongs. This and the action of heat distinguish them from potash and soda. But these same characters connect them with the fixed vegetable bases, such as quinine, morphine, strych-

nine, and the like; all of which are bitter, and all of which, when heated, yield a volatile nitryle base, as the base in question yields triethylamine. In short, the bases of this series are of the same type as the fixed vegetable bases, and this being so, it is easy to see that there is no improbability in our being able to form artificially the natural fixed organic bases. Before going farther, we shall here give the formulæ of a few of the artificial bases of this series, the general formula of which is $N, 4 (C_n H_{n+1}) O, HO$. They are called ammonium bases.

Hydrated oxide of ammonium (type)	NH_4, O, HO		$= Am O, HO$
Hydrated oxide of tetramethylium	$C_8 H_{13} NO_2$	$= NMe_4 O, HO$	$= Tme O, HO$
tetrethylium	$C_{16} H_{21} NO_2$	$= NAe_4 O, HO$	$= Tth O, HO$
. . tetramylium	$C_{40} H_{45} NO_2$	$= NAyl_4, O, HO$	$= Aym O, HO$

To show the analogy in composition with the natural fixed bases, let us take the formula of quinine, which is $C_{20} H_{12} NO_2$, which is intermediate between the second and third of those above given. But, in addition to this, there exists a volatile base, found in coal-tar, and formed also by the action of heat on quinine, and bearing to it the same relation that trimethylamine does to hydrated oxide of tetramethylium. It is called quinoline, and is a nitryle base. Now, by the action of iodide of methyle, it is converted into an ammonium base, as follows. Its formula is $C_{18} H_8 N$. Now, $C_{18} H_8 N + C_2 H_3 I = C_{20} H_{11} N, I$. This iodide, acted on by oxide of silver, yields the base, $C_{20} H_{11} NO, HO = C_{20} H_{12} NO_2$, which is either quinine or a base isomeric with quinine. It is such considerations which render the ammonium bases so interesting, and we have dwelt somewhat fully on them, as well as on the amide, imide, and nitryle bases, because of the insight thus obtained into the mode of formation of two very important classes of vegetable products, the volatile bases, and the fixed bases. We have dwelt, however, only on the principles which regulate these very curious and important reactions, and not on the individual compounds, which our space forbids us to do. There is no part of the science which so plainly demonstrates the value and importance of the laws we have endeavoured to explain concerning types, substitution, and homologous series. Yet the whole of the facts in reference to these four series of bases are of quite recent discovery, ethylamine and methylamine dating only from 1840, while the imide, nitryle, and ammonium bases have all been discovered much more recently. There is every reason to expect important practical applications of these discoveries; but even should this not be the case, they have already done more for the science than hundreds of practical applications could ever do.

We shall now turn to a group of homologous series, related to those we have described, but more particularly to a series of negative radicals, derived from the compounds of the positive radicals of series 1.

19. The nineteenth series here specified, is that of the derived or positive radicals themselves. They are little if at all known in the separate state, but may be traced in many compounds, and therefore it is convenient to assume their existence. They are derived, that is, their compounds are derived, from those of the positive radicals, by the removal of 2 eqs. of hydrogen, which is effected by oxidizing agencies, by chlorine, and otherwise. Their general formula is $C_n H_{n-1}$; and the following are the first in the series—

Formyle...........	$C_2\ H$	=	Methyle	$C_2 H_3$	−	H_2
Acetyle...	$C_4\ H_3$	=	Ethyle	$C_4 H_5$	−	H_2
Propionyle.	$C_6\ H_5$	=	Propyle	$C_6 H_7$	−	H_2
Butyryle.......... .	$C_8\ H_7$	=	Butyle	$C_9 H_9$	−	H_2
Valeryle...........	$C_{10}\ H_9$	=	Amyle	$C_{10} H_{11}$	−	H_2

and so on, regularly.

20. The twentieth series is that of the hydrated protoxides of these negative radicals, the general formula of which is $(C_n H_{n-1}) O, HO = C_n H_n O_2$. The type of this series is aldehyde, $C_4 H_3 O, HO = C_4 H_4 O_2$, the hydrated oxide of acetyle. It is called aldehyde, because it is obtained from alcohol by dehydrogenation, for alcohol, $C_4 H_5 O, HO - H_2 = C_4 H_3 O, HO$.

Aldehyde is formed whenever alcohol is acted on by oxygen, the first effect being the removal of 2 eqs. of hydrogen, converted by the oxygen into water. Thus, $C_4 H_5 O, HO + O_2 = 2 HO + C_4 H_3 O, HO$. Aldehyde is a very volatile, pungent, inflammable liquid, having a strong attraction for oxygen, and reducing the salts of silver to the metallic state by this attraction. With 2 eqs. of oxygen it forms pure acetic acid, which is the teroxide of the same radical of which aldehyde is the protoxide. $C_4 H_3 O, HO + O_2 = C_4 H_3 O_3, HO$.

The whole series of homologous compounds, which, as a class, are called the aldehydes, agree with this one in their derivation, and in their attraction for oxygen, by which they are converted into volatile acids homologous with acetic acid. Several of them are found in nature, and others are formed in various processes. There are two remarkable characters which are found in all aldehydes, even in such as belong to a different series. But here we speak only of that series of aldehydes which is derived from the ethylic series of alcohols, and yields the acetic series of acids. These characters are, that the aldehydes combine with ammonia, forming in several cases permanent, crystallizable compounds; and that they also form crystalline compounds with the sulphites of potash or ammonia. By one or other of these characters aldehydes are detected when mixed with compounds of different properties, and may be purified. But their most important character is that of absorbing oxygen from the air, and producing the volatile and oily acids of the next series.

The following are a few of the aldehydes:—

Hydrated oxide of	formyle....	$C_2\ HO, HO$	=	$C_2\ H_2\ O_2$
Do.	acetyle.....	$C_4\ H_3\ O, HO$	=	$C_4\ H_4\ O_2$
Do.	propyle.....	$C_6\ H_5\ O, HO$	=	$C_6\ H_6\ O_2$
Do.	butyryle...	$C_8\ H_7\ O, HO$	=	$C_8\ H_8\ O_2$
Do.	valeryle...	$C_{10}\ H_9\ O, HO$	=	$C_{10}\ H_{10}\ O_2$
Do.	œnanthyle	$C_{14}\ H_{13}\ O, HO$	=	$C_{14}\ H_{14}\ O_2$
Do.	capryle ..	$C_{20}\ H_{19}\ O, HO$	=	$C_{20}\ H_{20}\ O_2$

These and some others are known. The two last-named are found, the former among the products of distillation of castor oil, the latter in the volatile oil of rue.

21, 22. The next, or twenty-first series, is that of the hydrated teroxides of the negative or formylic radicals, which are volatile, and with the exception of two, oily and fatty acids of great interest and importance. Their general formula is $C_n H_{n-1} O_3, HO = C_n H_n O_4$. They are found abundantly in nature, generally combined with oxide of lipyle or glycerine, forming the fixed oils and fats; but they also occur free, and some of them combined with oxide of ethyle. These acids are formed by the direct oxidation of the aldehydes, which, as we have seen, are themselves formed by the action of oxygen on the alcohols, which removes hydrogen from these compounds. Hence the typical process, which is the conversion of common alcohol into acetic acid, consists of two stages, the production of aldehyde by dehydrogenation, and the oxidation of the aldehyde thus produced. Representing alcohol by $C_4 H_6 O_2$ for shortness' sake, we have first $C_4 H_6 O_2 + O_2 = 2 HO + C_4 H_4 O_2$; and secondly aldehyde, which is $C_4 H_4 O_2$, taking up 2 eqs. of oxygen, becomes acetic acid, $C_4 H_4 O_4 = C_4 H_3 O_3, HO$. It is in this way, and no other, that alcohol, wine, or beer, is converted into vinegar. If the supply of oxygen be deficient, great loss is sustained by the evaporation of the very volatile aldehyde, but with a full supply of oxygen the whole is acidified. As this oxidation, or slow combustion, or decay, of alcohol is set agoing by contact with a ferment, such as yeast, and air at the same time, it has been called the acetous fermentation; but it is merely a case of oxidation or

decay promoted by the presence of a ferment, as will be elsewhere explained.

Of all known homologous series, this one is the best known and the most complete, the series being unbroken from C_2 (in formic acid), to C_{42} (in behenic acid), and at least two acids being known beyond that point. We give here the list of these acids, premising that the two first, which contain, relatively, a very large amount of oxygen, are not oily, but that oily properties begin to appear in the third, and that all the rest are oily and fatty, exhibiting a perfect gradation of physical properties, such as density, fusibility, volatility, &c.; being, in short, a perfect example of a homologous series.

	Formic acid	$C_2\,H\,O_3, HO = C_2\,H_2\,O_4$
	Acetic acid	$C_4\,H_3\,O_3, HO = C_4\,H_4\,O_4$
Oily acids.	Propylic acid	$C_6\,H_5\,O_3, HO = C_6\,H_6\,O_4$
	Butyric acid	$C_8\,H_7\,O_3, HO = C_8\,H_8\,O_4$
	Valerianic acid	$C_{10}\,H_9\,O_3, HO = C_{10}\,H_{10}\,O_4$
	Caproic acid	$C_{12}\,H_{11}\,O_3, HO = C_{12}\,H_{12}\,O_4$
	Œnanthylic acid	$C_{14}\,H_{13}\,O_3, HO = C_{14}\,H_{14}\,O_4$
	Caprylic acid	$C_{16}\,H_{15}\,O_3, HO = C_{16}\,H_{16}\,O_4$
	Pelargonic acid	$C_{18}\,H_{17}\,O_3, HO = C_{18}\,H_{18}\,O_4$
Fatty acids.	Capric acid	$C_{20}\,H_{19}\,O_3, HO = C_{20}\,H_{20}\,O_4$
	Margaritic acid	$C_{22}\,H_{21}\,O_3, HO = C_{22}\,H_{22}\,O_4$
	Laurostearic acid	$C_{24}\,H_{23}\,O_3, HO = C_{24}\,H_{24}\,O_4$
	Cocinic acid	$C_{26}\,H_{25}\,O_3, HO = C_{26}\,H_{25}\,O_4$
	Myristic acid	$C_{28}\,H_{27}\,O_3, HO = C_{28}\,H_{28}\,O_4$
	Benic acid	$C_{30}\,H_{29}\,O_3, HO = C_{30}\,H_{30}\,O_4$
	Cetylic and Palmitic acids	$C_{32}\,H_{31}\,O_3, HO = C_{32}\,H_{32}\,O_4$
	Margaric acid	$C_{34}\,H_{33}\,O_3, HO = C_{34}\,H_{34}\,O_4$
	Bassic and Stearic acids	$C_{36}\,H_{35}\,O_3, HO = C_{36}\,H_{36}\,O_4$
	Balenic acid	$C_{38}\,H_{37}\,O_3, HO = C_{38}\,H_{38}\,O_4$
	Butinic acid	$C_{40}\,H_{39}\,O_3, HO = C_{40}\,H_{40}\,O_4$
	Behenic acid	$C_{42}\,H_{41}\,O_3, HO = C_{42}\,H_{42}\,O_4$
Waxy acids.	Cerotic acid	$C_{54}\,H_{53}\,O_3, HO = C_{54}\,H_{54}\,O_4$
	Melissic acid	$C_{60}\,H_{59}\,O_3, HO = C_{60}\,H_{60}\,O_4$

The acids of this truly remarkable series are all volatile, that is, may all be distilled unchanged, but the boiling point rises at each step just as with the alcohols, and to the same extent, namely, about 34° for each addition of $C_2\,H_2$. The two first are products of oxidation, usually artificial, but formic acid occurs in the ant, and acetic acid in some vegetable juices. The remaining acids are all found in nature, and in general, combined with oxide of lipyle, $C_3\,H_2\,O$, or $C_6\,H_4\,O_2$, forming the neutral fixed oils and fats, vegetable and animal. Of the former, olive oil and palm oil are examples; of the latter, tallow and butter. These fats and oils, however, contain also a peculiar oily acid, not of this series, combined also with oxide of lipyle. This is oleic acid, $C_{36}\,H_{33}\,O_3, HO = C_{36}\,H_{34}\,O_4$. The most abundant of the oils and fats are those containing oleic acid, stearic acid, palmitic acid, and margaric acid, which seems to be a compound, possibly a mixture of stearic and palmitic acids. The oils containing the acids lower in the scale, from C_8 to C_{20}, which are the more volatile of the oily acids, occur only in certain fats, and in small quantities, and give them their peculiar flavour, the fats higher in the scale having neither taste nor smell. The neutral fats are named shortly, after the acids they contain; thus, oleine, stearine, palmitine, margarine, butyrine, valerine, caproine, &c. Solid fats consist chiefly of stearine, palmitine, margarine, &c., with a little oleine; liquid oils of oleine, with some margarine, stearine, &c., dissolved. Butter is a very remarkable fat, containing butine, stearine, palmitine, and myristine, the stearine and palmitine together forming margarine, all of these being solid tasteless fats; and, in smaller quantity, caprine, capryline, caproine, and butyrine, which are oily and sapid, and give to butter its peculiar flavour, especially butyrine, the most abundant of them. It contains also oleine. But it is worthy of notice, that all the acids of the formic series in butter have formulæ in which the number of atoms of carbon is divisible by 4, none of the intermediate acids being present. Valerine is the compound which, being present in small quantity in whale oil, as butyrine is in butter, gives to that oil its peculiar and unpleasant flavour. When the neutral fat oils, such as stearine, palmitine (which constitutes the chief part of palm oil), margarine, and oleine, are boiled with alkalies, they yield soaps, which are compounds of the oily and fatty acids with potash and soda, the former yielding soft, the latter hard soaps. In this process the basic oxide of lipyle is separated, and combining with water, forms a sweetish solution, which by evaporation forms a syrup, called glycerine, or the sweet principle of oils. Oxide of lipyle is $C_3\,H_2\,O$, and glycerine is $2\,(C_3\,H_2\,O) + 3\,HO = C_6\,H_7\,O_5$. When glycerine is heated in sealed tubes with the oily acids, it again becomes oxide of lipyle and combines with the acids, reproducing neutral oils or fats. When heated by itself glycerine yields an intolerably acrid pungent vapour, which condenses into a liquid called acroleine, or hydrated oxide of acryle, $C_6\,H_3\,O, HO = C_6\,H_4\,O_2$. It appears to be either oxide of lipyle, which we have seen to be $C_3\,H_2\,O$, or $C_6\,H_4\,O_2$, or polymeric with it, the latter being the more probable view. It attracts oxygen with avidity, and is converted into an acid, acrylic acid, $C_6\,H_3\,O_3, HO = C_6\,H_4\,O_4$ resembling acetic acid. In consequence of the formation of acroleine, the action of heat on oils is an excellent means of detecting the presence in them of oxide of lipyle or glycerine. A drop of any oil containing that compound, heated in the bottom of a test tube, produces the pungent vapour of acroleine which attacks the eyes strongly, and is indeed formed, as all must have perceived, when a candle is blown out so as to leave the wick ignited, that is red-hot, without flame.

The reader will perceive that we have taken this opportunity of giving a brief general sketch of the oils and fats; and have, in fact, appended to the homologous series of the oily acids the description of another series, No. 22, which includes the compounds of those acids with oxide of lipyle or glycerine, that is, the neutral oils and fats. We trust that this brief notice will suffice to give the student an idea of the chemistry of both of these very important series, the oily and fatty acids, and the neutral oils and fats. It will also serve to illustrate the advantage of studying homologous series, since otherwise this numerous class of bodies would present only a mass of confusion.

23. The next, or twenty-third series we shall name is that of the salts formed by the acids of series 21 with oxide of ammonium. We shall not, however, enter into details, but only state, that from this series two others arise by the separation of water. As an example of the series itself, we take acetate of ammonia, $NH_4\,O, C_4\,H_3\,O_3$. General formula $NH_4\,O + (C_n\,H_{n-1})\,O_3$.

24. The twenty-fourth series is derived from the preceding by the separation of 2 eqs. of water, and includes the amides of the acids of series 21. Example acetamide, which is acetate of ammonia, *minus* 2 eqs. of water, $NH_4\,O, C_4\,H_3\,O_3 - 2\,HO = NH_2, C_4\,H_3\,O_2 = C_4\,H_5\,NO_2$. General formula $NH_2 + C_n\,H_{n-1}\,O_2$.

25. The twenty-fifth series is derived either from the twenty-third, by the separation of 4 eqs., or from the twenty-fourth by that of 2 eqs. of water, by which all oxygen is removed from both, and the result is a series of very remarkable volatile liquids, called nitryles, and containing the elements of one of the negative radicals, with 1 eq. of nitrogen. Take for example acetonitryle, which is thus derived from acetate of ammonia. $NH_4\,O, C_4\,H_3\,O_3 - 4\,HO = C_4\,H_3\,N$, or from acetamide; $NH_2, C_4\,H_3\,O_2 - 2\,HO = C_4\,H_3\,N$.

The most important point in regard to this series is, that in composition they are either niturets of the formylic radicals, or cyanides of the methylic radicals one step lower in the scale. Thus acetonitryle is either $C_4\,H_3, N$, or $C_2\,H_3, C_2\,N$, which latter formula is cyanide of methyle.

Now it is not yet certain whether in all cases the nitryles, as obtained from the ammonia salts of the acids of the formic series, are really the cyanides of ethylic radicals, or only

isomeric with them. In some cases they certainly appear to be identical with these cyanides as otherwise obtained, but in others they seem to be different. Supposing them to be the cyanides, then it will be possible from any acid of the series No. 21 to obtain the cyanide of the ethylic radical, having 2 eqs. of carbon less than the acid, as from acetic acid cyanide of methyle. Now from the cyanides we can reproduce the alcohol from which they are derivable. And thus we may probably be able to form artificially alcohols which otherwise might never be known. For example, the alcohol with 30 eqs. of carbon is unknown; but from the ammonia salt of the acid with 32 eqs. of carbon, palmitic acid, we can obtain the body palmitonitryle $C_{32}\,H_{31}\,N$, which is probably the cyanide of the radical $C_{30}\,H_{29}$. And if so, from this cyanide it might be possible to form the alcohol in question, which contains the radical $C_{30}\,H_{31}$. The general formula of the nitryles is $C_n\,H_{n-1}\,N$ or $C_n\,H_{n+1} + C_2\,N$.

26. The next, or twenty-sixth series, will be that of the terchlorides of the formylic radicals, of which chloroform, the terchloride of formyle is the type. The properties of chloroform are now well known. At present no other member of this series has been studied, but judging from that one they merit investigation. General formula $C_n\,H_{n-1}, Cl_3$.

27. The oil of olefiant gas, or of the Dutch chemists, represents a twenty-seventh series. It is the hydrochlorate of a protochloride of acetyle, $C_4\,H_3\,Cl, H\,Cl = C_4\,H_4\,Cl_2$. Of this series also hardly any others are known. The oil in question has a singular resemblance to chloroform in its taste and smell, as well as in its action on the system when inhaled. General formula, $C_n\,H_{n-1}\,Cl$, $H\,Cl$.

28. The twenty-eighth series is that of the hydurets of the formylic radicals, the type of which is olefiant gas, or hyduret of acetyle, $C_4\,H_3, H = C_4\,H_4$. This is a series of combustible gases, liquids, and solids, formed abundantly in the distillation of organic substances, such as wood, coal, or animal matter, along with the hydurets of the methylic radicals, typified by marsh gas $C_4\,H_6$. It is probable that several species of naphtha and of paraffine belong to this series, as well as to series 4. The compounds of this series, No. 27, are absorbed by chlorine even in the dark, which is not the case with those of series 4.

29. The next or twenty-ninth series is very remarkable; it is that of which oxalic acid is the type, and consists of bibasic acids, having a singular relation to the acids of series 21. Oxalic acid is $C_4\,O_6, 2\,HO = C_4\,H_2\,O_8$. Now, if we compare this with the formula of formic acid, $C_2\,H_2\,O_4$, we perceive that they differ exactly by $C_2\,O_4$, that is, by 2 eqs. of carbonic acid; so that, to obtain the formulæ of the acids of this series, we have only to add $C_2\,O_4$ to those of the acids of series 20, thus—

Monobasic volatile acids.				Bibasic fixed acids.	
Formic acid,	$C_2\,H_2\,O_4$	$+\,C_2\,O_4$	$=$	$C_4\,H_2\,O_8$	oxalic acid.
Acetic acid,	$C_4\,H_4\,O_4$	$+\,C_2\,O_4$	$=$	$C_6\,H_4\,O_8$	?
Propylic acid,	$C_6\,H_6\,O_4$	$+\,C_2\,O_4$	$=$	$C_8\,H_6\,O_8$	succinic acid.
Butyric acid,	$C_8\,H_8\,O_4$	$+\,C_2\,O_4$	$=$	$C_{10}\,H_8\,O_8$	lipic acid.
Valerianic acid,	$C_{10}\,H_{10}\,O_4$	$+\,C_2\,O_4$	$=$	$C_{12}\,H_{10}\,O_8$	adipic acid.
Caproic acid,	$C_{12}\,H_{12}\,O_4$	$+\,C_2\,O_4$	$=$	$C_{14}\,H_{12}\,O_8$	pimelic acid.
Œnanthylic acid,	$C_{14}\,H_{14}\,O_4$	$+\,C_2\,O_4$	$=$	$C_{16}\,H_{14}\,O_8$	suberic acid.
Caprylic acid,	$C_{16}\,H_{16}\,O_4$	$+\,C_2\,O_4$	$=$	$C_{18}\,H_{16}\,O_8$	?
Pelargonic acid,	$C_{18}\,H_{18}\,O_4$	$+\,C_2\,O_4$	$=$	$C_{20}\,H_{18}\,O_8$	sebacic acid.

It will be seen that up to C_{20}, there are only two blanks in this series; and it is a proof of their close relation to the oily volatile acids, that every one of these, except perhaps the last, is formed, along with the parallel oily acids, in the oxidation of fats and fatty acids by means of nitric acid. It is only very recently that these relations have been recognised and the series established; and as it includes oxalic acid, one of the commonest acids in plants, we are entitled to expect that the progress of science will develop series in which the other acids of acid fruits and leaves will find their place. We have another proof of the close relation between these two series of acids, the formic series and the oxalic series, in the fact that oxalic acid, when heated, yields formic and carbonic acids, which, in the above table, are shown to exist in it by their elements at least. This is, indeed, one of the best methods of obtaining formic acid. It seems probable that we shall succeed in applying the same method to obtain from the other acids of the oxalic series the oily acids parallel to them, as, for example, œnanthylic acid. from suberic acid, and the rare pelargonic acid from sebacic acid. This, however, has not yet been done. Sebacic acid is formed when oleic acid is distilled, and the production of it by heat is an excellent test of the presence of oleine in any oil or fat. The oxalic series of acids are all bibasic, and their general formula is $C_n\,H_{n-2}\,O_8 = C_n\,H_{n-4}\,O_6, 2\,HO$.

30. The next, or thirtieth series, is that of the cyanates of the oxides in series 2. The type is cyanic acid, which is remarkable for its transformation into urea, when combined with ammonia. Besides this, when heated with potash, it yields carbonic acid and ammonia, $C_2\,NO, HO + 2\,KO, HO = 2\,(KO, CO_2) + NH_3$. Now, the homologous cyanates of oxides of methyle, ethyle, &c., will undergo the same transformations. By the latter, heating with potash, they yield, instead of ammonia, the homologous bases, methylamine, ethylamine, &c., which were discovered by Wurtz in this way. The former metamorphosis, that is, with ammonia, gives rise to the next series, which is a very remarkable one. It is unnecessary to dwell longer on these cyanates, the general formula of which is $(C_n\,H_{n+1})\,O, C_2\,NO$.

31. The thirty-first series is that of which urea is the type. And here we have another example of the comprehensiveness of the principle of homologous series. Urea has long been considered as an isolated body, without any visible relation to others, and now we find that, viewed in the light of the principle alluded to, it is a type of a numerous class of compounds, the discovery of which is due to that principle. The following are the first members of this series:—

Cyanic acid, with ammonia—

$C_2\,NO, HO, NH_3$, yields $C_2\,H_4\,N_2\,O_2$, urea.

Cyanate of oxide of methyle, with ammonia—

$C_2\,NO, C_2\,H_3\,O_4, NH_3$, yields $C_4\,H_6\,N_2\,O_2$, methylo-urea.

Cyanate of oxide of ethyle, with ammonia—

$C_2\,NO, C_4\,H_5\,O, NH_3$, yields $C_6\,H_8\,N_2\,O_2$, ethylo-urea.

Cyanate of oxide of amylo, with ammonia—

$C_2\,NO, C_{10}\,H_{11}\,O, NH_3$, yields $C_{12}\,H_{14}\,N_2\,O_2$, amylo-urea.

The perfect analogy which here prevails is fully seen, if we consider hydrated cyanic acid as cyanate of oxide of hydrogen, and the cyanates of oxide of methyle, &c., as compounds in which methyle, &c., replace that hydrogen. The rational formula of urea is not certainly known, but as it is basic, we may suppose it to represent 2 equivalents of ammonia, in which 2 equivalents of hydrogen are replaced by CO, or carbonic oxide, thus: $N_2\,H_6 = 2$ eqs. ammonia, and urea $= N_2 \left.\begin{matrix} H_4 \\ C_2\,O_2 \end{matrix}\right\}$ or $N_2 \left.\begin{matrix} H_4 \\ (CO)_2 \end{matrix}\right\}$ we shall thus have—

Urea .... $N_2 \left.\begin{matrix} H_4 \\ (CO)_2 \end{matrix}\right\}$

Methylo-urea.......................... $N_2 \left.\begin{matrix} H_3 \\ C_2\,H_3 \\ (CO)_2 \end{matrix}\right\}$

Ethylo-urea.......................... $N_2 \left.\begin{matrix} H_3 \\ C_4\,H_5 \\ (CO)_2 \end{matrix}\right\}$

Amylo-urea....... .... $N_2 \left.\begin{matrix} H_3 \\ C_{10}\,H_{11} \\ (CO_2) \end{matrix}\right\}$

The compounds of this series, homologous with urea, are perfectly analogous to it in properties. Urea, the type, is found ready formed in urine, and is produced artificially by the above-mentioned transformation of cyanate of ammonia. It crystallizes in prisms, which in form as well as in taste resemble nitre. It is soluble in alcohol, and forms with acids salts, being a weak base. The nitrate and oxalate

of urea are sparingly soluble, and crystallize readily. The action of heat on urea has been already explained, as well as its production, under the head of isomeric and polymeric transformations.

32. The next series we shall mention is that which consists of compounds of the aldehydes with ammonia. Only one of them, that composed of acetic aldehyde and ammonia, is well known; but there is no doubt of the existence of several others, the tendency to form such compounds being a character of the aldehydes. The best known of these compounds, aldehydammonia as it is called, is $NH_3, HO, C_4 H_3 O = C_4 H_7 NO_2$. It crystallizes readily, and undergoes some remarkable transformations. The general formula of this series is $C_n H_{n-1} O, HO, NH_3$. One of its transformations is that caused by sulphurous acid, of which 2 eqs. unite with 1 of aldehydammonia, or 1 eq. of aldehyde unites with 1 eq. of bisulphite of ammonia, to form the compound $NH_3, HO, C_4 H_3 O, 2 SO_2 = C_4 H_7 NS_2 O_4$. This compound is isomeric with taurine, a very remarkable substance obtained from bile. It is probable that this is one of a new homologous series.

33. The type of the next series is derived from formic aldehyde, by the action of hydrocyanic acid and water, $C_2 H_2 O_2 + C_2 NH + 2 HO = C_4 H_5 NO_4$. This last formula is that of a remarkable base, found in bile and elsewhere in the animal body, and from its sweet taste called glycocine, glycocoll, or sugar of gelatine. We prefer the first name. It is best obtained by boiling hippuric acid, an acid found in urine, with strong hydrochloric acid, when two eqs. of water are taken up, and it is resolved into benzoic acid and glycocine. Hippuric acid is $C_{18} H_9 NO_6$, and with 2 HO, it yields $C_{14} H_6 O_4$, benzoic acid, and $C_4 H_5 NO_4$, glycocine. Glycocine is a base, and forms crystallizable salts with acids, but it also forms crystalline compounds with bases and with neutral salts. Of the series of glycocine three only are as yet known, which are—

Glycocine....................	$C_4 H_5 NO_4$	$= NH_2, C_4 H_3 O_4$
Alanine................	$C_6 H_7 NO_4$	$= NH_2, C_6 H_5 O_4$
...	...	...
...	...	...
Leucine......................	$C_{12} H_{13} NO_4$	$= NH_2, C_{12} H_{11} O_2$

The last column represents these compounds as amides of the acids which constitute the next series. Alanine is obtained by the action of hydrocyanic acid on aldehyde. Leucine is found in the animal body, as is also glycocine. It cannot be doubted that other compounds of this series will be discovered, and they are likely to be compounds of much interest.

34, 35. The next series consists of acids, and the type is lactic acid. They are in so far connected with the aldehydes, that they consist of formic acid, coupled with the aldehydes. Thus we have—

		Aldehydes.	Formic Acid.
Glycolic acid.......	$C_4 H_4 O_6 =$	$C_2 H_2 O_2 +$	$C_2 H_2 O_4$
Lactic acid.........	$C_6 H_6 O_6 =$	$C_4 H_4 O_2 +$	$C_2 H_2 O_4$
Leucic acid..........	$C_{12} H_{12} O_6 =$	$C_{10} H_{10} O_2 +$	$C_2 H_2 O_4$

The two first acids, if regarded as monobasic, will be written thus—

Glycolic acid..........	$C_4 H_3 O_5, HO$	$= C_4 H_4 O_6$
Lactic acid.....	$C_6 H_5 O_5, HO$	$= C_6 H_6 O_6$

And their ammonia salts, *minus* 2 eqs. of water, according to the usual law, will give the amides, glycolamide and lactamide, which have the composition of glycocine and alanine, but seem to be only isomeric with them.

Glycolate of ammonia, $NH_3, HO, C_4 H_3 O_5 - 2 HO = C_4 H_3 O_4, NH_2$
Lactate of " $NH_3, HO, C_6 H_5 O_5 - 2 HO = C_6 H_5 O_4, NH_2$

The reason why these two amides are not identical with glycocine and alanine seems to be that the acids are really bibasic, and that therefore the true formulæ of the acids, as well as the amides, are double those just given.

Glycolic acid,..... $C_8 H_6 O_{10}, 2 HO$ Glycolamide $C_8 H_6 O_8, 2 NH_2$
Lactic acid,..... .. $C_{12} H_{10} O_{10}, 2 HO$ Lactamide $C_{12} H_{10} O_8, 2 NH_2$

It is probable that the amides form a distinct series by themselves. There is, besides, another series, strictly isomeric with the glycocine series, namely, the hyponitrites of the oxides of series 2.

Hyponitrite of oxide of	methyle,	$C_2 H_3 O, NO_3$	$= C_2 H_3 NO_4$
... ..	ethyle,	$C_4 H_5 O, NO_3$	$= C_4 H_5 NO_4$
.. ..	propyle,	$C_6 H_7 O, NO_3$	$= C_6 H_7 NO_4$
... ..	caprotyle,	$C_{12} H_{13} O, NO_3$	$= C_{12} H_{13} NO_4$

The analogue of the first of these in the glycocine series is unknown. The others are analogous to and isomeric with glycocine, alanine, and leucine. This may be called series 35.

36. Another series, isomeric with 33 and 35, is that of which the type is urethan or carbamate of oxide of ethyle. Carbamic acid is an acid amide, or bicarbonate of ammonia *minus* 2 eqs. of water. $(NH_3, HO, 2 CO_2) - 2 HO = C_2 H_2 NO_3$. This last is carbamic acid, and with oxide of methyle it forms a compound isomeric with glycocine. $C_2 H_3 O + C_2 H_2 NO_3 = C_4 H_5 NO_4$. The compound with oxide of ethyle is isomeric with alanine; that with oxide of amyle is isomeric with leucine.

There is still another compound, sarcosine, a base, which is isomeric with alanine, but whether it be one of a series we do not yet know.

37. Analogous to the last series is that of the compounds of oxamic acid with the oxides of series 2. They are beautifully crystallized bodies, as are also those of series 36, and are formed by the action of ammonia on the oxalates of the oxides of methyle, ethyle, &c. Oxamic acid is acid oxalate of ammonia, *minus* 2 eqs. of water. $(C_4 O_6, HO, NH_4 O) - 2 HO = C_4 H_2 NO_5 = C_4 H_3 NO_6, HO$, and with oxide of methyle, this acid, oxamic acid, forms the first of the new series. $C_2 H_3 O + C_4 H_2 NO_5 = C_6 H_5 NO_6$. This is sometimes called oxamethylan. The next one is oxamethan or oxamate of oxide of ethyle, $C_4 H_5 O, C_4 H_2 NO_5 = C_8 H_7 NO_6$.

38. The next series is one consisting of certain newly discovered acids, the two first of which are known. These contain glycolic and lactic acids, coupled with benzoic acid, and thus form a connecting link between the extensive group of allied homologous series now under consideration, and that group to which benzoic acid, its congeners, and their derivatives belong. These acids are—

Benzoglycolic acid, $C_{18} H_8 O_8 = C_4 H_3 O_5 + C_{14} H_5 O_3$
Benzolactic acid, $C_{20} H_{10} O_8 = C_6 H_5 O_5 + C_{14} H_5 O_3$

Benzoleucic acid, $C_{26} H_{24} O_{10}$, is said to exist, but has not yet been studied. The amides of these acids probably form a new series, only one of which is yet known.

39. This is hippuric acid, $C_{18} H_9 NO_6$, which is the amide of benzoglycolic acid; that is, benzoglycolate of ammonia, $(NH_3, C_{18} H_8 O_8)$, *minus* 2 eqs. HO, which gives $C_{18} H_9 NO_6$. This is a very remarkable acid, found in large quantity in the urine of herbivorous animals. When boiled with strong hydrochloric acid, it is first resolved, like other amides, into ammonia and the acid, which is here benzoglycolic acid, 2 eqs. of water being taken up. But the benzoglycolic acid is itself resolved into benzoic acid and glycolic acid, 2 eqs. of water being taken up, and the glycolic acid, acting on the ammonia, produces, with the separation of 2 eqs. of water, glycolamide or glycocine. So that the ultimate results of the operation are benzoic acid and glycocine. Hippuric acid as yet stands alone, but as we already know homologues both of benzoglycolic acid and of glycocine, it cannot be doubted that we shall in time discover homologues also of hippuric acid.

40. The next series we shall mention is that of which acetone is the type. When the salts of acetic acid are decomposed by heat, they yield carbonic acid, which remains combined with the base, and acetone which distils over. In

Chemistry. the case of acetate of lime we have $Ca\,O, C_4\,H_3\,O_3 = Ca\,O, CO_2 + C_3\,H_3\,O$. The true formula of acetone appears to be double of this, or $C_6\,H_6\,O_2$, and it is regarded by some as a hydrated oxide analogous to alcohol; that is, as $C_6H_5\,O, HO$. This analogy is far from close, but all the acids of the acetic series, at least above acetic acid, seem to form singular compounds, which are isomeric with the aldehydes of the acids next above each. Thus acetone is isomeric with propylic aldehyde. Various opinions are entertained as to the real nature, and even as to the formulæ of these compounds, but for the present we adopt the formulæ which give to all of them 2 eqs. of oxygen.

We now come to a group of homologous series, of very recent discovery, and as yet but little known, save in the case of one or two, but which indicate the existence of a very large number of compounds of the most remarkable composition and properties. These are the compounds in which the elements of the radicals of series 1 are combined with a certain class of metals, giving rise to new and most singular radicals or compound metals having most energetic affinities, and in their compounds very analogous to metals. We can only briefly mention the characters of these compounds.

41. The first series of this group is that which contains zinc. When iodide of methyle or ethyle is heated with zinc in a closed tube, there is formed a crystalline mass, consisting of iodide of zinc, along with the new radical, zinco-methyle in the former, zinco-ethyle in the latter case. On distilling the mass in hydrogen gas, iodide of zinc is left, and the new radicals distil over. They are volatile, fetid, spontaneously inflammable liquids, and appear to act as energetic positive radicals, analogous to metals, combining with oxygen, chlorine, sulphur, &c. They decompose water, producing oxide of zinc and the carbohydrogen of series 4. Thus with zinco-methyle, which is $C_2\,H_3\,Z_n$, and water HO, we have $Z_n\,O$ and $C_2\,H_4$; zinco-ethyle is $C_4\,H_5\,Z_n$, and zinco-amyle which has been formed, is $C_{10}\,H_{11}\,Z_n$. No other radicals of this series are yet known.

42. The next series contains antimony. It is formed by the action of an alloy of potassium and antimony on iodide of methyle or ethyle. The formula of stibiomethyle is $Sb\,Me_3 = Sb\,C_6\,H_9$. That of stibethyle is $Sb\,Ae_3 = Sb\,C_{12}\,H_{15}$. These properties resemble those of zinco-ethyle, and they are powerful radicals, of the class of metals.

43. This series also contains antimony. The formula of the first compound is $Sb\,Me_4 = Sb\,C_8\,H_{12}$, and it is called stibiomethylium. It is analogous to ammonium and potassium, and forms a hydrated oxide, resembling caustic potash.

44. The next series contains tin, and the compounds are called stannomethyle and stannoethyle. Their formulæ are $Sn\,C_2\,H_3 = Sn\,Me$ and $Sn\,C_4\,H_5 = Sn\,Ae$. They are analogous to the preceding.

45. In this series, 2 eqs. of the preceding one seem to be condensed into one, so that the formulæ are, $Sn_2\,C_4\,H_6 = Sn_2\,Me_2$, and $Sn_2\,C_8\,H_{10} = Sn_2\,Ae_2$. These also are powerful quasi-metallic radicals.

46. In the next series lead is the metal combined with the organic radicals. A compound has been described, consisting of $Pb_2\,Ae_3$, which, like the others is a positive radical, forming a base with oxygen, and salts with chlorine, iodine, &c. There seem to be several other radicals, formed of lead and ethyle, in different proportions. They are all liquid and fuming, and burn when kindled, producing thick fumes of oxide of lead. Each of the lead radicals will of course belong to a distinct series.

47. Tellurium also combines with ethyle to form one or more radicals. The best known is tellurethyle, $Te\,Ae = Te\,C_4\,H_5$. Another, which belongs to a different series, is $Te\,Ae_2$. They are both very fetid and poisonous liquids, and powerful radicals.

48. Arsenic forms similar compounds, both with ethyle and methyle. The best known of them is kakodyle, $As\,Me_2 = C_4\,H_6\,As$. This is a crystalline volatile substance, having all the chemical relations of a metal. Its protoxide is a volatile, fetid, spontaneously inflammable, and frightfully poisonous liquid, which is strongly basic. Its teroxide is an acid, and is devoid of smell and of poisonous action. Its compounds with chlorine, iodine, sulphur, cyanogen, &c., are all volatile, fetid, and poisonous. There are several other compounds of arsenic with methyle and ethyle, forming so many separate series, but as yet they are little known. Chemistry.

49. The next series we shall mention is typified by kakoplatyle, which consists of kakodyle, platinum, and water, or perhaps oxygen and water. It is also a positive radical, of the formula $C_4\,H_6\,As\,Pt\,O, HO$, and forms a hydrated oxide, a chloride, iodide, sulphuret, &c. &c.

50. In the next series, methyle and ethyle are combined with phosphorus. There are several compounds with each, and they appear to correspond to the compounds of phosphorus with hydrogen. The compound $P\,Me_2$, which corresponds to kakodyle, is like it a very fetid and poisonous liquid. Besides this, there are the radicals $P_2\,Me$, $PH_2\,Me$ and $P\,Me_3$, all of which are analogous to the first. Each of course indicates a separate series.

We have only indicated the existence of these very remarkable compounds of metals and phosphorus with radicals of the methylic series. Already they are very numerous, and they have all striking properties and strong affinities. New compounds of this class are daily discovered, and almost every new one is the first of a new series. Besides the metals we have named, bismuth and potassium are said to form similar compounds, not yet described. It will be seen that all the metals which have yet been found to unite with the methylic radicals are more or less volatile, and all the compounds are so, whereas the compounds of most of these metals with oxygen, chlorine, sulphur, &c., are fixed in the fire. Most of these compound radicals or compound metals are spontaneously inflammable in the air, from their strong attraction for oxygen, and most of them are poisonous in the highest degree, apparently because they bring the metals they contain in contact with the system in a very fine state of division.

We have now indicated most of the established homologous series, connected with the methylic radicals. It will be seen that these include a large number of important organic compounds, such as alcohol, ether, compound ethers, volatile and oily acids and their salts, volatile and fixed bases and their salts, carbohydrogens, amides, &c. There are, however, many compounds which cannot as yet be classified in this way. But before turning to these, we must mention another group of homologous series, not directly connected with the methylic radicals, but rather in some points running parallel to the series already described. This is the benzoic group, so called from benzoic acid, which is a characteristic feature of the group.

1. The first series of this group is that of which benzoic acid is the type. This acid is found ready formed in gum benzoin, and is also produced by the oxidation of hyduret of benzoyle, by the decomposition of hippuric acid, so that it often occurs in the urine of herbivora, and among the products of the oxidation of such bodies as fibrine, albumen, &c. Its formula is as follows, with those of its homologues:—

Benzoic acid.........	$C_{14}\,H_5\,O_3, HO$	=	$C_{14}\,H_6\,O_4$
Toluylic acid.........	$C_{16}\,H_7\,O_3, HO$	=	$C_{16}\,H_8\,O_4$
Xylitic acid?.........	$C_{18}\,H_9\,O_3, HO$	=	$C_{18}\,H_{10}\,O_4$
Cuminic acid.........	$C_{20}\,H_{11}\,O_3, HO$	=	$C_{20}\,H_{12}\,O_4$

The third acid is hardly known, but some of its derivatives are known, and are perfectly homologous with those of benzoic acid. Toluylic acid is connected with substances found in balsam of Tolu, and cuminic acid with those found in oil of cumine. These acids are all crystallized,

volatile, soluble in water and in alcohol, and approach in characters to resinous bodies.

2. In the next series are those compounds of which the type is hyduret of benzoyle. This is an oily liquid, found in the oil of bitter almonds with hydrocyanic acid. These substances, with others, are formed in the fermentation of amygdaline, a substance peculiar to bitter almonds. The hyduret when pure is $C_{14}\ H_6\ O_2 = C_{14}\ H_5\ O_2$, H. It absorbs 2 eqs. of oxygen from the air, and is soon converted into benzoic acid; $C_{14}\ H_6\ O_2 + O_2 = C_{14}\ H_6\ O_4$. It may be viewed as the hyduret of the radical benzoyle, $C_{14}\ H_5\ O_2$; and this radical, with 1 eq. of oxygen, forms dry benzoic acid, $C_{14}\ H_5\ O_2 + O = C_{14}\ H_5\ O_3$. At the same time the hydrogen is converted into water, which combines with the dry acid to form the crystals $C_{14}\ H_5\ O_2$, $H + O_2 - C_{14}\ H_5\ O_3$, HO. The oil of cumine, $C_{20}\ H_{12}\ O_2$, may be viewed as the hyduret of cumyle, C_{20}, $H_{11}\ O_2$, H, and is homologous with it. These hydurets may be regarded as the aldehydes of the acids they yield.

3. The next series may be that of the radicals, benzoyle, cumyle, &c. They are hardly at all known.

4. The next is that of the amides of the acids of series 1. Benzamide, toluylamide, cuminamide, &c. Benzamide is benzoyle + amide, or $C_{14}\ H_5\ O_2$, NH_2, and the others are analogous.

5. The next may be that of chloride of benzoyle, $C_{14}\ H_5\ O_2$, Cl.

6. The next, that of cyanide of benzoyle, $C_{14}\ H_5\ O_2$, Cy.

7. The next may be that of sulphuret of benzoyle, $C_{14}\ H_5\ O_2$, S. Many more might be added, but these will suffice to illustrate the compounds in which benzoyle, $C_{14}\ H_5\ O_2$, may be traced.

8. The next series contains products of decomposition of the acids of this series. When benzoic acid is heated with excess of lime, it is resolved into 2 eqs. of carbonic acid, containing all its oxygen, and a remarkable carbohydrogen, containing all the hydrogen, $C_{14}\ H_6\ O_4 + 2\ CaO = 2\ (CaO, CO_2) + C_{12}\ H_6$. This last is benzoyle, or hyduret of phenyle, $C_{12}\ H_5$, H. It is a somewhat fragrant liquid, which is found also in coal tar. Four homologous liquids are known, which are toluole, $C_{14}\ H_8$; xylole, $C_{16}\ H_{10}$; cumole, $C_{18}\ H_{12}$; and cymole, $C_{20}\ H_{14}$.

9. The next series is that of which the radical phenyle, $C_{12}\ H_5$, is the type. They are not known in the separate state, but enter into many compounds, the bodies of the last series being their hydurets. They have some analogy to the methylic radicals.

10. The next series is that of the hydrated oxides of the phenylic radicals. Hydrated oxide of phenyle, the type, $C_{12}\ H_5\ O,\ HO = C_{12}\ H_6\ O_2$, is found in coal tar, and often called carbolic acid. It much resembles creosote, and it is most probable that the compound next to it, $C_{14}\ H_8\ O_2 = C_{14}\ H_7\ O$, HO, is creosote itself.

11. We next come to the compounds of the phenylic radicals with amide, which, as in the case of the ethylic radicals, are volatile bases. The first of them is phenylamine or aniline, $C_{14}\ H_7\ N = C_{12}\ H_5,\ NH_2 = NH_2\ Ph$ ($Ph = C_{12}\ H_5$). It is an oily base, distinguished by the great tendency of its salts to crystallize. Its homologues are solid but fusible, and quite analogous to it. We have—

Phenylamine......	$C_{14}\ H_7\ N{=}NH_2,\ C_{12}\ H_5$	Aniline
Toluylamine.......	$C_{16}\ H_9\ N{=}NH_2,\ C_{14}\ H_7$	Toluidine
Xylamine	$C_{18}\ H_{11}\ N{=}NH_2,\ C_{16}\ H_9$	Xylidine
Cumylamine	$C_{20}\ H_{13}\ N{=}NH_2,\ C_{18}\ H_{11}$	Cumidine
Cymylamine	$C_{22}\ H_{15}\ N{=}NH_2,\ C_{12}\ H_{13}$	Cymidine

Aniline is obtained by heating indigo with potash, and is also found, with some of the others, in coal tar and animal oil, that is animal tar oil. In this oil, obtained by distilling bones, there is another homologous series of volatile bases, discovered by Dr Anderson, isomeric with these, but far more volatile. The first of them, picoline, is isomeric with aniline, lutidine with toluidine, &c.

12. There are no compounds which yield a greater number of substitution products than those we are here reviewing. In the first place, besides the amide bases above given, there are two other series, imide and nitryle bases, of which the types are diphenylamine, $NH\ Ph_2$, and triphenylamine, $N\ Ph_3$. These also have their homologues, and form two new series. Then aniline, by replacement of its own hydrogen by chlorine, bromine, &c., and nitrous acid, yields such compounds as chloraniline, dichloraniline, trichloraniline, bromaniline, dibromaniline, tribromaniline, nitraniline, dinitraniline, and others, in which 1, 2, or 3 eqs. of the hydrogen of the radical phenyle in aniline are replaced by the elements just mentioned. To take an example or two, we have—

Aniline..............................	$NH_3,\ C_{12}\ H_5$
Chloraniline	$NH_2,\ C_{12}\left.\begin{matrix}H_4\\Cl\end{matrix}\right\}$
Dibromaniline..............	$NH_2,\ C_{12}\left.\begin{matrix}H_3\\Br_2\end{matrix}\right\}$
Nitraniline	$NH_2,\ C_{12}\left.\begin{matrix}H_4\\NO_4\end{matrix}\right\}$

Most of these are basic and crystallize well. The homologues of aniline yield similar products, so that each is the commencement of a series.

13. Besides this, the hyduret of phenyle, or benzole and its homologues, also yield similar substitution products with chlorine, bromine, and nitrous acid. Thus we have, with others,

Benzole	$H,\ C_{12}\ H_5$
Nitrobenzole	$H,\ C_{12}\left.\begin{matrix}H_4\\NO_4\end{matrix}\right\}$
Dinitrobenzole	$H,\ C_{12}\left.\begin{matrix}H_3\\NO_4\end{matrix}\right\}$
Chlorobenzole.	$H,\ C_{12}\left.\begin{matrix}H_4\\Cl\end{matrix}\right\}$
Bromobenzole............	$H,\ C_{12}\left.\begin{matrix}H_4\\Br\end{matrix}\right\}$

These compounds, each of which represents or typifies a new homologous series, give rise also to various reactions, producing other compounds. But even without this, we have here another large group of homologous series.

14. Another considerable group consists of the various substitution products derived from benzoic acid itself. For example, there is nitrobenzoic acid. Benzoic acid, $C_{14}\ H_6\ O_4$, or rather $C_{14}\ H_5\ O_3$, HO, has one of the 5 eqs. of hydrogen in the anhydrous acid replaced by nitrous acid, and gives the new acid, $C_{14}\left.\begin{matrix}H\\NO_4\end{matrix}\right\}O_3$, HO. Then there is bromobenzoic acid, as well as others, each of which typifies a series.

Here also might be added two other series, namely, that of benzoglycolic acid and that of its amide, which is hippuric acid; but these have been already noticed among the series connected with the ethylic radicals. These two series, in fact, serve to connect the benzoic with the ethylic group of homologous series.

Hyduret of benzoyle gives rise to a very large number of new compounds, by the various reactions it undergoes with different substances, such as bases, ammonia, sulphuret of ammonium, &c. &c. Among these new products are several remarkable bases, such as amarine, sophine, and picrine. It is not known that these belong to homologous series, but it is probable.

Allied to the benzoic group are some others, of which but few members are yet known.

Thus oil of anise and oil of estragon yield when oxidized by nitric acid an acid, anisic acid, $C_{16}\ H_8\ O_6$. Oil of Gaultheria procumbens contains, in union with oxide of methyle, an acid called salicylic acid, because it can be formed artificially from salicine, the bitter principle of willow-bark. Sali-

cylic acid is $C_{14} H_6 O_6$, and is therefore homologous with anisic acid.

There are also the hydurets of salicyle and of anisyle, which bear the same relation to these two acids as hyduret of benzoyle does to benzoic acid. Hyduret of salicyle is the oil of spiræa, and is isomeric with benzoic acid, $C_{14} H_5 O_3, HO = C_{14} H_5 O_4, H$.

There are many interesting compounds connected with salicylic acid and hyduret of salicyle, and these probably belong to homologous series, as the two bodies themselves do.

Again there is oil of cinnamon, which yields hyduret of cinnamyle, $C_{18} H_8 O_2, H$, and this by oxidation becomes cinnamic acid, $C_{18} H_7 O_3, HO = C_{18} H_8 O_4$. This acid is very analogous to benzoic and salicylic acids. Heated with lime, it yields the carbohydrogen $C_{16} H_8$, analogous to benzole or hyduret of phenyle, along with 2 eqs. of carbonic acid. It is probable that these compounds are each members of new homologous series, and that these series are nearly allied to those of the benzoic group.

Having thus very briefly indicated the existence and nature of a large number of homologous series, we must shortly notice those compounds which cannot as yet be reduced to such series, although we have every reason to expect that in time they may be so classified.

These we must notice very briefly, but as they form certain well-marked natural groups, it will be possible, in small space, to convey a general notion of their nature and properties.

1. *Organic Acids.*

These are numerous, and it is but in very few cases that we know, as yet, anything about their constitution, that is, about the radicals they contain. We have seen that something is known, in that respect, of formic and acetic acids, of the oily acids homologous with these, of oxalic acid, and of benzoic acid and its congeners.

The commonest of the vegetable acids not yet noticed are the following, oxalic acid being prefixed, as having a great analogy in properties with most of them, and as being of all the simplest in composition. These acids are all crystallizable, soluble in water, and, with one or two exceptions, sour to the taste. As a general rule the number of eqs. of oxygen exceeds that of hydrogen; and lastly, they are either monobasic or polybasic, as indicated by the number of eqs. of basic water in each:—

Oxalic acid....................	$C_4 O_6$, 2 HO	=	$C_4 H_2 O_8$
Fumaric and aconitic acids..	$C_4 HO_3$, HO	=	$C_4 H_2 O_4$
Gallic acid...	$C_7 HO_3$, 2 HO	=	$C_7 H_3 O_5$
Racemic and tartaric acids..	$C_8 H_4 O_{10}$, 2 HO	=	$C_8 H_6 O_{12}$
Malic acid.........	$C_8 H_4 O_8$, 2 HO	=	$C_8 H_6 O_{10}$
Citric acid.....................	$C_{12} H_5 O_{11}$, 3 HO	=	$C_{12} H_8 O_{14}$
Meconic acid....	$C_{14} HO_{11}$, 3 HO	=	$C_{14} H_4 O_{14}$
Tannic acid...........	$C_{18} H_5 O_9$, 3 HO	=	$C_{18} H_8 O_{12}$
Kinic acid.	$C_{14} H_{10} O_{10}$, 2 HO	=	$C_{14} H_{12} O_{12}$

Citric acid is found in the juice of the fruits of the orange or citron tribe, and in other acid fruits, as in the currant. Malic acid occurs in unripe fruits of the apple and pear tribe, especially in the fruit of the mountain ash or service tree. Tartaric acid is found in the grape as acid tartrate of potash, and racemic acid, which is isomeric with it, occurs only in the grapes of certain districts. Oxalic acid occurs in wood sorrel, *Oxalis acetosella*, and in the leaf stalks of rhubarb; also in other plants, as acid oxalate of potash; in lichens, Sedum, Sempervivum, &c., as oxalate of lime. Fumaric acid occurs in fumaria, aconitic acid in aconite and equisetum, meconic acid only in opium, the juice of the poppy, and kinic acid in cinchona bark. Tartaric acid and gallic acid, which are not sour, but astringent, are found in nutgalls, oak bark, and other astringent vegetables.

The frequency of polybasic, especially bibasic and tribasic acids, among vegetable acids, gives rise to many acid salts, such as the acid tartrate and acid oxalate of potash, and to many double salts, as the tartrate of potash and soda, and the tartrate of potash and antimony, Rochelle salt, and tartar emetic.

The neutral salts of vegetable acids with lime, oxide of lead, and oxide of silver, are usually insoluble, or if not, sparingly soluble. As there is a general analogy in composition, especially in regard to the excess of oxygen over hydrogen, so there is a general analogy in properties. But the astringent acids above named, and others like them, strike a deep blue or green colour, approaching to black, with the salts of iron; and kinic acid, in which the oxygen only equals the hydrogen, is a very weak acid.

Like all vegetable products, these acids, and all similar to them, are formed by the plant from carbonic acid and water, which contain the elements of all of them. But if we take as many eqs. of carbonic acid as the acid contains of carbon, and as many eqs. of water as it contains of hydrogen, which of course is the smallest quantity that can yield a given acid, we shall find that these materials always contain more oxygen than the acid formed from them. In other words, the plant in forming them deoxidizes carbonic acid and water, more or less, and thus oxygen, so removed, is given out as gas. Thus, oxalic acid, $C_4 H_2 O_8$, cannot be formed from less than 4 eqs. of carbonic acid and 2 of water, which are $C_4 H_2 O_{10}$, so that in this case 2 eqs. of oxygen are given out. All the other acids contain a smaller proportion of oxygen than oxalic acid, and therefore, in their formation, more oxygen is given out. Moreover, they may be formed either from carbonic acid and water, or from oxalic acid and water, or from any acid containing more oxygen than themselves; and it is probable that it is in this way by a succession of steps, that the plant produces all the vegetable acids, of which only the chief have been given above.

2. *Neutral and Mild Organic Compounds.*

Kinic acid, in which the hydrogen and oxygen are equal, leads to the next group, in all of which that is the case. They are few in number, but very abundant, widely distributed, and of great importance, as they constitute the chief mass of the vegetable kingdom. They are mild in character, and generally tasteless or sweet. They are as follows:—

Woody fibre or cellulose, *a*..................	$C_{12} H_8 O_8$
Woody fibre or cellulose, *b*..................	$C_{12} H_{10} O_{10}$
Starch	$C_{12} H_{10} O_{10}$
Cane sugar......	$C_{12} H_{11} O_{11}$
Gum...	$C_{12} H_{11} O_{11}$
Grape sugar, dry	$C_{12} H_{12} O_{12}$
Grape sugar, crystallized	$C_{12} H_{14} O_{14}$

In consequence of the equality between the oxygen and hydrogen in these compounds, they may be viewed as formed of carbon *plus* water; or, in other words, in forming them from carbonic acid and water, either directly or indirectly, that is, by successive steps, the plant gives out exactly as much oxygen as was contained in the carbonic acid from which they were derived. Hence their formation follows that of the acids, and they are probably formed in general from these acids, which would account for the uniform presence of the latter in vegetable juices.

Another fact, depending on the circumstance that they all contain 12 eqs. of carbon, and differ only in the amount of water, or its elements, is this: that all before grape sugar in the table may be converted, even artificially, into that kind of sugar. The conversion of starch into sugar constantly takes place in germination, as in malting, and that of both starch and woody fibre into sugar occurs in the ripening of fruits. In these processes, it is effected by the contact of a ferment. It consists in the addition of water or of its elements. The same result is obtained artificially by boiling them with diluted sulphuric acid, and also, in the case of starch, by adding an infusion of malt.

Woody fibre is insoluble in all solvents, and perfectly indifferent. Its most remarkable character is that of forming gun-cotton, or nitro-cellulose, when acted on by nitric acid. In that case, 2, 3, or more eqs. of nitric acid are taken up, while water is in some cases expelled, in others not. Gun-cotton is, in some instances at least, $C_{12} H_8 O_8, 4 NO_5$, so that if formed from cellulose *a*, 4 eqs. of nitric acid are taken up; if from cellulose *b*, 2 eqs. of water are given out at the same time. But there are several varieties of gun-cotton.

Woody fibre, by long digestion with alkalies or acids, is partially converted into a substance which, like starch, strikes a blue with iodine.

Starch consists of small grains, which are said to be hollow sacs, formed of an insoluble membrane, containing a soluble jelly. Others say that the grains are formed of successive layers of insoluble matter. Hot water causes them to swell and burst, allowing the contents to escape. The leading characters of starch are the becoming deep blue with iodine, and the being converted into sugar and rendered soluble by acids and by ferments. Before becoming sugar, it passes through an intermediate stage, in which it is dissolved as dextrine or gum.

Cane sugar is known by its crystals, and by being more soluble and sweeter than grape sugar. In contact with acids or a ferment, it becomes grape sugar, and then, but not before, it undergoes fermentation.

The action of the ferment appears to depend on its being in a state of decomposition, consequently of molecular motion; and this motion, communicated to the molecules or rather to the atoms of the sugar, suffices to destroy the existing equilibrium and produce a new one. Sugar undergoes several different fermentations, which we shall mention under grape sugar.

Gum is tasteless, viscid, soluble in water, insoluble in alcohol. By the action of nitric acid it is converted into mucic acid $C_{12} H_8 O_{14}, 2 HO$, and not, like sugar, into oxalic acid.

Grape sugar is distinguished from cane sugar by being less soluble and less sweet, and also by being easily decomposed into brown products by heating with diluted alkalies. It is the only kind of sugar which undergoes fermentation; all the others are first converted into grape sugar and then ferment.

When the ferment is yeast, or vegetable fibrine in a state of decomposition, the vinous fermentation takes place in solution of sugar. The juice of the grape and infusion of malt both contain sugar and fibrine, and only require to be exposed to the air. But if the air be carefully filtered, by being made to pass through tubes filled with cotton, no fermentation takes place. Hence, and because certain low organisms appear in fermenting liquids, it is probable that the change is induced in the ferment, not as was supposed by the oxygen of the air, but by the introduction of the minute spores or germs of these organisms, which find an appropriate soil in the fibrine. The vinous fermentation is expressed by the equation—

$$C_{12} H_{12} O_{12} = 4 CO_2 + 2 (C_4 H_6 O_2)$$

We have already stated that other allied fermentations take place, by which propylic, butylic, amylic, and other alcohols are formed along with common alcohol, but in small quantity. In these, water is probably also one of the products.

When caseine is the ferment, sugar, at the temperature of from 70° to 90°, is converted into lactic acid, or undergoes the lactic fermentation, which is this:—

$$\overbrace{C_{12} H_{12} O_{12}}^{\text{Sugar.}} = \overbrace{C_{12} H_{10} O_{10}, 2 HO}^{\text{Lactic acid.}}$$

With the same ferment at a rather higher temperature, lactic acid undergoes the butyric fermentation, especially if first neutralized. The change is—

$$\overbrace{C_{12} H_{12} O_{12}}^{\text{Lactic acid.}} = \overbrace{C_8 H_8 O_4}^{\text{Butyric acid.}} + 4 CO_2 + H_4$$

There is another fermentation not yet fully understood, but which occasionally accompanies the lactic fermentation. In this, sugar disappears, and we find only gum and mannite. Mannite is $C_6 H_7 O_6$, or $C_{12} H_{14} O_{12}$; and as gum is $C_{12} H_{11} O_{11}$, it is not easy to see where the mannite gets the excess of hydrogen. Probably some other substance is formed which has escaped notice as yet. It must contain an excess of oxygen, and is therefore probably an acid.

Sugar of milk has the same formula as dry grape sugar, and passes into that form by contact with acids and ferments.

In consequence of its being the only source of the compounds of ethyle, such as alcohol and ether, as well as of other alcohols and ethers, sugar is closely connected with the ethylic group of homologous compounds. We know nothing of its intimate constitution, except that, although resolved into alcohol and carbonic acid by fermentation, it does not seem to contain carbonic acid, nor consequently alcohol, ready formed. For by the action of permanganate of potash it is entirely converted into oxalic acid and water, which implies the addition to its elements of 18 eqs. of oxygen. Now, since carbonic acid is the ultimate product of the full oxidation of carbon in all organic compounds, it is hardly conceivable that oxalic acid, which is an inferior stage of oxidation, should be the sole product of the oxidation of carbon in a substance where any part of that carbon was already in the form of carbonic acid. We cannot, therefore, regard sugar as a compound of ethyle, and for the present must consider it as an appendix to the ethylic series, without knowing the precise relation between them.

Besides the kinds of sugar we have named, all of which pass into grape sugar, and in that form undergo fermentation, there appears to be a kind of sugar which is uncrystallizable, but which is probably rendered so by the presence of impurities. Molasses, or the syrupy uncrystallizable mother liquor from the cane juice is rendered uncrystallizable by the action of bases on the sugar during the evaporation, which produces two brown acids, glucic and melassic acids, the presence of which deprives a great part of the sugar of its power of crystallizing. This source of loss is now greatly diminished by carefully neutralizing with acid the lime used in clarifying the cane juice, and also by evaporating *in vacuo*, at a low temperature. The uncrystallizable sugar in molasses, and that in the residues of the cane, may be fermented, and yields the spirit called rum, which when new contains a trace of butyric acid, derived, no doubt, from a small portion of sugar having undergone the lactic and butyric fermentations. This butyric acid, on keeping, gradually combines with oxide of ethyle from a portion of alcohol, producing butyric ether, and the spirit thus acquires its very peculiar and fragrant odour, as well as the pleasant flavour of pine-apple. In Germany, rectified potato spirit, being first purified by rectification from all the oils which make the crude spirit so coarse in flavour, is converted into highly-flavoured rum by the addition of a very minute quantity of butyric ether artificially prepared. The presence of this ether in the pine-apple, to which it gives the flavour, is one of the few instances of the occurrence of a compound of ethyle as a natural product, and even here it derives its origin from sugar.

It is entirely in the form of sugar that all the starch in seeds, which usually contain it, becomes available in germination for the growth of the first stem and leaves; and it is in the same form that the starch in the food of man and animals enters the circulation, and is enabled to perform its proper function of supporting, by its slow oxidation, the animal heat. Here we see the extreme importance of the tendency in an organic substance like starch to undergo

isomeric transformation, for starch and grape sugar, differing only by 2 HO, may be held as isomeric. In the insoluble form of starch, this important element of food is stored up till required; and whether in germination or in digestion, for these processes are almost exactly the same, is rendered soluble and conveyed into the circulation or the juices of the animal or the plant. The reader will also observe that cellulose or woody fibre is most probably formed from sugar by another transformation of the same kind, in which water is separated.

3. Neutral Compounds; bitter, acrid, coloured, or yielding colours with ammonia.

In this group, which is a very numerous one, but formed of compounds generally limited to families, genera, or even species of plants, we include such bodies as the following. In their formation, the deoxidizing process has been carried a step farther than in the last group, for not only all the oxygen of the carbonic acid (or a quantity equal to it), but also a part of that of the water, has been given out. In the vegetative process. therefore, they are naturally produced after, and in all probability from, the substances of group 2.

Mannite	$C_6 H_7 O_6$, or $C_{12} H_{14} O_{12}$
Parietine	$C_{10} H_8 O_3$
Antiarine	$C_{14} H_{15} O_5$
Smilacine	$C_{15} H_{13} O_5$
Orcine	$C_{16} H_{11} O_7$
Quassine	$C_{20} H_{12} O_6$
Elaterine	$C_{20} H_{14} O_5$
Salicine	$C_{26} H_{18} O_{14}$
Pectine	$C_{28} H_{20} O_{26}$
Hæmatoxyline	$C_{40} H_{17} O_{13}$
Limonine	$C_{42} H_{25} O_{13}$
Cnicine	$C_{42} H_{37} O_{15}$
Phloridzine	$C_{42} H_{29} O_{24}$

We must observe that all of these formulæ are not absolutely ascertained, and that few of these substances have been as yet fully studied. But the general character of their formulæ is no doubt correct, and some, such as mannite, orcine, salicine, pectine, and phloridzine, are well known. As to their properties, mannite, as it is close to sugar in composition, so is it also in taste and mildness. Antiarine and elaterine are acrid and virulent poisons; quassine, salicine and phloridzine are bitter and febrifuge; pectine and pectic acid, a body closely allied to it, form the vegetable jelly of the juices of plants, such as the apple, currant, or carrot juices, and in fact are almost universally present. Hæmatoxyline is the red colouring principle of logwood, and is a type of a class hardly studied as yet. Orcine, which crystallizes beautifully, is a colourless principle found in some lichens, which, with ammonia, gives rise to the fine and permanent blue dye called archil, and is also a type of an interesting class of compounds recently investigated with great success by Schunck and others, particularly by Stenhouse. The rest are devoid of marked characters. This list is only a selection from a very large number of similar bodies, which, for the most part, have yet to be investigated, and on which, therefore, we need not dwell.

4. Oxygenated Volatile Oils, and Volatile Acids derived from them.

These we have already noticed under the head of the benzoic group. They are strongly marked in character, and in forming them the deoxidizing process has been carried still farther, as may be seen in the following list, which includes only the most important of them.

Oil of bitter almonds	$C_{14} H_6 O_2$
Benzoic acid	$C_{14} H_6 O_4$
Oil of spiraca	$C_{14} H_6 O_4$
Salicylic acid	$C_{14} H_6 O_6$
Oil of anise	$C_{16} H_8 O_4$
Anisic acid	$C_{16} H_8 O_6$
Cumarine	$C_{18} H_4 O_4$
Cumaric acid	$C_{18} H_4 O_6$
Oil of cinnamon	$C_{18} H_8 O_2$
Cinnamic acid	$C_{18} H_8 O_4$
Oil of cumine	$C_{20} H_{12} O_2$
Cuminic acid	$C_{20} H_{12} O_4$

It will be seen that in every case the oil, or in that of cumarine the resinoid crystalline body, differs from the related acid only by 2 eqs. of oxygen. These oils and resinoid bodies are moreover fragrant (cumarine is the odorous principle of the tonka bean), and both they and the acids. especially the latter, approach to resins in properties. as well as in composition.

5. Volatile Oily and Fatty Acids, with the oils and fats containing them.

As the growing plant pushes its deoxidizing agency still further, fixed oils and fats are produced, a class of compounds both important and abundant. We already know their proximate constituents, namely, the acids of the formic or acetic series (excepting only the two acids lowest in the scale, which are not oily) on the one hand, and on the other the basic oxide of lipyle, or of glyceryle, or glycerine. It is unnecessary to repeat the list of acids. but we shall quote a few for illustration, with the oxide of lipyle.

Oxide of lipyle (the base in fixed oils and fats)	$C_3 H_2 O$
Glycerine	$C_6 H_7 O_5$ $2 (C_3 H_2 O) + 3 HO$
Butyric acid	$C_8 H_8 O_4$
Capric acid	$C_{20} H_{20} O_4$
Myristic acid	$C_{28} H_{28} O_4$
Cetylic and palmitic acids	$C_{32} H_{32} O_4$
Margaric acid	$C_{34} H_{34} O_4$
Oleic acid	$C_{36} H_{34} O_4$
Stearic acid	$C_{36} H_{36} O_4$
Cerotic acid	$C_{54} H_{54} O_4$
Melissic acid	$C_{60} H_{60} O_4$

We have already explained that fixed oils and fats consist of such acids as these, combined with oxide of lipyle, which, when the oil is saponified by boiling with potash or soda, separates in the shape of glycerine. The only exceptions yet known are those of spermaceti, which is composed of cetylic acid, isomeric with palmitic acid, combined with oxide of cetyle, $C_{32} H_{33} O$, and wax, which consists partly of free cerotic acid, partly of palmitic acid combined with oxide of ceryle, $C_{54} A_{55} O$; and in some kinds of wax of melissic acid and oxide of melissyle, $C_{60} H_{61} O$. Drying oils, such as oil of linseed, of walnut, &c., consist of oxide of lipyle, united to a peculiar oleic acid, which rapidly absorbs oxygen and dries up into a resinous mass or varnish. The neutral fixed oils and fats, composed as we have stated, are produced by a very high degree of deoxidation, when compared with the preceding groups, and are therefore formed in an advanced stage of the vegetative process. Hence they abound in seeds. In some of them, as in wax, the oxygen is reduced to a small fraction. But, taken as a whole, the group may be represented as sugar or starch *minus* oxygen, for sugar is $C_{12} H_{12} O_{12}$, and the average composition of fixed oils and fats is represented by the proportion $C_{12} H_{12} O$, or $C_{12} H_{10} O$. Hence, if fats are formed in the animal body from starch or sugar, as it seems certain they are, it must be by a process of deoxidation. although the general nature of the animal vital process is that of oxidation.

6. Resins and Camphors.

This group is small in point of numbers, but very abundant and widely diffused. In it the oxygen is still farther diminished, as may be seen in the following list.

Many resins	$C_{10} H_7 O$
Camphor	$C_{10} H_8 O$
Borneo camphor	$C_{20} H_{16} O_2$
Many resins	$C_{20} H_{14} O_2$
Many acid resins	$C_{20} H_{15} O_2$

Among these bodies isomerism and polymerism prevail

to a great extent. The general character of the group is that they are very inflammable, fusible, insoluble in water, soluble in alcohol, frequently acid, but weak acids. Camphor is very volatile.

7. *Non-oxygenated Volatile Oils.*

In this group, which is both numerous and widely diffused, no oxygen is left. Isomerism and polymerism predominate among them, so that the following short list includes the most frequent proportions.

Oil of lemons and various others	$C_5\ H_4$
Oil of turpentine and various others	$C_{10}\ H_8$
Toluole	$C_{14}\ H_8$
Styrole or cinnamole	$C_{16}\ H_8$
Metastyrole or dracole	$C_{14}\ H_7$
Oil of juniper and others	$C_{15}\ H_{12}$
Cumole	$C_{18}\ H_{12}$
Cymole	$C_{20}\ H_{14}$

Most of the volatile or essential oils of this class have a strong aromatic smell, and are indeed the source of the smell of the plants in which they occur. They are usually obtained by distilling the plants, flowers, seeds, or exudations from trees, with water, with the vapour of which the oils readily pass over. Many of them occur in the exudation from trees, especially from many of the coniferæ, mixed with resins, constituting what is called turpentine or balsam. When this is distilled with water the resin is left behind, and in this way common resin is obtained along with oil of turpentine, from the turpentine of commerce. Balsam of copaiva and Canada balsam are turpentines which, containing more oil, are more fluid. These oils, exposed to air, absorb oxygen, and dry up into a resinous mass. Indeed most resins in composition are the oxides of the volatile oils which occur with them. Hence the use of oil of turpentine as a varnish and in oil painting. True varnishes, however, are solutions of resins in oil of turpentine, alcohol, naphtha, pyroxilic spirit, and other solvents.

The groups we have thus briefly sketched include all those vegetable compounds which consist of carbon, oxygen, and hydrogen only. But there are many and very important compounds which contain also nitrogen, and these we shall now endeavour briefly to indicate according to their natural affinities.

In order that these substances should be formed, the plant must be supplied with nitrogen, and this is done chiefly in the form of ammonia, or of nitric acid, both of which are conveyed to plants in the water which reaches their roots. In germination, however, there is another source of ammonia, namely, the decomposition of the albuminous or sanguigenous matter in the seed. Now it is remarkable that in germinating plants, before true leaves have been formed, and, what is the same thing, in etiolated plants, or those grown in the dark, the juice is found to contain a large proportion of a crystallizable nitrogenized compound, namely, malamide or asparagine. It would seem, therefore, as if this were the first nitrogenized body produced by the plant. Its origin is obvious. The plant first produces some acids, and among these malic acid. This meets with ammonia, and, water being separated, malamide is formed, or we may simply suppose it to be produced from carbonic acid, water, and ammonia. In the first case, malate of ammonia, $C_8 H_4 O_8, 2 NH_4 O$, losing 2 eqs. of water, yields malamide or asparagine, $C_8 H_{10} N_2 O_8$. In the second, 8 eqs. of carbonic acid, 4 of water, and 2 of ammonia, yield 1 eq. of malamide and 12 of oxygen; so that, whether malic acid be first formed, or malamide be directly produced, if it be formed from carbonic acid, ammonia, and water, it must be by deoxidation, as in all the preceding groups. This is no doubt the case in growing plants where it occurs, but in germination it may be formed, at least in part, by the decomposition of fibrine, albumen, or caseine. All other compounds of amide, or those of imide, or, in short, all derived from ammonia, are formed in growing plants in the same way, that is by deoxidation. There are thus formed several classes of compounds, neutral amides, such as asparagine or malamide, amygdaline, and similar bodies, of which white or colourless indigo, the source of the coloured indigo, is one; the volatile bases, which may be either amide, imide, or nitryle bases; and the fixed bases, which are either ammonium bases, or coupled compounds containing such bases. The formation of the volatile and fixed bases in the various forms of amide, imide, nitryle, and ammonium bases, we have already explained in their proper place. We shall here unite in one short list a few nitrogenized vegetable compounds of the kinds we have mentioned, all of which are produced in plants, either directly from carbonic acid, ammonia, and water, by deoxidation, or indirectly from ammonia acting on substances already formed by deoxidation from carbonic acid and water, as we have explained above with reference to malamide.

Asparagine or malamide		$C_8\ H_{10}\ N_2\ O_8$
White indigo		$C_{16}\ H_6\ N\ O_2$
Amygdaline		$C_{40}\ H_{27}\ N\ O_{22}$
Nicotine	volatile bases	$C_{10}\ H_8\ N$
Coneine	volatile bases	$C_{16}\ H_{16}\ N$
Morphine	fixed bases	$C_{35}\ H_{20}\ N\ O_6$
Quinine	fixed bases	$C_{20}\ H_{12}\ N\ O_2$
Strychnine	fixed bases	$C_{44}\ H_{22}\ N_2\ O_4$
Caffeine		$C_{16}\ H_{10}\ N_4\ O_4$

This list will give an idea of the composition of the greater number of crystallizable or volatile nitrogenized products found in plants. The number of fixed bases is very large, but they all resemble those quoted, which are the active principles of the plants in which they occur; morphine of opium, where it is associated with several other bases, codeine, papaverine, narcotine, thebaine, and narceine; quinine of cinchona bark, which also yields cinchonine and quinidine, and strychnine of nux vomica, which also contains brucine. Besides these, there are veratrine in veratrum, atropine in belladonna, aconitine in aconite, digitaline in digitalis, daturine in datura, colchicine in colchicum, and others of less interest. Nicotine and coneine, the active and very poisonous principles of tobacco and hemlock, are in all respects analogous to the volatile bases of the ethylic and benzoic series already noticed. Amygdaline is a bitter substance, peculiar to the bitter almond, which, in contact with water and the albuminous compound of the almond, undergoes a peculiar fermentation, and is resolved into several bodies not entirely known, but among them are hyduret of benzoyle and hydrocyanic acid, which together form the oil of bitter almonds of commerce.

White indigo is the substance present in the juice of indigofera, or at all events is produced by the action of ammonia on a substance there present, and as soon as it is formed attracts oxygen, and is converted into indigo, $C_{16} H_5 NO_2$, the white indigo losing 1 eq. of hydrogen. Indigo, when acted on by different reagents, yields a large number of very interesting products of decomposition. With 2 eqs. of oxygen it forms isatine, $C_{16} H_5 NO_4$, and this yields a whole series of substitution products, in which chlorine and bromine are substituted for its hydrogen, besides many derivatives from these. When heated with potash, isatine yields carbonate of potash, hydrogen, and aniline, or phenylamine, $C_{12} H_7 N$; so that the products of decomposition of indigo and its derivatives fall into the phenylic series. By the action of nitric acid, indigo is converted into two acids, according to the strength of the nitric acid. One of these belongs to the salicylic series, and is nitrosalicylic or indigotic acid, $C_{14} \left.\begin{matrix} H_5 \\ NO_4 \end{matrix}\right\} O_6$; the other is a yellow, intensely bitter, crystallizable acid, which forms with potash a salt nearly indissoluble. It has been called carbazotic, picric, nitropicric, and nitrophenisic acid; but it is simply hy-

drated oxide of phenyle, or carbolic acid, $C_{12}H_5O, HO$, in which 3 eqs. of hydrogen are replaced by 3 of nitrous acid, $C_{12}\left.\begin{matrix}H_2\\3\,NO_4\end{matrix}\right\} O, HO$. This again connects indigo with the phenylic series. The same acid, which might perhaps be best named trinitrocarbolic acid, is formed in many other cases of the oxidation of organic compounds by nitric acid, as, for example, from aloes, and from several resins. But we can only indicate the existence of the numerous derivatives of indigo in this place.

Caffeine is found, not only in coffee, but also in tea; and in Paraguay tea or guarana, used for the same purpose as tea or coffee. It has considerable analogy in composition, and also in the products of its decomposition, with certain animal products connected with uric acid, and it is probably in virtue of this that it acts as a kind of stimulant.

There are one or two volatile oils, such as those of garlic and assafetida, which contain sulphur. One, if not both of these, is sulphuret of allyle, C_6H_5, S; allyle being a radical either isomeric or identical with propionyle, the radical of propylic acid. Oil of mustard and oil of cochlearia are the sulphocyanide of allyle, C_6H_5S, C_2NS_2, and contain, therefore, both sulphur and nitrogen. In the formation of these oils in plants, carbonic acid, water, ammonia, and sulphuric acid are employed, and, as in all other cases, oxygen is given out.

There are various substances of no great importance which we have not specifically mentioned, but which all find their place in one or other of the groups of vegetable products we have named. Such are various colouring matters, and various volatile and crystallizable bodies, allied to the volatile oils.

But there remains one most important group of compounds formed by plants alone, and essential to the food of animals. This is the group of the albuminous or sanguigenous bodies, the only substances from which the animal system can form blood. These are three in number—albumen, fibrine, and caseine; and they are of all vegetable products the most complex, containing not only the five elements already mentioned (carbon, hydrogen, nitrogen, oxygen, and sulphur), but also—as essential constituents, without which, though in small proportion, they cannot even exist—mineral salts, especially phosphates. Moreover, the number of atoms in these compounds is far larger than in any we have mentioned, amounting, indeed, to hundreds. It is evident that one chief object of vegetation is the formation of these substances, and also that from their complexity they must be the last formed; and in fact they abound in the seeds, tubers, and other parts capable of reproducing the plant, and after the formation of which the plant dies down, either for a season or permanently. They are always accompanied by the two other classes of compounds, which with these constitute not only the first food of the young plant, but the food of animals, namely, starch, sugar, gum, or cellulose, on the one hand, or oils and fats on the other; these two constituting the respiratory part of animal food, as the three more complex products constitute the sanguigenous part of that food.

We may either conceive these compounds to be formed directly from carbonic acid, water, ammonia, and sulphuric acid, with the separation of oxygen; or, what is much more probable, we may suppose them formed from compounds already of a certain degree of complexity, such as sugar, with the aid of ammonia and sulphuric acid, or finally from sugar or some such substance, acted on by some nitrogenized compound, such as malamide. The precise steps of the process are unknown, but it is obvious that, whether formed directly or indirectly, they must be ultimately derived from the original food of plants—carbonic acid, water, ammonia, sulphuric acid, and the mineral salts derived from the soil—and that this cannot take place without the separation of a large amount of oxygen. The nearest approach we can make to the formulæ of these compounds is the following:—

Albumen and fibrine.....	$C_{216}H_{169}N_{27}S_2O_{68}$
Caseine.........	$C_{288}H_{228}N_{36}S_2O_{90}$

besides the phosphates. It is very difficult to ascertain with certainty such formulæ; but these, with respect to the proportions, represent the results of analysis; and as to the absolute number of atoms, we assume 2 eqs. of sulphur, because we find that these bodies contain sulphur in two different states, which implies at least 2 atoms.

These substances are essential to the growth of plants, as the vegetable cell, even if formed of cellulose alone, cannot be formed without the presence of one of these bodies. But in fact they also take part frequently in the formation of the cell wall, and the primordial utricle, or lining membrane of the cell, seems to consist chiefly of them.

Vegetable fibrine and albumen are isomeric; or, at least, the best analyses have not been able to show more difference between them than between different analyses of one of them. When dissolved in the vegetable juices, the fibrine coagulates spontaneously, the albumen when the liquid is boiled, and the caseine on the addition of an acid after the coagulation of the albumen, if all three or two of them be present together. In the solid form they are found, fibrine in the seeds of grasses and cerealia, albumen in those of nuts, almonds, and the kernels of stone fruit; and caseine in the seeds of the leguminosæ. The fibrine in grain is accompanied by starch and a little sugar, and in some cases also a little oil; the albumen is almost always associated with oil, as in almonds, walnuts, hazelnuts, and many other seeds; and in the seeds of leguminosæ the caseine is mixed chiefly with starch. In edible roots and tubers there is the same mixture. In the potato, fibrine and starch; in carrots, turnips, &c., fibrine, sugar and pectine; in pulpy fruits, fibrine, starch, sugar, and pectine, are the chief ingredients. In short, the vegetable cannot live and grow, and bear fertile seeds, without at the same time providing food for animals, not only in seeds, roots, and tubers, but also in leaves, leaf-stalks, leaf-buds, flower-buds; and, indeed, every part which is full of juice. And this leads us to consider the composition of the animal body.

But first we must remind the reader, that we have seen that plants live on carbonic acid, water, ammonia, sulphuric acid (in the form of sulphates), and phosphates, chlorides, alkalies, and other mineral matters—the three first compounds derived from the air, the rest from the soil. Secondly, that in germination, which takes place in the dark, oxygen is absorbed along with water, the albuminous matter in the seeds enters into decomposition, and becomes a ferment, by which means the starch is converted into sugar and dissolved, along with the greater part of the albumen, which is also rendered soluble by the fermentative action of the decomposed portion, while malamide appears, probably derived from the same source, and carbonic acid is given out. And thirdly, that as soon as the first leaves are formed, and light obtains access, the true, proper, vegetative process begins, in which, from the articles of their food above enumerated, plants produce acids, neutral substances, mild or acrid, or bitter or coloured, bases, oils and fats, resins, volatile oils and volatile acids; and finally, sanguigenous compounds, the formation of all of these being dependent on light, and being accompanied by the continual evolution of oxygen. Such is the nature of the vegetative process, carried on in virtue of the energy derived from the solar rays, and it is marked by three essential characters; the first is, that light is absolutely essential to it; the second is, that it is essentially a constructive process, in which the least complex compounds forming the food of plants are built up into more and more complex forms, till at last the sanguigenous bodies, the most complex of all, are produced; and the third, that it is a process of deoxidation of the food

of plants to a greater or less extent, and occasionally complete; but a deoxidation of a kind unknown in the laboratory, where we can only deprive bodies of oxygen by using others which seize and retain the oxygen, whereas the plant retains the carbon, hydrogen, and nitrogen, &c., and liberates the oxygen. The power required for this must be prodigiously great, and must far surpass that of our most energetic agencies; yet the vegetable cell effects it, without the help either of heat or of any other appliance. There can be no doubt that light is the source of this astonishing power; but, be this as it may, it is characteristic of vegetation.

Let us now turn to the animal system. We have stated that the food of animals is composed of two kinds of substance, the sanguigenous, and the respiratory. Both must be rendered soluble in order that they may enter the circulation, and this is effected in the process of digestion. It is remarkable, that this first animal process agrees with the first vegetable one, namely, with germination. In mastication, the food is divided and mixed with saliva, oxygen being added from the air, and being inclosed by the viscidity of the saliva. In the stomach, the gastric juice is added, which contains a little free acid, some albuminous matter dissolved, and the usual animal salts. The dissolved albuminous matter, acting as a ferment, at the temperature of the body, renders the sanguigenous portion of the food soluble, while either the same ferment, or, as is now believed, one peculiar to the saliva, converts the starch, if any be present, into sugar, so that it also is dissolved. The dissolved sanguigenous matter is gradually converted into blood, and from that fluid the various tissues are formed. The fibrine of flesh and the albumen of the blood are identical with vegetable fibrine and albumen; but the fibrine of the blood and the albumen of eggs are different. The two former, as we have already stated, are $C_{216} H_{169} N_{27} S_2 O_{68}$. Now, when one of them is employed to produce blood fibrine, or hematofibrine, which is $C_{298} H_{228} N_{40} S_2 O_{92}$, it may be in this manner that 2 eqs. albumen (or fibrine) with 2 eqs. of water are converted into 1 of hematofibrine, 1 of gelatine, $C_{82} H_{67} N_{13} O_{32}$, and 1 of choleic acid, one of the acids of bile, $C_{52} H_{45} NS_2 O_{14}$. Or it may be that 2 eqs. albumen and 4 of water yield 1 eq. hematofibrine, 1 gelatine, 1 cholic acid, the other acid of bile, $C_{52} H_{43} NO_{12}$, and 2 of sulphuric acid. Lastly, these two processes may be combined, so that—

$$\left.\begin{array}{c}\text{4 eqs. albumen}\\ \text{with}\\ \text{6 eqs. water}\end{array}\right\}\text{yield}\left\{\begin{array}{l}\text{2 eqs. hematofibrine.}\\ \text{2 eqs. gelatine.}\\ \text{1 eq. choleic acid.}\\ \text{1 eq. cholic acid.}\\ \text{2 eqs. sulphuric acid.}\end{array}\right.$$

By this it will be seen that the formation of blood fibrine is accompanied most probably by that of gelatine, necessary for membranes and bones, and that of the chief constituents of bile. Indeed, blood fibrine may be regarded as ordinary fibrine and albumen, half converted into gelatine and bile, for 1 eq. of it with 18 of water, may yield 3 of gelatine and 1 of choleic acid.

This example will illustrate the fact, that while the animal body cannot produce any sanguigenous body from food in which none of them is present, it can transform one into the other, as albumen into fibrine, fibrine into albumen, or both into caseine, or, as we have just seen, albumen or fibrine into hematofibrine; but that, where such changes are not isomeric transformations, they are a commencement of destruction, and their production, even if more complex, as is the case with hematofibrine, is not a pure case of construction as in the plant, but one in which with one more complex body others much less complex are produced. In the same way, when the food contains caseine, as milk does, and when hematofibrine is formed from caseine, it is accompanied by the production of chondrine, the substance of which cartilage, so necessary to the young animal, is formed. 1 eq. caseine with 10 of water may yield 1 of hematofibrine, and 1 of chondrine, $C_{72} H_{59} N_9 O_{32}$.

In this way, then, the animal body, if supplied with albumen, fibrine, or caseine, can produce from them, or any one of them, the materials necessary, in addition to themselves, for the formation of blood, muscular fibre, membranes, cartilage, bones, &c., even although these should be in part more complex than the food. But it is beyond the power of the animal body to produce any one of these substances from food which does not contain at least one of them, and for that food it is absolutely dependent on vegetables. Although we do not know the details, there can be no doubt that the formation of nervous matter or cerebral substance, is effected on the same principles. In this stage, water, as we have seen, is taken up, but oxygen is not required, nor is it given out. It is after the formation of blood and of the tissues, by some such changes as those we have specified, that the true vital process peculiar to animals begins. This process is exactly the reverse of the vegetative one; for while the latter, acting by deoxidation of the least complex among compounds which are its food, constructs or builds up those that are more and more complex, till it produces the most complex of all, that is, the food of animals, giving out during the whole succession of changes a large amount of oxygen; the former takes up, in respiration, a large amount of oxygen, acts by oxidation, and beginning with the most complex compounds, destroys them, and breaks them up into such as are less and less complex, ending at last with the very same substances as form the food of plants, and giving out all the time, in respiration, carbonic acid, in quantity equal, or very nearly so, to the oxygen absorbed, the difference of oxygen being given out as water.

These two great processes are exactly opposed, and, in point of fact, exactly balance each other, so that the air remains always of the same composition, although animals are constantly removing oxygen and replacing it by carbonic acid, because plants, on the other hand, are constantly removing carbonic acid, and replacing it with oxygen.

As to the products of the oxidation and destruction of the tissues in the animal body, they are very numerous, and only partially known. Such bodies as gelatine, chondrine, and the like, are among them, and it is to be observed that these products of destruction of the tissues, even when they approach in complexity the sanguigenous bodies, are not capable of forming blood. Thus gelatine alone can never support animal life, not being convertible into blood, as fibrine, albumen, and caseine are.

After such complex products of oxidation as gelatine and chondrine, there come probably a number of intermediate compounds, which, however, are as yet unknown. But at a certain stage in the oxidizing process bile is formed, which is composed of the two acids, choleic acid $C_{52} H_{45} NS_2 O_{14}$, and cholic acid $C_{52} H_{43} NO_{12}$, both combined with soda. We have already noticed these acids under the series of glycocine, which may be formed from cholic acid, while taurine, a compound containing all the sulphur of the bile, is obtained from choleic acid. In both acids, these substances are coupled with cholalic acid, $C_{48} H_{40} O_{10} = C_{48} H_{39} O_9, HO$.

Anhydrous cholalic acid........................	$C_{48} H_{39} O_9$
Anhydrous glycocine...........................	$C_4 H_4 NO_3$
Cholic acid....................................	$C_{52} H_{43} NO_{12}$
Anhydrous cholalic acid........................	$C_{48} H_{39} O_9$
Anhydrous taurine..............................	$C_4 H_6 NS_2 O_5$
Choleic acid...................................	$C_{52} H_{45} NS_2 O_{14}$

Cholalic acid, by boiling with water, is converted into a resinous acid, isomeric with the anhydrous cholalic acid, which is called choloidic acid; and when this is further boiled with acids, it yields a very insoluble resin, called dyslysine, which is choloidic acid *minus* 3 eqs. of water, or $C_{48} H_{36} O_6$.

Such are the chief products of bile. It is probable that all the sulphur of the tissues takes the form of choleic acid, that is, passes into the bile, before being expelled from the body as sulphuric acid by farther oxidation. The bile, which is mixed with the digested mass of food as it leaves the stomach, is apparently reabsorbed after producing some important effect in digestion, or in the conversion of the food into perfect chyle or blood, and being thus thrown into the circulation, it is destroyed by oxidation. We have already seen how the acids of bile may be formed from albumen or fibrine, along with hematofibrine, and also from the latter body by the addition of water; but they are also formed by oxidation. For example:—

$$\left.\begin{array}{l}\text{1 eq. albumen,}\\ \text{10 eqs. water, and}\\ \text{56 oxygen,}\end{array}\right\}\text{ may yield }\left\{\begin{array}{l}\text{6 eqs. choleic acid,}\\ \text{2 eqs. cholic acid,}\\ \text{12 eqs. urea,}\\ \text{36 eqs. carbonic acid.}\end{array}\right.$$

Or cholic acid may be formed, beside various other processes of oxidation, from chondrine and gelatine, as follows:

$$\left.\begin{array}{l}\text{1 eq. chondrine by}\\ \text{a fermentation,}\\ \text{probably}\end{array}\right\}\text{ may yield }\left\{\begin{array}{l}\text{1 eq. cholic acid,}\\ \text{2 eqs. uric acid,}\\ \text{8 eqs. water.}\end{array}\right.$$

$$\left.\begin{array}{l}\text{1 eq. gelatine, with}\\ \text{10 eqs. water,}\end{array}\right\}\text{ may yield }\left\{\begin{array}{l}\text{1 eq. cholic acid,}\\ \text{3 eqs. uric acid,}\\ \text{12 eqs. water.}\end{array}\right.$$

In all these three examples, it will be seen that the biliary products are accompanied by such as are urinary, urea, uric acid, and water, and also by carbonic acid. There are, no doubt, many other modes of decomposition and intermediate products, and some of these products we know, as for example, kreatine $C_8 H_{11} N_3 O_6$, and hippuric acid $C_{18} H_9 N O_6$, the former being found in the juice of muscle and in urine, the latter in urine. Now we can easily see how they may be formed, from gelatine for example, for—

$$\left.\begin{array}{l}\text{1 eq. gelatine, and}\\ \text{58 eqs. oxygen,}\end{array}\right\}\text{ may yield }\left\{\begin{array}{l}\text{3 eqs. kreatine,}\\ \text{2 eqs. hippuric acid,}\\ \text{12 eqs. water,}\\ \text{22 eqs. carbonic acid.}\end{array}\right.$$

Any of these substances, fully oxidized, will yield carbonic acid, ammonia, water, and, if sulphur be present, sulphuric acid. Thus—

$$\left.\begin{array}{l}\text{1 eq. of choleic acid, and}\\ \text{144 eqs. oxygen,}\end{array}\right\}\text{ yield }\left\{\begin{array}{l}\text{1 eq. ammonia,}\\ \text{2 eqs. sulphuric acid,}\\ \text{52 eqs. carbonic acid,}\\ \text{42 eqs. water.}\end{array}\right.$$

When uric acid is formed, it must, in warm blooded animals, be farther oxidized, so as to yield soluble compounds, or else by its insolubility it is deposited, producing calculous disease. In general, all the uric acid but a very small portion is thus oxidized, and the results are (uric acid $= C_{10} H_4 N_4 O_6$)—

$$\left.\begin{array}{l}\text{1 eq. uric acid,}\\ \text{3 eqs. water,}\\ \text{2 eqs. oxygen,}\end{array}\right\}\text{ yield }\left\{\begin{array}{l}\text{2 eqs. oxalic acid,}\\ \text{1 eq. urea,}\\ \text{1 eq. allantoine.}\end{array}\right.$$

or

$$\left.\begin{array}{l}\text{1 eq. uric acid,}\\ \text{8 eqs. water,}\\ \text{6 eqs. oxygen,}\end{array}\right\}\text{ yield }\left\{\begin{array}{l}\text{4 ammonia,}\\ \text{10 carbonic acid,}\end{array}\right\}\text{ or }\left\{\begin{array}{l}\text{2 urea,}\\ \text{4 water,}\\ \text{3 carbonic acid.}\end{array}\right.$$

It will be seen that the less complete oxidation of uric acid produces, besides urea, oxalic acid and allantoine. Oxalic acid does occur, and when it meets with lime is apt to form a calculus of the insoluble oxalate of lime. Allantoine is found in the allantoic fluid or fœtal urine, and in the urine of very young animals, in whom respiration, and consequently oxidation, is somewhat imperfect. But when the oxidation is complete, urea or ammonia, carbonic acid, and water, are the products.

Many more examples might be given of the mode in which the changes in the animal body may be supposed to be effected, and in some such modes they must be effected. But as we do not know all the different stages of the oxidation, nor all the products, we only give these representations as possible or probable, in regard to the details, although in principle certain; for all the facts we know prove that in the animal body every change is the result either of oxidation, more or less complete, or of a transformation with or without the addition of water, but never, as in plants, of deoxidation with liberation of oxygen. On the contrary, oxygen is constantly absorbed, carbonic acid constantly given out, and the complex substance of the tissues is constantly broken up into less and less complex compounds, till the final result is the food of plants.

It is in the very performance of their proper functions that the tissues are oxidized, and as fast as a portion of any tissue, being oxidized, is, while doing its work, broken up, the blood replaces it by a new portion derived from the food. At the same time the blood carries off the broken up or effete tissues, and out of them produces, according as the oxidation is more or less advanced, gelatine and the like, bile, juice of muscle, or urine. It is the blood which conveys to every part the oxygen necessary for the destruction of the tissues, that is, for the performance of their functions, which *is* their destruction. This is the reason why great efforts of any kind, muscular or otherwise, are attended with great waste of substance, and require an increased supply of food. It is the blood also, which, after it has carried the oxygen to act on the tissues, so as to enable them to perform their part, and in so doing to be destroyed, *pro tanto;* and after it has replaced the effete tissues which have, in becoming effete, fulfilled their office, by fresh material, also carries away not only the solid and liquid products of oxidation, but also the carbonic acid so largely formed, which it conveys to the lungs, and there exchanges for oxygen. But there is another source of carbonic acid besides the oxidation of the tissues. This is the oxidation or slow combustion of the respiratory food, of the sugar, &c., and the oils or fats, some of which are always present in food, as provided by Nature. And it is by this oxidation of the carbon and hydrogen of these matters as well as those of the tissues that the animal heat is kept up, without which none of the vital processes could be carried on. Now both the oxygen required for this purpose and the carbonic acid produced are carried to and fro by the blood, which at the same time has to perform three most essential functions, or rather four; first to enable the tissues, by oxidizing them, to perform their functions; secondly, to repair the waste of tissue; thirdly, to concoct or assist in concocting, out of the first products of oxidation, the various secretions and excretions; and lastly, to effect by the oxygen it carries the oxidation also of the respiratory food, or the production of animal heat, and to convey to the lungs the carbonic acid which is formed, and exchange it for oxygen.

The blood is admirably fitted for these purposes. It consists of water, holding in solution, besides salts, albumen and fibrine, and in this solution are suspended the red and white blood corpuscles. These seem to have much to do in the conveyance of the gases, which probably adhere to them. At all events, their colour changes from dark to bright red, according as the blood is loaded with carbonic acid (venous), or with oxygen (arterial). But that the blood may absorb so much carbonic acid, and yet give it out easily, it must be alkaline, and yet not too alkaline, which would retain the carbonic acid. This is accomplished by the presence of the peculiar phosphate of soda, tribasic with 2 eqs. of soda, which, acid in composition, is alkaline in character; namely $P O_5$, $2 Na O$, $H O$. It absorbs carbonic acid as well as carbonate of soda, and gives it off much more readily and completely. For another reason, the blood must be alkaline; for if it were acid, or even neutral, neither fibrine nor albumen could remain dissolved, nor could the necessary changes take place. Moreover, it must be phosphate of soda in the blood, and not that

of potash, for potash tends to form the salt $PO_5, KO, 2HO$, which is an acid salt. This very salt exists in the juice of muscle, which is almost in absolute contact with the blood, and in the gastric juice, but never in the blood, though the fluids which contain it are only separated from it by the most delicate possible membrane. The presence of these two fluids, blood and juice of muscle, one alkaline, the other neutral or slightly acid, in such close proximity, is probably connected with the existence of currents of electricity in the body, which have been demonstrated especially in muscular action. Two such fluids, with a porous solid between them, will always create an electric current.

It is obvious that for two chief reasons the supply of oxygen to the animal body must be abundant. It has to oxidize and destroy the tissues, that is, to enable them to perform their functions; and it also has to consume the respiratory food, and ensure the regular supply of animal heat. The effects of a deficient supply of oxygen are easily seen. The tissues being less thoroughly oxidized, the blood must become loaded with intermediate products. Among others, uric acid must occur, and give rise to calculous and gouty diseases. And this is the case. But deficiency of oxygen may arise from two causes; either from an absolute defect of oxygen, from diminished respiration, sedentary habits, which diminish respiration, and other analogous causes, or, what is more common, excess in food, whereby a full ordinary supply of oxygen becomes insufficient. This is the principal reason why excess in eating causes disease. Another cause may contribute to this, namely the deficiency of alkaline salts in the food, which is apt to occur if too much animal food and too little vegetable food be taken. The alkaline salts of vegetable acids are converted into carbonates in the system, and the presence of these greatly promotes oxidation; hence their absence or deficiency is injurious. For the same reasons, the strong wines of the south, which contain hardly any tartar, that is, acid tartrate of potash, are apt to cause calculus and gout, if habitually used; while on the Rhine, where wine is the only beverage, but the wines are weaker, and strongly charged with tartar, these diseases are unknown, save as imported.

When from any cause the supply of oxygen in proportion to the sanguigenous food is too small, the animal body possesses the singular power of obtaining a supply of oxygen from sugar or starch, which, by losing oxygen, are converted into fat. In this way the animal body can produce fat from sugar, like the plant, but the oxygen, instead of being given out, is employed to make up for the deficiency of that element. At the same time, as fat is formed along with it, the animal becomes fat. This explains why stall-fed animals fatten sooner than such as are outside; the former having a deficient supply of oxygen, that is, deficient respiration, compared with the latter; it also explains how the most fattening food is such as contains, with a certain proportion of sanguigenous matter, a large amount of starch or sugar. In this point, the practice of experienced feeders is entirely according to theory.

The food of animals and of man must contain a due proportion of sanguigenous and respiratory matter. For man, the best proportion is that found in grain and in milk, which are almost the only articles of food on which, alone, that is, on either of them without addition, life and health can be sustained. In them, the proportion is 1 part of sanguigenous matter to $4\frac{1}{2}$ or 5 of respiratory matter. Lean meat contains too little respiratory matter, although it contains a good deal of fat or oil diffused through it. Pease and beans and cheese are also too rich in sanguigenous matter, while potatoes and rice contain a great excess of respiratory food, which is the case also with very fat meat, such as bacon, &c. Hence, we usually add potatoes or rice to lean meat, and bacon or fat pork to pease and beans. Working men fed on potatoes require a very large supply of that food, so poor in sanguigenous matter, for it contains but 1 part of fibrine to 8, 10, or 11 of starch, to supply the daily waste of tissue, which starch cannot supply. With a large amount of potatoes they may thrive, but in that case much starch passes off unchanged in the excreta. On the other hand, when men are fed exclusively on flesh, they require a very large supply of it, as do carnivorous animals, because, besides supplying the waste of tissue, a large part has to be oxidized to yield the animal heat, for which it is far less fitted than starch. To burn off, or oxidize, so much sanguigenous matter requires a very large supply of oxygen, and this is the reason why carnivorous savages must lead a life of continual exertion, as they generally do in hunting for their food. For the same reason, carnivorous animals in confinement are always in motion except when asleep. The exercise increases the frequency and depth of respiration, and thus promotes oxidation. Lastly, the respiratory food is required, not merely to yield animal heat by its slow combustion, but also to yield fat by its deoxidation, which fat or oil assists in the formation of tissues from sanguigenous matter.

Such, in a very few words, are the general laws which regulate the food of animals. As to the excreta, they consist, for the most part, of the gases and vapours formed by oxidation, or carbonic acid and water, excreted by the lungs and skin, and ammonia, chiefly excreted in the form of salts in the urine; of the soluble salts which have served their purpose in the economy, or are the result of oxidation, as phosphates of potash, soda, and ammonia, sulphates, chlorides of potassium and sodium, &c.; of soluble organic excreta, as urea and kreatine, with traces, in man, of uric and hippuric acids, which, with the soluble salts and other less known substances, are excreted in the urine; and, finally, of the insoluble salts, as phosphates of lime, magnesia, and iron, along with any undissolved or insoluble matter in the food, as woody fibre, excess of starch, resinous matters, and certain fetid products of the oxidation of sanguigenous bodies which are also insoluble, but have not been fully studied, all of which insoluble matters form, with a certain amount of water, the solid or semisolid excreta. In cold-blooded animals, such as reptiles, where oxidation is very imperfect, there is no liquid urine; the whole excreta form one mass, which, in serpents for example, consists partly of undigested matters, bones, hair, feathers, and the like, but chiefly of a white salt, urate of ammonia. The same is true, to a great extent, of carnivorous birds, such as sea fowl, whose excreta consist of the bones of fishes and urate of ammonia. Exposed to the air, they became partly altered, the uric acid being in part converted into oxalic acid and other products, and the result is guano, which owes its value as a manure to the phosphates it contains, to the salts of ammonia, and to the uric acid, which is a source of ammonia when further decomposed.

We have seen that the animal process is the reverse of the vegetable one; that it begins where the other ends, with the sanguigenous and respiratory substances, and ends where the other begins, in the excreta, gaseous, liquid, and solid, which amount to carbonic acid, ammonia, water, sulphuric acid, or sulphates, phosphates, chlorides, &c., in short the very substances which are the food of plants. Urea, on being expelled in the urine, is soon transformed into carbonic acid and ammonia; for $C_2\,H_4\,N_2\,O_2 + 2\,HO = 2\,(NH_3,\,CO_2)$. This change takes place under the influence of a ferment, and the ferment in the urine is the mucus suspended in it; for if this be at once separated by filtration, the urea does not ferment.

We have noticed the composition of the best known among the constituents of the animal body, and the products of the various changes which occur during life. The various secretions are formed chiefly of water, with certain animal substances dissolved, generally in small quantity, and

 certain salts. Milk, which is important as a naturally prepared food, adapted more especially to the growth of the young animal, contains a considerable amount of caseine dissolved, which is identical with the caseine of pease, beans, and other leguminous plants. The respiratory food in milk consists of fat or oil, called butter, which we have already described under the head of the volatile oily acids of the acetic series, and of a peculiar form of sugar, called lactine or sugar of milk, the composition of which is $C_{12}\,H_{12}\,O_{12}$, the same as that of dry grape sugar, with which, however, it is only isomeric, not identical.

When milk is left to itself, the oil rises to the surface as cream. But soon after, the caseine enters into decomposition, becomes a ferment, and induces in the sugar the lactic fermentation, by which lactic acid is formed. This goes on till so much free acid is formed as checks the fermentation; which is, however, immediately renewed if the acid be neutralized by soda or chalk. The coagulation of the caseine instantly follows the formation of lactic acid, that is, as soon as the alkaline reaction proper to milk is neutralized, and it becomes distinctly acid. This is why milk when sour is found coagulated. The other method of coagulating milk, by means of rennet, an infusion of the lining membrane of the calf's stomach, depends on the dissolved sanguigenous matter in the rennet acting as a ferment, and coagulating the caseine rather by an action of contact, as it converts starch into sugar, than by the formation of lactic acid, for the coagulation by rennet is complete before the milk becomes perceptibly acid. The whey or serum, separated from the curd, contains all the sugar, various salts, especially phosphate of potash, and a small quantity of an albuminous matter not fully studied.

Cheese is the coagulated caseine, more or less perfectly separated from the whey, and containing more or less of the oil or butter, according as made from cream, from milk as drawn, or from skimmed milk, when only traces of oil are left. The different flavours and qualities of cheese also depend in part on the pastures, in part on the mode of manufacture followed in different places.

The gastric juice has been mentioned as resembling the juice of muscle, in being acid from the acid phosphate of potash, $P\,O_5$, $K\,O$, $2\,H\,O$. Its power of dissolving fibrine, albumen, &c., depends on its being acid, and on the presence of a ferment, or dissolved sanguigenous matter in a state of decomposition. We can imitate this solvent action out of the body by placing flesh in a solution of 1 part of hydrochloric acid in 1000 of water at the temperature of the body. A small part of the flesh, or of some of the membranes about it, is first dissolved, and by degrees the whole is softened and converted into chyme, in which the greater part of the fibrine is dissolved, and the oil suspended, giving it a milky aspect.

The pancreatic juice seems to have a special action in rendering fats and oils soluble, or at least capable of being absorbed. It is said to set free the acids which are more soluble than the fats themselves. Its composition is not perfectly known, but it resembles that of the saliva, which, as we have seen, is supposed to be the special agent in the conversion of starch into sugar. The bile and the urine we have already described. The latter is a solution of urea with salts, and certain little known products of the changes in the body, which are commonly grouped together as the extractive matter, besides traces of krealine, kreatinine, a base differing from kreatine in containing 4 eqs. of water less, hippuric acid, and uric acid. In the extractive matter of cow's urine there have been found a substance, taurylic acid, very analogous to, and probably homologous with, carbolic acid, also carbolic acid itself, and two other acids, both volatile and resembling carbolic acid. Carbolic acid is $C_{12}\,H_6\,O_2$, taurylic acid $C_{14}\,H_8\,O_2$, damaluric acid is $C_{14}\,H_{12}\,O_4$, and damalic acid, $C_{26}\,H_{24}\,O_4$. All these are, like carbolic acid, which occurs in tar, products of incomplete oxidation or combustion, as tar itself is; and their occurrence is a strong illustration in favour of the view which regards the body as a furnace, in which the food is the fuel, the carbonic acid, water, and ammonia are the products of complete combustion, and the soot and ashes combined are represented by the solid and liquid excreta.

The juce of muscle or of flesh is remarkable for being either neutral or acid, although in close proximity to the alkaline blood with only a thin and permeable membrane between them; also for containing potash where blood contains soda; and for the occurrence of kreatine in much greater quantity than in the urine. It also contains albumen, coagulable by heat.

Uric acid has been much studied, in reference chiefly to its products when oxidized. It yields a very large number of remarkable derivatives, but for the present these, although interesting to the chemist, do not admit of any application so important as to render it necessary to detail them here. We have stated what the most practically important results of its more or less complete oxidation are, and in the human body it is only a trace of it which, from its sparing solubility, can enter the urine, the rest being converted into urea chiefly with allantoine and oxalic acid in one case, and in the more frequent one, carbonic acid and water, or carbonic acid and ammonia.

Now that we have traced the two great processes of organized life, the vegetable and animal, and have seen how they are mutually related, and how they balance, and are dependent on each other, we can easily understand the principles which ought to regulate agriculture. Vegetation is entirely a chemical process, and subject therefore to chemical laws, although the vital force which modifies their action be beyond our reach. The plants, as we have shown, nay, the single cell, can effect changes which are beyond the power of the chemist, with all his appliances of heat, electricity, and chemical agents. But still these are chemical changes. If, then, vegetation be a chemical process, the foundation of a rational agriculture must be laid in chemistry.

Now the food of plants consists of two parts, the atmospheric and the terrestrial. The former is but little in our power, and therefore it is to the latter, that is, to the soil, that we must direct our attention.

We have already specified those elements which the plant derives from the soil, and which are fortunately present in almost every soil. They are sulphur, in the form of gypsum, phosphates of lime and magnesia, oxide of iron, carbonate of lime, potash, soda, silicic acid, and in some cases iodides and fluorides. But some of the most essential, especially the phosphates, are often present in so small a proportion as not to suffice for the purposes of agriculture.

The first principle that may be laid down is this, that to render a soil generally fertile, all the mineral substances which are really essential to the crops must be present, and in sufficient quantity. The absence of one essential ingredient renders the others, however abundant, totally useless. No plant can grow in a soil destitute of phosphates, or of sulphates, or of alkalies. Some plants may grow, indeed, in the absence of one important mineral element, as, for example, of potash, but only on condition that some other analogous substance, such as soda in some cases, and lime in others, replaces it. There is no means of remedying the absence of phosphates or of sulphates, because nothing else can replace them.

The next point to be noticed is, that the crops raised for food in agriculture exhaust the soil of certain constituents to a far greater extent then any natural vegetation can do. In all cultivated plants, the edible part, whether seeds, roots, or leaves, has been brought to a most unnatural development, for the sake of the food they yield. Now, a great

part, and the most valuable part of that food consists of sanguigenous matter; and this, as we have already stated, cannot exist without a certain amount of phosphates of lime and magnesia. There is no such thing known as albumen, fibrine, or caseine, without phosphates. Now of all the useful constituents of the soil, the phosphates are the least abundant, so that in many cases a cultivated crop or two exhausts the soil of all its available phosphates. The same thing is true of any other constituent required for the cultivated crop and not very abundant in the soil.

The next principle is this, that if the soil by nature can produce an average cultivated crop, this degree of fertility can only be kept up in one way, that is, by restoring to the soil exactly what we have removed of mineral matter in the crop. For this is another difference between natural vegetation and cultivated crops, that in the latter case a great part of the crop, and that by far the richest in mineral matter, especially in phosphates, is exported or abstracted from the land. This is the principle on which the use of manures depends, for manures are nothing but different means of restoring to the soil what we have extracted from it.

The next remark we would make is, that common or farm-yard manure is evidently, from its origin, a most excellent form of manure; for, consisting of straw which is part of the crop, and of the solid and liquid excreta of animals fed on another part of it, the latter, as we have explained, represent the ashes of that part of the crop on which the animals have fed. But the ashes of any crop are exactly the mineral substances which it required and extracted from the soil, and in the very proportions required; so that the ashes of any crop must be the best manure for another crop of the same, provided the first crop was a good one.

Unfortunately only a part of the crop is consumed on the spot and converted into manure, and therefore the farmer must have recourse to other modes of restoring what has been removed, or of supplying what may be deficient.

The most natural quarter to which he can apply is the excreta of large town populations, both of men and of animals, which have consumed that part of his crops which was exported. But hitherto this invaluable manure has been, for the most part, carefully washed down into the sea, and thus lost for ever to the land, except in so far as a part of it is recovered, at a most disproportionate cost, in the shape of sea-ware, and still more of guano. For the town manure, conveyed into the sea, there promotes the growth of sea plants of all kinds; on these small animals feed; on these again fish; on these larger fish, and on these perhaps sea-fowl, whose excreta, after ages of exposure, are imported as the most precious manure, while at the same moment we are recklessly casting away the very best manure for our crops, being the ashes or mineral part of these crops, contained in the excreta of towns.

Another manure, imported also at great cost, and like guano very likely to fail us ere long, is bones or bone dust. As we have already said of guano, in speaking of uric acid, that its value chiefly depends on the phosphates it contains, so is the value of bones measured by the phosphates. But the animals whose bones we purchase feed on our crops, or on others similar to ours, and every particle of phosphate in them has been extracted from the soil in these crops. In bones, therefore, we are only restoring, as in guano, at great cost, a part of what we have removed from the soil. And what we gain in bones is lost to the countries exporting them.

In short, every particle of manure ought to be carefully preserved, whether on the farm, or in large cities where it is now thrown away to the value of millions annually. Experience and observation have taught this truth long ago to the Chinese, who do not allow the smallest portion of that to be wasted which has been extracted from the soil; and yet probably they have no theory, no science to guide them. When shall we, who can see why this ought to be done, act with the same common sense as the Chinese have long exhibited?

Besides the phosphates, for the sake of which farm-yard manure, guano, and bone-dust are chiefly valued, there are other substances which must be restored to the soil. Sulphate of lime or gypsum is fortunately present in considerable proportion in most soils, but where it is deficient one crop may exhaust the soil of it. It is easily obtained, being a common rock, or mineral.

The alkalies, although almost always present in considerable proportion, are yet apt to fail, because it is only that portion which is soluble that can avail the plant. Now the potash is all derived from felspar, but felspar is quite insoluble, and it is only in so far as it is decomposed that it yields its potash. This decomposition is effected by exposure to air, and one of the chief advantages of ploughing and fallow is to facilitate the decomposition of the disintegrated felspar, which is the chief ingredient of clay soils, and forms part of all soils. Some kinds of felspar are much more slowly decomposed than others, and but a small quantity of potash is available at any one time when such kinds prevail. One crop may entirely exhaust the available potash, and the most liberal supply of phosphates and sulphates will be of little use unless the supply of potash is at the same time attended to. Hence the use of nitre as a manure, or at least one use of it, and of carbonate or sulphate of potash.

But there is another expedient, which acts by increasing the supply of potash. This is the use of lime. The true action of lime is not, as has been supposed, to destroy the organic matter remaining in the soil, but to assist in the decomposition of felspar, which is rapidly decomposed when in contact with quicklime and water. This is the reason why lime is more advantageous in stiff clay soils, which are soils full of felspar.

The burning of very stiff clay also promotes the subsequent action of the weather on the felspar.

In grain crops and in grass much silica is required for the straw. Now silica abounds in all soils, except perhaps some chalky soils. But silica can only enter the plant in the form of alkaline silicates, and therefore the decomposition of felspar which directly supplies silicate of potash is doubly important.

A question naturally arises here. What is the value of organic matter in the soil or in manures. Now it is at once evident that it cannot be essential to the growth of plants as some have stated, that the soil, or the manure, or both, should contain organic matters, or mould, which is organic matter half decayed. For the first plants must have grown in a soil without a trace of mould. Moreover, direct experiment has often proved that plants will thrive in a purely mineral soil, provided it contain all the mineral elements essential to the growth of the plant. In that case the plant obtains from the air exclusively, through water, the carbonic acid and ammonia from which it obtains the whole of its carbon and nitrogen.

But fertile soils do contain mould and other organic matters, as do also most manures. Are these of no use? —far from it. The advantages are these. The slow and constant decay, or oxidation of the mould, &c., gives rise to a constant supply of carbonic acid in the soil itself. A part of this is conveyed to the plant dissolved in water along with the carbonic acid of the air. Another part of it being also dissolved by the water of the soil, dissolves out of the soil carbonates and phosphates of lime, magnesia, and iron, and is the chief means of introducing these into the juice of the plant. And in both ways, in supplying carbon and in supplying mineral matter, this carbonic acid derived from the carbonaceous matter in the soil greatly accelerates the growth of the plants, and very much shortens the period required for them to reach maturity. This, in our northern latitudes, is a matter of the last importance. But even in-

dependent of this advantage in point of time, it is probable that a very large part of the phosphates, &c. enters the plant by virtue of the carbonic acid formed in the soil.

The advantages derived from the presence of ammonia in the manure, or of substances yielding it either in the manure or in the soil, is analogous. The plant, if supplied with all the necessary mineral matter, will, indeed, obtain the ammonia, without which it cannot avail itself of these from the atmosphere. But the proportion of ammonia in the air is so small, that a long time in our climate is required for this, and any addition to the supply of ammonia has the effect of enabling the plant to attain maturity sooner.

While, therefore, the plant is not absolutely dependent on the presence of organic matter in the soil or in the manure, there is a decided advantage in its presence there.

Those who have employed a special manure, such as gypsum, or bone-dust, or guano, with good effect, are apt to make sure of the same result on repeating the application. But they are often completely disappointed; for the effect of the first application, say that of gypsum, to a soil deficient in it, has been to produce a heavy crop for which gypsum alone was wanting. But it must be remembered that the heavier the crop the more probable is it that the raising of it has exhausted the soil for the time of some one of the other essential elements, perhaps of the phosphates, in which case a second application of gypsum is dead loss.

Again, it often happens that when a special manure has been found very successful, the same farmer or his neighbour immediately applies it to the first field he has in hand, and perhaps derives no benefit whatever from it. The reason is, that a special manure can only do good where the soil is deficient in the substance supplied by that manure. Gypsum will produce astonishing effects on soils destitute of that substance, but containing all the other elements of fertility; but if added to a soil which, like very many, contains already far more gypsum than is required for many crops, it is merely thrown away.

The advantage of rotation of crops is very obvious. Both the phosphates, which are usually minutely diffused in rocks, and silicate of potash, so essential to grain crops, are only rendered gradually available by the gradual disintegration and decomposition of the felspar and other rocks. If, then, by one crop, one mineral element has been more exhausted than another, let us suppose this to be the case with the available or soluble silicate of potash, a grain crop having been raised, a repetition of the same crop would fail for want of a sufficient supply of this material. But a green crop, requiring hardly any, if any, silicate of potash, would find sufficient phosphates, gypsum, lime, and alkalies, and would allow the action of the weather to go on gradually rendering available a new supply of the silicate. This example will illustrate the principle. In the application of it, as of the other principles we have laid down, experience is the best guide, because there are still very many points, the theory or principle of which is quite obscure, but in regard to which the experienced and intelligent farmer acts with confidence. We cannot attempt to do more here than briefly to indicate the general principles of the application of chemistry to agriculture. The agricultural reader must be referred to works expressly written on this most important subject, such as those of Davy, Liebig, Johnston, and others.

We have now brought to a conclusion the brief and imperfect sketch which we proposed to give of organic chemistry. Our limited space made it absolutely necessary to condense and select the matter presented to the reader. Moreover, the science is in a state of transition, and of very rapid progress, which renders the task doubly difficult. We have endeavoured to lay down, as much as possible, leading principles, and to avoid mere details. We have not even dedicated a section to the destructive distillation of organic substances; but most of the products will be found alluded to under various heads, as those of the hydurets of the ethylic and acetic radicals, the volatile bases of the ethylic and benzoic series, acetic acid, &c. &c.

We can only trust that the difficulty of condensing so large and varied a multitude of facts and their relations into so small a space will excuse the many imperfections of the execution. (W. G.)

CHEMNITZ, or CHEMNITIUS, MARTIN (1522–1589), a famous Lutheran divine, the disciple of Melancthon, was born at Britzen in Brandenburg. He was employed in several important negotiations by the Lutheran princes, and was professor at Brunswick for 30 years. He wrote *Examen Concilii Tridentini*, Frankf. 1585, 4 vols. fol. and 4to; *A Treatise on Indulgences*, 8vo, Geneva, 1599; *Harmonia Evangelica*, 1600, and *Theologiæ Jesuitarum præcipua capita*, Rochelle, 1589.

CHEMNITZ, a town of Saxony, in the circle of Zwickau, stands in a beautiful and well-watered valley on the river Chemnitz, an affluent of the Mulde, 35 miles W.S.W. of Dresden. It is the first manufacturing town in Saxony. In point of population it ranks third, having (1849) 30,753 inhabitants, of whom 30,036 are Lutherans. The cotton goods, especially stockings, for which it is chiefly celebrated, and to which it owes its present prosperity, rival even those of England in quality and cheapness; one factory, the largest in Saxony, having 18,600 spindles. It is also celebrated for the making of spinning machinery. Chemnitz is a place of considerable trade, exporting a great part of its industrial products to the United States; and has manufactures of linens, bleaching and dye works, and tanneries. A railway connects it with Riesa, and thence with Leipzig, Dresden, Berlin, &c. The town is neat, clean, and well built, containing many fine edifices, among which may be mentioned the great church, town-house, and cloth-hall. Chemnitz was for four centuries a free imperial city.

CHEMOSH, or CHAMOSH, the name of a national god of the Moabites and of the Ammonites, whose worship was introduced among the Israelites by Solomon (1 Kings xi. 7). No etymology of the name which has been proposed, and no attempt which has been made to identify this god with others whose attributes are better known, are sufficiently plausible to deserve particular notice. Jerome's notion that Chemosh is the same as Baal Peor has no historical foundation; and the only theory which rests on any probability is that which assumes a resemblance between Chemosh and Arabian idolatry (cf. Beyer, *Addit. ad Selden.* p. 322; Pocock, *Specimen*, p. 307). Jewish tradition affirms that he was worshipped under the symbol of a black star; and Maimonides states that his worshippers went bareheaded, and abstained from the use of garments sewn with the needle. The black star, the connection with Arabian idolatry, and the fact that Chemosh is coupled with Moloch, favour the theory that he had some analogy with the planet Saturn.

CHEMOSIS, an inflammation of the eyes, causing the cornea to redden and swell, so as to impede vision.

CHENAUB, the ancient Acesines, a river of the Punjaub, which has its source in Lat. 32. 48., Long. 77. 27., in the British district of Lahoul, S. of Ladakh, or Middle Thibet. Its course is first north-westerly to Kishtawar, in the dominions of Gholab Singh, the present ruler of Cashmere; thence it proceeds S.W. to Riasi, where it leaves the mountains and enters the plain of the Punjaub. At Akmur, 50 miles below this point, it becomes navigable—at least for timber rafts. From Akmur it continues a south-west-

erly course for 250 miles to its confluence with the Jhelum or Behut, a little above the ferry of Trimo, in Lat. 31. 12., Long. 72. 12. About 50 miles below the confluence the Chenaub forms a junction with the Ravee, and subsequently with the Ghara, the united stream being thence designated the Punjnud (five rivers), a name which it bears to its fall into the Indus. The length of course of the Chenaub to its confluence with the Ghara measures about 765 miles.

CHENIER, Marie Joseph de, was the son of Louis Chenier, the author of *Recherches Historiques sur les Maures*, and *Révolutions de l'Empire Ottoman*. He was born in 1764 at Constantinople, where his father was French consul-general. At an early period of life he entered the army; but soon afterwards retired to Paris, and devoted himself to literary pursuits. His first production, a tragedy, was acted in 1786, but was unsuccessful. A few years afterwards, availing himself of the political feelings of the period, he produced the tragedies of *Charles IX.*, *La Mort de Calas*, and the republican tragedies of *Gracchus* and *Timoleon*, which were received with great applause by the then dominant party, and procured him a seat in the National Convention. His last dramatic production, founded on the accession of Cyrus to the throne of the Medes, failed more completely even than his original piece, and led him to confine himself to translations and imitations from the Greek and German. His lyric productions, published in 1797, consist chiefly of odes imitated from Ossian. His other poems are devoted to the celebration of political events.

He was chosen deputy to the national convention, and afterwards president; was twice elected a member of the council of Five Hundred; and in 1799 was appointed a member of the tribunate. Under the régime of the first consul he had more ample leisure for literary pursuits, and at his suggestion to the Institute, wrote a historical and critical account of the most celebrated productions in French literature from 1788 to 1808, which was afterwards published under the title *Tableau Historique de l'Etat et des Progrès de la Littérature Française depuis* 1789. Chenier spent the rest of his life in retirement at Paris, where he died in 1811.

CHEOPS, or, as his name is written by Diodorus, Chemmis or Chembes, one of the first of the Egyptian kings, who is said to have built the pyramid called by his name, the largest and most ancient of those in the district of El Ghizeh. He died after a long and bloody reign of fifty years, and was succeeded by his brother Chephren or Cephren, who built the second of the pyramids, and for fifty-six years rendered himself as odious to his subjects as Cheops had been. See Pyramid.

CHEPSTOW, a market-town and river-port of England, county of Monmouth, on the Wye, 2 miles from its junction with the Severn, and 135 miles from London. Pop. (1851) 4295. It occupies the slope of a hill on the western bank of the river, and is environed by scenery of much beauty and grandeur. The town is generally well built, and the streets are broad and clean. The church, originally the conventual chapel of a Benedictine priory, has been recently restored to its former dimensions by the rebuilding of the chancel and transepts. The western entrance and other parts are richly decorated, and the interior contains many interesting monuments. The castle, founded in the eleventh century by W. Fitz-Osborn Earl of Hereford, and almost wholly rebuilt in the thirteenth, is still a magnificent pile. It stands on the summit of a cliff, the base of which is washed by the Wye and occupies about three acres of ground. The river is crossed by a fine iron bridge of five arches, erected in 1816. It is 532 feet in length, 20 feet wide, and the middle arch has a span of 112 feet. The river is navigable for large vessels as far as the bridge; but barges of from 18 to 30 tons can ascend as far as Hereford. From the narrowness and depth of the channel the tide rises suddenly and to a great height, frequently above 50, and it is said even to 70 feet, forming a dangerous bore. There are no manufactures, but the export trade is considerable. During 1852, 401 vessels of 10,712 tons entered, and 113 vessels of 7491 tons cleared at the port; and in the end of that year 58 vessels of 2533 tons were registered as belonging to the port. The exports are bark, iron, coal, cider, and millstones, large quantities of timber to the royal dockyards, and of grain to Bristol.

CHER, a central department of France, embracing the eastern part of the ancient province of Berry and part of Bourbonnais; bounded N. by the department of Loiret, W. by Loire-et-Cher and Indre, S. by Allier, and E. by Nièvre and the Loire. It is situated between N. Lat. 46. 18. and 47. 41., and between E. Long. 1. 50. and 3. 6. Area 2840 square miles. The surface of the department in general is extremely level, the only elevated districts being on the northern and north-western frontiers, which are skirted by a range of low hills. The principal rivers which traverse it, besides the Cher and its tributaries, are the Grand Sauldre and Petit Sauldre on the N.; but the Loire and Allier, though not falling within the department, drain the eastern districts, and are available for navigation. The Cher itself becomes navigable when it receives the Arnon and Yevre, and the communications of the province are greatly facilitated by the canal Du Berry, which traverses it in all its length, and the lateral canal of the Loire which stretches from Digoin to Briare. With the exception of the *Sologne*, a sandy and sterile tract in the N.W., the soil is generally fertile, but varies considerably in different localities. The most productive region is that on the E., which belongs to the valley of the Loire; the central districts are tolerably fertile but marshy, being often flooded by the Cher; while in the S. and S.W. there is a considerable extent of dry and fertile land. The department contains a comparatively large extent of pasturage, which has given rise to a considerable trade in horses, cattle, sheep, and wool for the northern markets. Among the agricultural productions hemp holds the first place; but wine, fruits, chestnuts, truffles, &c., are important articles of traffic. Mines of iron and coal are wrought; and marble, millstones, lithographic stones, manganese, gypsum, and porcelain clay are procured in different parts. The smelting of iron-ore and the manufacture of steel and cutlery is carried on to a considerable extent. The other manufactures are of coarse cloth and canvas, cotton and woollen gauze, porcelain, and toys. Cher is comprised in the fifteenth military division, and its tribunals hold of the imperial court of Bourges. It is divided into three arrondissements, cognominal with their capitals, of which the population and subdivision are as follows:—

Arrondissement.	Cantons.	Communes.	Pop. 1851.
Bourges	10	111	120,149
Sancerre	8	75	77,585
St Amand	11	121	108,530
	29	307	306,261

CHERASCO, a town of Piedmont, province of Mondovia, near the junction of the Stura and the Tanaro, 30 miles S.E. of Turin. It is well built, surrounded by walls, and watered by a canal from the Stura. Its principal manufacture is silk, and it has some trade in corn and wine. In 1796 its citadel and other fortifications were dismantled. Pop. 9000.

CHERBOURG, a naval station, fortified town, and seaport of France, department of La Manche, on the northern shore of the peninsula of Cotentin, at the mouth of the small river Divette. It stands on a bay formed by Cape Levi on the E. and Cape La Hogue on the W., and is distant 75 miles from the Isle of Wight, 41 miles W. by N. from St Lo, and 212 in the same direction from Paris. N. Lat. 49. 38., W. Long. 1. 38. The town is small and unimportant in itself. The houses are built of stone and roofed with slate; but the streets are narrow and dirty, and the only public buildings of any interest or importance are the

tower (a remnant of the old fortifications), the church close beside it, the Chapelle de Nôtre Dame du Vœu, the Hôtel de Ville, and the theatre. Cherbourg derives its chief importance from its naval and commercial harbours, which are distant from each other about half a mile. The former is cut out of the rock, and is capable of accommodating fifty men-of-war of the largest size. The depth of water at full tide is 50 feet, at low tide 25 feet. Connected with the harbour are the dry docks, the yards where the largest ships in the French navy are constructed, the magazines, rope walks, and the various workshops requisite for a naval arsenal of the first class. The works are carefully guarded on every side by redoubts and fortifications, and are commanded by the batteries on the overhanging hills so completely that the harbour of Cherbourg may fairly be pronounced impregnable. The commercial harbour at the mouth of the Divette communicates with the sea by a canal 650 feet in length and 54 in width. It consists of two parts, an outer harbour 262 yards long by 218 wide, and a basin 446 yards long and 138 wide, in which the depth of water is 19 feet at low tide. Outside these harbours is the triangular bay which forms the roads of Cherbourg. This bay is admirably sheltered by the land on every side but the north. To protect the shipping from the violence of the north winds the great *digue* or breakwater has been constructed. This immense work is 2½ miles in length; its breadth at its base 262 feet, and at its summit 101 feet. Its foundation was formed by massy wooden frames, which were sunk and filled with stones; and it is now protected from the waves by a parallel line of large blocks weighing each 44 tons. (For a detailed account of the breakwater of Cherbourg, see article BREAKWATER.) The trade of Cherbourg is considerable, and consists principally of cotton yarn, refined sugar, leather, and chemical products. A lace factory in the town gives employment to nearly 400 women. The principal articles of export, besides those already mentioned, are farm and dairy produce. The imports consist principally of colonial produce, and of coal, iron, and other articles required for the arsenal. Cherbourg possesses tribunals of first instance, of commerce, and of naval affairs, a departmental college, an academical society, public and naval libraries, and several museums. Pop. 24,212.

CHERIBON, or SHERIBON, a seaport-town on the N. coast of Java, capital of a district of the same name, and the residence of a Dutch governor, is situated at the head of a wide bay 125 miles E.S.E. of Batavia. Lat. 6. 48. S., Long. 108. 37. E. It was formerly a place of considerable importance, but in the early part of the present century a pestilential disorder carried off the greater part of its inhabitants. Though it has never fully recovered from the effects of this disaster, it has still a considerable trade. The town and harbour are defended by a fort. The district is very fertile, and produces the finest coffee raised in the island. Timber, cotton, indigo, sugar, and pepper, are exported in large quantities.

CHERRY. See HORTICULTURE and PLANTING.

CHERSO, an island of Illyria, government of Trieste, in the gulf of Quarnero, connected with the island of Osero by a bridge. It is about 35 miles in length, with an area of 105 square miles, and about 14,000 inhabitants. It is traversed by a range of mountains, forming natural terraces, on which vines and olive trees flourish. The other parts of the island are covered with bushes of laurel and mastic, but scarcely any large trees. There is a scarcity of springs, and the houses are generally furnished with cisterns for rain water. The capital of the same name, on the western side of the island, has a cathedral, several churches and monasteries, and 3500 inhabitants.

CHERSON. See KHERSON.

CHERSONESUS, or CHERRONESUS (from χέρσος or χέρρος, *land*, and νῆσος, *island*), in ancient geography signified *peninsula*. Thence Chersonesus Thracica, Chersonesus Taurica or Scythica, Chersonesus Cimbrica, respectively applied to the peninsula of the Dardanelles, the Crimea, and Jutland.

CHERTSEY (in Anglo-Saxon, *Ceortes Eye* or *Ceort's Island*), a market-town on the S. bank of the Thames, in the hundred of Godley, Surrey, 20 miles W.S.W. from London. It is connected with Middlesex by a bridge of seven arches, erected in 1785. The parish church, rebuilt in 1808, contains a monument to Charles James Fox, who resided at St Anne's Hill in the vicinity. It has also several dissenting chapels and schools, the principal of which is erected on a foundation yielding L.400 per annum, and gives education to 130 children of both sexes, of whom 60 belong to Chertsey. It is the seat of a county court, and contains both a literary and an agricultural institute. Its principal trade is in farm produce for the London markets; but bricks are also made there to a considerable extent. It communicates directly with London by a branch of the South-Western railway. During the heptarchy Chertsey was the residence of the South Saxon kings. Near it was a famous Benedictine abbey, rebuilt by Edgar in 963, but destroyed at the Reformation. No remains of the abbey are now visible. Pop. (1851) 2743.

CHERUB (plural, CHERUBIM), an angelic spirit, which in the celestial hierarchy is placed next to the seraphim. The term *cherub*, in Hebrew, is sometimes taken for a calf or ox. Ezekiel represents the face of the cherub as synonymous with the face of an ox. The word *cherub* in Syriac and Chaldee signifies to *till* or *plough*, which is the proper work of oxen. Cherub also signifies *strong* and *powerful*. Grotius says that the figures of the cherubim resembled that of a calf; Bochart likewise thinks that the cherubim had more likeness to the figure of an ox than to anything besides; Spencer is of the same opinion; and St John, in the Revelation, calls cherubim *beasts*. Josephus says that the cherubim were extraordinary creatures, of a figure unknown to mankind. Clemens Alexandrinus believes that the Egyptians imitated the cherubim of the Hebrews in the representations of their sphinxes and other hieroglyphical animals. Indeed all the descriptions which the Scripture gives us of cherubim differ from one another, but agree in representing them by a figure composed of various creatures, as a man, an ox, an eagle, and a lion. Such were the cherubim described by Ezekiel. The seraphim described by Isaiah had the figure of a man with six wings, two of which covered their faces, and two more covered their feet, while with the two others they flew. The cherubim which Solomon placed in the temple at Jerusalem are supposed to have been nearly of the same form. But those which St John describes in the Revelation were all eyes before and behind, and had each six wings. The first was in the form of a lion, the second in that of a calf, the third in that of a man, and the fourth in that of an eagle. The figure of the cherubim was not always uniform, since they are variously described as having the shapes of men, eagles, oxen, lions, and sometimes of all these put together. Moses likewise calls the symbolical or hieroglyphical representations which were embroidered on the veils of the tabernacle cherubim of costly work. Such were the symbolical figures which the Egyptians placed at the gates of their temples, and the images of the generality of their gods, which were commonly statues composed of the figures of men and animals combined on metaphorical or rather on allegorical principles.

CHERUBINI, MARIA LUIGI CARLO ZENOBI SALVADOR, was born at Florence 8th Sept. 1760, and died at Paris 15th March 1842. On the 19th of that month the funeral service was performed for him at the church of St Roche, and the requiem which he had composed for himself was sung. He received his earlier musical education at Florence, under the Felici, and Bizarri and Castrucci. In

1778 he was placed under Sarti at Bologna, with whom he studied four years, and to whose excellent method he owed his profound knowledge of counterpoint and fugue, and his taste and skill in the ideal style of composition. In 1784 he visited London, and brought out there two operas; and again in 1787, when he wrote some pieces for an opera by Cimarosa, and for one by Paesiello, which were produced at the King's Theatre. In 1788 he returned to Paris, where his new and superior style of music was at first not understood by the French; but in 1791 his *Lodoiska* at once wrought a revolution in the French school of composition, and the original genius of Cherubini was acknowledged and appreciated. His *Elisa* and his *Médée* added to his fame. Notwithstanding his superior talents and high European reputation, his position as an inspector of the conservatory at Paris was unworthy of him. Napoleon neglected him shamefully, and from a very mean motive—personal pique. At a private party, when Bonaparte was only general of the French army, he and Cherubini happened to make two of the company. The conversation turning upon music, Bonaparte contradicted Cherubini rudely, and attempted to dogmatise on the subject. Cherubini coolly said to him, "Citizen Bonaparte, in the art of war your knowledge is pre-eminent; but you should leave music to those who understand it." Napoleon never forgot or forgave this well-merited reproof; and, when master of France, could never be induced by those about him to do justice to Cherubini. In 1805 Cherubini went to Vienna, where he produced his *Faniska* with the greatest applause. Soon afterwards he composed a mass in F. for three voices, in a style quite new and admirable. After the restoration of the Bourbons he composed a number of masses and motets for the Royal Chapel, all of such excellence that even Beethoven, so chary of praise, declared Cherubini to be the greatest living composer of sacred music. Besides a great many operas and church compositions, &c., Cherubini produced some admirable instrumental music. His quartets for violins, viola, and violoncello have lately been heard and admired in London. His last work, published in 1835, was his *Cours de Contrepoint et de Fugue*, a summary of the lessons on strict composition which he had given for several years at the Paris conservatory of music. The writer of this article was personally acquainted with Cherubini at Paris in 1819, and through him received free access to the valuable library of the conservatory. (G. F. G.)

CHERUSCI, a celebrated tribe of ancient Germany, whose country was bounded on the E. by the Albis or Elbe, and on the W. by the Visurgis or Weser. Their history up to the time of Cæsar is comparatively obscure, but they seem to have been on the whole inclined to cultivate the friendship of the Roman people. In the time of Augustus, however, the cruelty and misgovernment of Varus, the Roman commander in these regions, drove the Cherusci into open rebellion. Under their leader Arminius they annihilated the army sent against them. This disaster preyed for years upon the mind of Augustus, who often started up at night out of his sleep exclaiming, "Quinctilius Varus, restore me my legions." All subsequent attempts of the Romans to reduce them again to subjection completely failed. In the course of their repeated wars with their neighbours, however, the Cherusci gradually lost the power and influence they once enjoyed. In the fourth century the Cherusci once more appear in history as members of the Frankish confederation.

CHESAPEAKE BAY, the largest bay in the United States of North America. Its entrance is in the state of Virginia, between Capes Charles and Henry, about 12 miles apart, and it extends inland 270 miles, dividing Maryland into two unequal parts. It is from 7 to 20 miles broad, and generally 9 fathoms deep. This great bay furnishes many fine harbours and a safe and convenient navigation. The Susquehanna, at its northern termination, and the Potomac and James on its west side, are the largest rivers that flow into it. The fisheries of the bay are of immense value to the inhabitants of its shores.

CHESELDEN, WILLIAM, an eminent surgeon and anatomist, was born at Barrow-on-the-Hill, Leicestershire, in 1688. He studied surgery under Mr Ferne of St Thomas's Hospital, whom he afterwards succeeded as head surgeon of that institution. Having devoted a large share of attention to the subject of lithotomy, he published a work on the high *Operation for the Stone;* and his skill as an operator in this department soon placed him at the head of his profession. He added greatly to his reputation by a successful couching operation performed on a youth of fourteen who had been blind from infancy. The details of the operation are given in the *Philosophical Transactions of the Royal Society* for 1828, and are valuable in a metaphysical point of view, as throwing considerable light on the doctrine of perception. Cheselden published also a *Text-Book of Anatomy*, a work on *Osteography* or *Anatomy of the Bones*, and a series of twenty-one plates, with descriptive letter-press appended to Gataker's Translation of Le Dran's *Operations of Surgery*. In 1737, disheartened by the frequent attacks to which his success exposed him, he retired from practice, and accepted the office of honorary surgeon to Chelsea Hospital. He died suddenly at Bath, of an attack of apoplexy, April 11, 1752.

CHESHAM, a market-town in the valley of the Chess, a tributary of the Colne, hundred of Burnham, Buckinghamshire, 26 miles N.W. from London. It contains an ancient cruciform parish church, and two dissenting places of worship, several schools, and an alms-house erected on an ancient foundation. It is the seat of a county court, and has a considerable manufacture of boots and shoes, straw-plait, and wooden ware, for the London markets. There are several paper-mills and a small silk-mill in the vicinity. Pop. (1851) 2496.

CHESHIRE, a maritime county in the N.W. of England, is bounded on the N. by Lancashire, on the N.E. by Yorkshire, on the E. by Derby and Stafford shires, on the S. by Shropshire and Denbighshire, on the W. by Flintshire, and on the N.W. by the Irish sea. Its greatest length from E. to W. is about 48 miles, and its greatest breadth from S. to N. about 33 miles. It possesses an area of 1105 square miles, or 707,075 acres, and is thus the eighteenth largest county in England.

The principal geological formation is the new red sandstone, which extends over the whole of the central and western parts of the county. The coal measures occur in the north-eastern district, which is within the boundary of what is usually called the great Lancashire coal-field. This county, in addition to coal, yields small quantities of both copper and lead; but its principal mineral product is salt, of which enormous quantities are raised from the mines, which are principally situated near Northwich. These mines when lighted up (as they are sometimes on special occasions) present a most singular and beautiful spectacle, almost realizing the ideal of a fairy palace, sparkling with crystal and gems. Besides the rock-salt from the mines, large quantities are manufactured from the brine springs in the neighbourhood. It is said that nearly 500,000 tons of rock and manufactured salt are exported annually.

The general aspect of the county is flat; but there are some hills on the east, on the Derbyshire and Yorkshire boundary; while for a few miles to the N.W. of Macclesfield, and also on the southern boundary of the county, the surface is somewhat broken and undulating. There is also a low range of hills near Chester. The greater part of the county is richly wooded, and the surface is diversified by numerous pools of water and small lakes, called meres. There are some extensive tracts of peat, and much of the

Cheshire.

county is very wet, having the surface covered with rushes and other subaquatic plants.

Cheshire possesses a number of streams and rivers, some of which are of considerable importance. The principal rivers are:—the Dee, which, rising in the Welsh mountains, forms the county boundary, separating it from Denbigh and Flint on the S.W., and, after traversing a portion of the county, forms a wide navigable estuary near Chester, and falls into the Irish sea; the Mersey, which rises in the Yorkshire hills, forms the county boundary along the whole of its northern edge, and after flowing in a nearly due W. course, and forming the important ports of Liverpool and Birkenhead, also falls into the Irish sea; the Weaver, which, after having received the Dane which rises in Derbyshire, flows in a N.W. course, and empties itself into the Mersey. By means of locks, this latter stream has been rendered navigable for vessels of 100 tons burthen as far as Northwich, which is ten miles from its mouth, and thus furnishes a ready means of transport for the produce of the salt mines.

The principal lakes are Combermere and Delamere, both of which have given titles to noble familes. The royal forest of Delamere is also within this county.

The climate is temperate, and somewhat moist, and the soil is for the most part fertile; but owing to the general flatness of the surface, much of the land is very wet and greatly in want of draining. Dairy farming is the description of agriculture principally pursued; the greater portion of the land is therefore in pasture. On some estates a good deal has been done in draining, and in afterwards applying bone-manure to the surface with the best effect; but, generally speaking, agriculture is in a very low condition, and the general management of the land discreditable alike to landlords and tenants. The principal agricultural produce is cheese, of which an immense quantity is annually produced; and it is somewhat singular that the best quality is generally obtained from the poorest lands. It is said that not less than 14,000 tons of Cheshire cheese are annually sold in the London market alone. Seldom more than one-fourth of a dairy farm is cultivated, the other three-fourths being in permanent pasture. The crops usually raised on the cultivated lands are beans, potatoes, wheat, turnips, and oats. The farms are seldom large, and the farmers are a hard-working, hard-living race of men. It is calculated that not more than one-seventeenth part of the whole county is waste land; but of the remainder a large portion is in natural pasture.

This county is everywhere intersected by railways and canals or navigable streams, and thus possesses means of communication second to no county in England. The celebrated Bridgewater canals which traverse it rank among the finest and most useful works of the kind in any country, and have been the means of developing the resources and industry of the county to a surprising extent.

The principal towns are Chester, Birkenhead, Macclesfield, Stockport, and Congleton. At Stockport the manufacture of cotton and hats is carried on on a large scale, while Macclesfield and Congleton are chief seats of the silk manufacture. A large trade is also carried on in bricks and draining pipes, for making which the clay soils of the county are well suited.

Cheshire returned but two members to parliament from 1543 to the period of the Reform act. Since that time it has returned ten, viz., two for the southern, and two for the northern division of the county; and two each for the city of Chester and boroughs of Macclesfield and Stockport. The constituency of the northern division in 1852 was 7494. The political influence is chiefly in the hands of Lord Stanley of Alderley, the Egertons of Oulton Park, the Earl of Stamford and Warrington, and the Leighs of High Leigh. The constituency of the southern division in 1852 was 8117. The political influence is chiefly in the hands of the Marquis of Westminster, the Marquis of Cholmondeley, and the Egertons of Oulton. The average gross rental of the county is estimated at 28s. 7d. per acre. The annual value of real property paying income-tax is L.2,062,283; and the amount of property assessed for the relief of the poor is L.1,593,157.

Chesne.

The population of the county by the last census was 455,725, giving an average of 412 persons to a square mile, or 1·6 acres to each person. Of the total number 222,386 were males, and 233,339 females. The number of inhabited houses, including the represented city and boroughs, was 85,260; uninhabited, 4341; and building, 845;—giving an average of 77 inhabited houses to a square mile, and 5·3 persons to each house. The following table gives the census returns for the last 50 years:—

YEARS.						Increase of population per cent. in fifty years.
1801.	1811.	1821.	1831.	1841.	1851.	
192,305	227,031	270,098	334,391	395,660	455,725	137

It is calculated that more than twenty-three per cent. of the population live by trade, manufactures, &c., nearly seven per cent. by agriculture; about one-eight of the whole population are in the condition of servants, labourers, &c.; upwards of three thousand follow professions; while eight thousand persons possess independent means.

Cheshire in 1844 occupied the nineteenth place in a table showing the ignorance of the kingdom, as illustrated by the numbers of men who signed the marriage registers with a mark—not being able to write. Its proportion above the average of ignorance was thus 0·4. In 1842–7 it occupied the thirty-fifth lowest position, in a table showing the crime of the kingdom, as illustrated by the criminal commitments of Wales to assizes and quarter sessions; its proportion above the average being 24·3. In a similar table showing the commitments for more serious offences against the person, and malicious offences against property, it occupied the forty-third or second worst place (Wales being taken in two divisions, and Yorkshire in three); the proportion above the average being 71·2. In a similar table showing the amount of bastardy in 1842, it occupied the fifth worst position; its proportion above the average being 40·3. In a similar table of pauperism for 1844, it occupied the fourth best place, its proportion under the average being 30·0.

CHESNE, André du, surnamed the Father of French history, was born at Ile-Bouchard in Touraine in the year 1584. He began his studies at Loudun, and finished them at Paris under the celebrated Julius Cæsar Boulanger. His favourite pursuits were geography and history, in which he made such rapid progress that at the age of eighteen he dedicated to his teacher his first book, entitled *Egregiarum seu electarum lectionum et antiquitatum liber*. He next translated into French the Satires of Juvenal with notes and illustrations. By these and other works he gained for himself the favour and protection of some of the leading men of his country. Cardinal Richelieu in particular, who was born in the same neighbourhood as Du Chesne, testified his esteem for him in a variety of ways. In 1608 Du Chesne married. The only fruit of his marriage was a son, who cultivated history with as much zeal, though not with the same success, as his father. In 1640 he was run over by a carriage and killed, while on his way from Paris to his country seat at Verrière.

His principal works are—*Les antiquites et recherches des villes, chateaux, &c., de toute la France; Histoire d'Angleterre, d'Ecosse, et d'Irlande; Histoire des Rois, Ducs, et Comtes de Bourgogne*, 1634, 2 vols. fol.; *Historiæ Normanorum Scriptores Antiqui*, 1619, fol.; *Historiæ Francorum Scriptores*, 5 vols. fol., 1636–49. Besides these Du Chesne published a great number of genealogical histories of illustrious French families; of which the best is said to be that of the house of Montmorency. His Lives of the French Cardinals and of the Saints of France have been published by the Bollandists, Mabillon, and others.

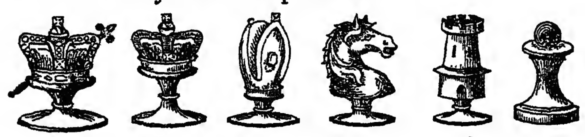
CHESS,

Chess.

A VERY ancient and ingenious game, performed by two persons, with thirty-two pieces of wood or ivory called men, on a square board divided into sixty-four equal squares, usually stained black and white alternately. Each player has sixteen men, those of the one player being usually either black or red, and those of the other white, in order to distinguish them.

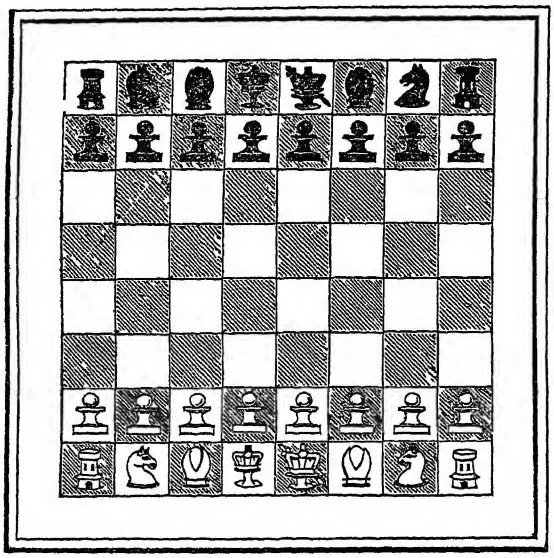
Of the sixteen men on either side, eight are called *Pieces*, and eight *Pawns*. The eight pieces consist of a *King*, a *Queen*, two *Castles* or *Rooks*, two *Bishops*, and two *Knights*.

The men may be thus represented:



King. Queen. Bishop. Knight. Rook. Pawn.

The following diagram represents the board, with the men as placed on it when a game is to be played:



Each row of squares running from the bottom to the top of the board is called a *file*. Each row of squares running from side to side is called a *rank* or *line*. Four lines of squares belong to the black men, and four to the white. A row of squares running obliquely from one side of the board to the other is called a *diagonal*. A diagonal consists either wholly of black squares or wholly of white.

The board must be so placed between the two players, that each of them may have a white corner at his right hand. This manner of placing the board, though not essential to the game, is invariably observed.

The eight pieces are ranked up on the first line of the board next each player, according to the following distribution: The two rooks occupy the two lateral squares which form the angles of the board; the two knights occupy the squares next to the rooks; the two bishops are next to the knights; and the king and queen occupy each of them one of the two centre squares of the line, *the queen being upon a square of her own colour*.[1] It follows, that when the pieces are properly placed, the white king will be found occupying the square to the right, and the black king the square to the left, each of his respective queen.

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The pieces on the king's side of the line are called the king's bishop, the king's knight, and the king's rook. Those on the queen's side are called the queen's bishop, the queen's knight, and the queen's rook.

The eight pawns are ranked up on the second line of squares, and take their denomination from the several pieces before which they are respectively placed. Thus, the pawn in the square in front of the king is called the king's pawn, the one in front of the queen is called the queen's pawn, and so on with the rest, as king's bishop's pawn, queen's bishop's pawn, king's knight's pawn, queen's knight's pawn, king's rook's pawn, queen's rook's pawn.

In like manner the *squares* of the board take their denomination from the several pieces. The square occupied by the king at the beginning of the game is called the king's square, the one occupied by the queen the queen's square, and so on. The square immediately in front of the king's square is called the king's second square, the one in front of his second square is his third square, and the one in front of his third is his fourth square. The eight pieces of each of the two players have thus their respective squares, and second, third, and fourth squares, exhausting among them the whole sixty-four squares of the board. For the sake of clearness, however, it is sometimes convenient to carry the numeration into the adverse side of the board. Thus, the square in front of the king's fourth is sometimes called his *fifth* square, and so on to the eighth square, which of course is the adverse king's square.

The *pawn* moves straight forward on its own file, one square at a time, except at first setting off, when, in the option of the player, it may move two squares at once. For example, if it be proposed to move the king's pawn, which stands on its own square, being the king's second square, it may be moved either to the king's third or to his fourth square, but afterwards it can be moved forward only one square at a time.

The pawn, although it moves straight forward, attacks and captures its adversaries diagonally or obliquely. Thus suppose a white pawn to be on its king's fourth square, and a black pawn to be also on its king's fourth square, the one pawn cannot attack and take the other; on the contrary, the one stops the other in its progress onward. But suppose the black pawn to be on its queen's fourth square, then the white pawn can attack and take the black pawn. This is done by removing the black pawn from the board, and advancing the white pawn obliquely, and placing it on the square left vacant by the removal of the black pawn; that is to say, the white pawn is removed from its own king's fourth square, and placed on the adverse queen's fourth square. It still retains the name of the king's pawn. When this pawn has again occasion to move, it goes straight forward on its new file, unless it should avail itself of another opportunity of making a capture, when it again passes obliquely to a square in another file. When a pawn has arrived at the eighth or last square of the file, it loses its character of a pawn, and may be converted into any piece.

[1] Sequitur regina colorem.

except the king, that the player chooses. He is said to *queen* his pawn when he carries it up to the ultimate square.

The *knight* moves in a manner somewhat difficult to be described. It leaps obliquely over an adjoining square to one of the next squares, having a colour different from the colour of the square which it leaves. For example, let the king's knight be on its own square; it may be moved to the king's second square, to the king's bishop's third square, or to the king's rook's third square; or, supposing it to be standing on its king's fourth square, it may be moved to the king's knight's third square, or to the king's bishop's second square, or to the queen's second square, or to the queen's bishop's third square, or to the adverse queen's bishop's fourth square, or to the adverse queen's third square, or to the adverse king's bishop's third square. On turning to the diagram, the reader will be able easily to follow and understand this description of the knight's move. It is the only piece that is allowed to move *over* another.

The *bishop* moves diagonally forward or backward any number of squares at a time, provided the course be open, by being free of other men. A bishop must necessarily continue to move over squares of a colour the same with that on which it was originally placed. The one bishop always moves upon black diagonals, the other upon white.

The *rook* or *castle* moves straight forward, straight backward, or straight across, any number of squares at a time, provided the intermediate squares be unoccupied by other men; that is to say, a rook moves either upon *files* or upon *lines*.

The *queen* can move either like a rook or like a bishop.

The *king* can move one square only at a time, and that backwards, or forwards, or sidewise, or obliquely. He can also, once in the course of a game, make the singular move called *castling*. Castling usually takes place for the double purpose of removing the king into a more secure situation, and of bringing a castle more into play; and it may be done either on the king's side of the board or on the queen's. When it is done on the king's side, the king and his rook are simultaneously lifted from their respective squares, and placed, the king on his knight's square, the rook on the bishop's. When it is done on the queen's side, the king and the queen's rook are lifted from their squares, and placed, the king on the queen's bishop's square, the rook on the queen's.

The adverse kings cannot approach each other so as to be on conterminous squares. One square at least must intervene between them. The reason of this obviously is, that if one king were to come to a square adjoining that occupied by the other, he would be within the range of his attack.[1]

All the *pieces* (it is otherwise with the pawns) *take* in the direction in which they move. The manner of taking is to place the attacking piece on the square of the piece or pawn captured, the captured piece being removed from the board. A player, however, is not obliged to take a piece or pawn under attack and subject to capture. He may take it or not as he thinks fit.

The principal technical terms made use of in chess-playing will now be explained.

CASTLING.—This has been treated of already.

CHECK.—When an attack is made upon a king by any piece or pawn, he is said to be *checked*. This will be best understood from a practical illustration. Let your king be upon his own square, and let your adversary play his queen to his king's second square. If there be no piece or pawn on any of the squares which separate the king and queen, your king is directly exposed to the action of the queen, and is said to be *checked* by her. The check is to be got the better of by capturing the queen, if she happen to be within the range of any of your men, or by interposing some piece between your king and the attacking queen, or by moving the king to another square beyond the scope of her action.

CHECK BY DISCOVERY, or DISCOVERED CHECK.—This takes place when the removal of an interposed piece opens up a check from another piece. For example, let your king be on his own square, and the adverse queen on her king's second square, and let all the intermediate squares of the file be vacant, except the adverse king's third, upon which third square his queen's bishop happens to be placed. It is evident that the interposition of this bishop covers or protects your king from the action of his queen. But if your adversary should play away his bishop from his king's third square, your king would be instantly exposed to the action of the queen; and this is called *check by discovery*, or *discovered check*.

CHECK-MATE.—The object of the game is to give check-mate. When the king is so assaulted and beset that he cannot move out of check, nor take the piece or pawn that checks him, nor interpose any man for his protection, he is *check-mated;* and the party giving the check-mate wins the game.

STALE-MATE.—When the king is *not* in check, but yet is so circumstanced that he cannot move without going into check, and when, at the same time, all his men are either off the board, or in such a situation that none of them can move, he is said to be *stale-mated*. When stale-mate is given, the game is held to be drawn.

DRAWN GAME.—A game is said to be drawn, when neither party can give check-mate to the other. This happens, 1*st*, where perpetual check is given to the adverse king without the possibility of his averting it; 2*dly*, where the force left on the board is not sufficient to give check-mate; 3*dly*, where the force left being sufficient, the party possessing it is unacquainted with the method of giving check-mate in fifty moves, as required by the laws;[2] 4*thly*, where both parties stand on the defensive, neither of them being inclined to hazard an attack; and, 5*thly*, where one of the kings is stale-mated.

DOUBLED PAWN.—A pawn is said to be doubled, when, by having made a capture, it has passed from its own file to another file, already possessing a pawn on some other square.

PASSED PAWN.—A pawn is said to be passed, when there is no adverse pawn to oppose its march to queen, nor any adverse pawns on the two adjacent files; or, if there be hostile pawns on the adjacent files, when it has already passed them.

EN PASSANT.—In explaining the pawn's moves, it was stated, that at first setting off a pawn may be played two squares at once. This statement, however, is subject to qualification. Suppose your king's pawn to be upon its own square, and your adversary to have a pawn on your queen's fourth square, it is evident that you cannot play your king's pawn two squares without passing over a square exposed to the action of your adversary's pawn, the square so exposed being your king's third. Now, your adversary is entitled to arrest, as it were, your pawn in its passage over that square, and to capture it. *You* play your pawn from king's second to king's fourth; *he*

[1] In *Il Giuoco Incomparabile Degli Scacchi*, this reason is given:—" *Non bene conveniunt, nec in una sede morantur Majestas, et Amor.*

[2] See Art. xxii. of the Laws.

lifts it up, and moves his own pawn obliquely from your queen's fourth square to your king's third; and this operation is called taking your pawn *en passant.* He may take it, however, or let it alone, just as he likes.

En Prise.—When a piece or pawn is liable to be taken by another, it is said to be *en prise* of that other.

Minor Pieces.—Knights and bishops are called minor pieces, because they are of less value than the other pieces.

To Gain the Exchange or Difference.—When a player wins his adversary's rook, in exchange for his own knight or bishop, he is said *to gain the exchange.* In the Edinburgh Chess Club the expression used is, to *gain the difference.*

Gambit.—This is a peculiar opening of a game, where a player sacrifices a pawn or piece, in order to remove the adverse king's pawn from its fourth square, and thus be the better enabled to make an attack. Examples of it will be given hereafter, from which its nature will be much more easily understood than from any general description or definition.

Relative Value of the Pieces.

King.—As the king can never be taken, and as the very existence of the game depends upon him, he can, of course, have no relative value. But his power both of attack and defence being considerable, he should be brought forward to action as soon as the more powerful pieces, particularly the queen, are off the board.

Queen.—The queen is the most powerful of all the pieces, being worth two rooks and a pawn. Towards the end of a game, when the board has become more open for the action of the rooks, her relative value is lessened a little, and she is then worth two rooks only. Properly speaking, however, this arises not from any diminution of power upon her part, but from an increase of power on the part of the rooks.

Rook.—The rook is next in value to the queen, and is reckoned equal to a minor piece and two pawns, or to five pawns. A rook increases in power of action as the board gets clear of other pieces and pawns; and it is the only piece except the queen that can give check-mate with no other assistance than its own king.

Bishop.—The bishop is worth more than three pawns, and less than four. It is reckoned of equal value with a knight. At the beginning of a game the king's bishop is more serviceable for attack than the queen's. Two bishops, with the assistance of the king, can give check-mate.

Knight.—The knight, like the bishop, is worth more than three pawns, but less than four. It is distinguished by these two peculiarities: *1st,* It is never *en prise* of the piece that it attacks, except when it attacks another knight; and, *2dly,* the piece attacked cannot get the better of the attack by the interposition of a third piece, but must itself move to another square. Two knights, with the assistance of the king, *cannot* give check-mate. A knight and bishop *can.*

It is usual with writers on chess to give a great many *general* instructions as to the mode of opening and conducting a game; but as such general instructions are of little or no practical use, we shall withhold them entirely, in order to make room for a few examples of the game, by going over which with the aid of a board and men, the reader will become much better acquainted with chess-playing, than if he were to peruse whole volumes of general observations.

The following are the laws usually observed in this country in playing the game:

1. The chess-board must be placed in such a manner that each player may have a white square corner on his right hand. If the board be improperly placed, and the mistake not discovered till after four moves have been played on each side, it must remain as it is till the end of the game.

2. If the pieces or pawns be improperly placed, the player who first perceives it may insist on the mistake's being rectified, provided four moves on each side have not been played.

3. If a player begin a game without having all his pieces, and if he do not perceive it until the fourth move has been played, he must finish the game without the pieces or pawns which he has forgotten.

4. When the game is played *even,* the players must draw lots for the first move; after the *first* game the move belongs alternately to each player.[1]

5. The player who gives odds has always the advantage of the move; except, of course, in those games where the move is also given to the inferior player; such, for example, as the *pawn and move,* &c.

6. When a player has *touched* a piece he must *move* it. *N. B.*—If a piece be not placed exactly in the centre of its square, or if it should fall, the player must say *J'adoube* in placing it properly, else his adversary may compel him to play it.

7. As long as a player holds a piece, he is at liberty to play it where he chooses; but when he has *let it go,* he cannot recal his move.

8. If a player *touch* one of his adversary's pieces without saying *J'adoube,* he may be compelled to take it; if the piece cannot be taken, the player must move his king; and if neither the piece nor the king can be moved, no penalty shall be inflicted.

9. If a player should, by mistake, play one of his adversary's pieces instead of his own, his adversary may compel him either to take it, if it can be taken, to replace it where it was, or to let it remain where he played it.

10. If a player take one of his adversary's pieces with a piece that cannot take it without a false move, his adversary may compel him either to take it with any other piece, or to play the piece which he has touched.

11. If a player take one of his pieces with another of his own, his adversary may oblige him to play either of the two pieces.

12. If a player make a false move, his adversary may oblige him to let the piece remain where he played it; or to play it to some other square; or to replace the piece where it previously was, and to play the king instead of it.

13. If a player should play two successive moves, it is in his adversary's power to oblige him to put back the *second* move; or, if he choose it, he may insist on continuing the game, as if only *one* move had been played.

14. A pawn that is pushed two squares may be taken *en passant,* by the adversary's pawn.[2]

15. The king cannot castle: *1st,* If he has moved; *2dly,* if he be in check; *3dly,* if any of the squares over which he moves in castling be occupied by or under the power of one of his adversary's pieces; and, *4thly,* if the rook has moved. A player who castles in either of these *four*

[1] In Germany he who wins the game has the advantage of playing first the next game.

[2] This is not the case in Italy; a pawn is allowed to pass *en prise,* which is called *passar battaglia.*

cases must put back the move; and his adversary has the option of compelling him to play either the king or the rook with which he intended to castle.

16. If a player touch one of his pieces which cannot be moved without placing his king in check, he must play his king; and if the king cannot move, no penalty is to be inflicted.

17. Whenever a player attacks his adversary's king, he must say *check;* and if he forget to say it, the adversary needs not move his king, or take notice of the check; and if the player who did not say *check*, should, on the next move, attack the queen, or any of his adversary's pieces, and say *check*, the player whose king is in check may put back his last move, and, instead of it, remove his king, or cover the check.

18. If the king have been in check during two or more moves, and it be not possible to ascertain how it happened, he whose king is in check may, as soon as he perceives it, put back his last move, and remove his king, or cover the check.

19. If a player say *check* without giving check, and his adversary should in consequence move his king, or touch any piece to cover the check, and should afterwards perceive that he is *not in check*, he may put back his last move, provided his opponent have not already played his next move.

20. If a player has moved previously to perceiving a false move, or any other mistake which his adversary may have committed, he can no longer insist on the penalty: he should have noticed the mistake before he *moved* or *even touched* a piece.

21. When a player has pushed a pawn *to queen*, he is at liberty to make a *second queen*, a *third rook*, or any other piece which he may deem more useful for his attack or defence.

22. At the end of a game, when a player remains with a rook and a bishop against a rook, with both bishops, or with a knight and bishop, against the king, &c. if he cannot check-mate his adversary in *fifty* moves, the game shall be considered as a drawn game.

But if a player engage to check-mate his adversary with a marked pawn, or with any particular piece, the number of moves is then unlimited.

23. If the king be *stale-mated*, the game is a *drawn game.*

Explanation of the Abbreviated Terms made use of in the Notation of the Games.

K.	signifies	King or King's.
Q.	...	Queen or Queen's
R.	...	Rook or Rook's.
B.	...	Bishop or Bishop's.
Kt.	...	Knight or Knight's.
P.	...	Pawn or Pawn's.
Sq.	...	Square.
Adv.	...	Adverse or Adversary's.
Chg.	...	Checking.

First Game,

Being the first of the match (1824–8) between the London and Edinburgh Chess Clubs. White represents the Edinburgh side, black the London.

White.	Black.
1. K. P. two squares.	1. K. P. two squares.
2. K. B. to Q. B. 4th sq.	2. K. B. to Q. B. 4th sq.
3. Q. B. P. one sq.	3. Q. to K. 2d sq.
4. K. Kt. to K. B. 3d sq.	4. Q. P. one sq.
5. Q. P. one sq.	5. K. Kt. to K. B. 3d sq.
6. Q. to K. 2d sq.	6 King castles.
7. Q. B. to adv. K. Kt. 4th sq.	7. K. R. P. one sq.
8. Q. B. to K. R. 4th sq.	8. Q. B. to K. 3d sq.
9. K. B. to Q. Kt. 3d sq.	9. B. takes B.
10. Q. R. P. takes B.	10. Q. Kt. to Q. B. 3d sq.
11. Q. Kt. to Q. 2d sq.	11. Q. to K. 3d sq.
12. P. to Q. Kt. 4th sq.	12. K. B. to Q. Kt. 3d sq.
13. Q. B. takes Kt.	13. Q. takes B.
14. Q. Kt. to Q. B. 4th sq.	14. Q. to K. 3d sq.
15. K. Kt. to K. R. 4th sq.	15. Q. Kt. to K. 2d sq.
16. K. Kt. P. two sqrs.	16. Kt. to K. Kt. 3d sq.
17. K. Kt. takes Kt.	17. K. B. P. takes Kt.
18. K. castles with K. R.	18. K. R. to adv. K. B. 4th sq.
19. K. R. P. one sq.	19. Q. R. to K. B. sq.
20. Kt. takes B.	20. Q. R. P. takes Kt.
21. K. B. P. one sq.	21. Q. to K. B. 3d sq.
22. K. to K. Kt. 2d sq.	22. Q. B. P. one sq.
23. K. R. to K. B. 2d sq.	23. P. to Q. Kt. 4th sq.
24. Q. to K. 3d sq.	24. K. R. P. one sq.
25. K. to K. Kt. 3d sq.	25. Q. to K. Kt. 4th sq.
26. Q. R. to K. sq.	26. K. to K. R. 2d sq.
27. Q. to K. 2d sq.	27. R. to K. R. sq.
28. Q. to K. 3d sq.	28. K. to K. Kt. sq.
29. R. to K. R. 2d sq.	29. K. R. P. takes P.
30. K. R. P. takes P.	30. R. takes K. B. P. chg.
31. K. takes R.	31. Q. takes Q. chg.
32. K. takes Q.	32. R. takes R.
33. R. to Q. R. sq.	33. R. to adv. K. R. 3d sq. chg.
34. K. to K. 2d sq.	34. R. to adv. K. R. 2d sq. chg.
35. K. to K. 3d sq.	35. K. to adv. K. R. 3d sq. chg.

The game was here declared to be drawn.

As this game happened to be drawn, we shall give a variation of it, in order to make it terminate with a check-mate. Supposing white to have played, for its 26th move, K. R. P. one square, instead of Q. R. to K. sq. the following would probably have been the train of moves:

26. K. R. P. one sq.	26. K. R. takes K. Kt. P. chg.
27. K. B. P. takes R.	27. Q. takes Q. chg.
28. K. to his Kt. 2d.	28. R. takes K. R. chg.
29. K. to his R. sq.	29. Q. to ad. K. R. 3d chg.
30. K. to his Kt. sq.	30. Q. to ad. K. Kt. 2d sq. or to ad. K. R. 2d sq. giving check-mate.

Second Game.—(From Greco.)

1. K. P. two squares.	1. K. P. two squares.
2. K. Kt. to K. B. 3d sq.	2. Q. P. one sq.
3. K. B. to Q. B. 4th sq.	3. Q. B. to adv. K. Kt. 4th sq.
4. K. R. P. one sq.	4. Q. B. to K. R. 4th sq.
5. Q. B. P. one sq.	5. K. Kt. to K. B. 3d sq.
6. Q. P. one sq.	6. K. B. to K. 2d sq.
7. Q. B. to K. 3d sq.	7. K. castles.
8. K. Kt. P. two squares.	8. Q. B. to K. Kt. 3d sq.
9. K. Kt. to K. R. 4th sq.	9. Q. B. P. one sq.
10. K. Kt. takes Q. B.	10. K. R. P. takes K. Kt.
11. K. R. P. one sq.	11. Q. Kt. P. two sqrs.
12. K. B. to Q. Kt. 3d sq.	12. Q. R. P. two sqrs.
13. Q. R. P. two sqrs.	13. Q. Kt. P. one sq.
14. K. R. P. one sq.	14. P. takes K. R. P.
15. K. Kt. P. one sq.	15. K. Kt. to adv. K. Kt 4th sq.
16. K. R. takes P.	16. K. Kt. takes Q. B
17. K. R. to adv. K. R. sq. chg.	17. K. takes K. R.

Chess.

White.	Black.
18. Q. to ad. K. R. 4th sq. chg.	18. K. to K. Kt. sq.
19. K. Kt. P. one sq.	19. K. R. to K. sq.
20. Q. to adv. K. R. 2d sq. chg.	20. K. to K. B. sq.

21. Q. to adv. K. R. sq. giving check-mate.

Third Game.

This is an example of the king's gambit. It is from Philidor, and is his seventh back-game on the first gambit.

1. K. P. two squares.	1. K. P. two squares.
2. K. B. P. two sqrs.	2. K. P. takes K. B. P.
3. K. Kt. to K. B. 3d sq.	3. K. Kt. P. two sqrs.
4. K. B. to Q. B. 4th sq.	4. K. B. to K. Kt. 2d sq.
5. K. R. P. two sqrs.	5. K. R. P. one sq.
6. Q. P. two sqrs.	6. Q. P. one sq.
7. Q. B. P. one sq.	7. Q. B. P. one sq.
8. Q. to K. 2d sq.	8. Q. B. to K. 3d.
9. K. B. takes Q. B.	9. K. B. P. takes B.
10. K. P. one sq.	10. Q. P. takes K. P.
11. Q. P. takes P.	11. Q. Kt. to Q. 2d sq.
12. K. Kt. P. one sq.	12. K. Kt. P. one sq.
13. K. Kt. P. takes P.	13. K. Kt. P. takes Kt.
14. Q. takes P.	14. Q. to K. 2d sq.
15. Q. Kt. to Q. 2d sq.	15. K. castles with Q. R.
16. Q. Kt. P. two sqrs.	16. K. R. P. one sq.
17. Q. Kt. to K. 4th sq.	17. Q. Kt. to Q. Kt. 3d sq.
18. B. to K. 3d sq.	18. K. Kt. to K. R. 3d sq.
19. B. to ad. Q. B. 4th sq.	19. Q. to Q. B. 2d sq.
20. Q. R. P. two sqrs.	20. K. B. to its own sq.
21. Q. R. P. one sq.	21. B. takes B.
22. P. takes B.	22. Q. Kt. to Q. 2d sq.
23. Kt. to ad. Q. 3d sq. chg.	23. K. to Q. Kt. sq.
24. Q. R. to Q. Kt. sq.	24. Q. Kt. takes P. at Q. B. 4th sq.
25. Kt. takes Q. Kt. P.	25. Q. Kt. takes Kt.
26. Q. R. P. one sq.	26. K. to Q. R. sq.
27. R. takes Kt.	27. Q. to Q. B. sq.
28. K. R. to K. R. 2d sq.	28. Q. R. to Q.'s 2d sq.
29. K. R. to Q. Kt. 2d sq.	29. K. R. to K. R. 2d sq.
30. Q. takes Q. B. P.	30. Q. takes Q.

31. Q. R. to ad. Q. Kt. sq. giving check-mate.

Fourth Game.

This is an example of Cunningham's gambit.

1. K. P. two sqrs.	1. K. P. two sqrs.
2. K. B. P. two sqrs.	2. K. P. takes K. B. P.
3. K. Kt. to K. B. 3d sq.	3. K. B. to K. 2d sq.
4. K. B. to Q. B. 4 sq.	4. K. B. to ad. K. R. 4 chg.
5. K. Kt. P. one sq.	5. P. takes P.
6. K. castles.	6. K. P. takes ad. K. R. P. chg.
7. K. to K. R. sq.	7. K. B. to K. 2d sq.
8. K. B. takes K. B. P. chg.	8. K. takes B.
9. Kt. to ad. K. 4th sq. chg. and discovering check from R.	9. K. to his 3d sq.
10. Q. to K. Kt. 4th sq. chg.	10. K. takes Kt.
11. Q. to ad. K. B. 4th sq. chg.	11. K. to his Q. 3d sq.

12. Q. to ad. Q. 4th sq. giving check-mate.

Fifth Game.

This is an example of Salvio's gambit.

1. K. P. two sqrs.	1. K. P. two sqrs.
2. K. B. P. two sqrs.	2. K. P. takes P.
3. K. Kt. to K. B. 3d sq.	3. K. Kt. P. two sqrs.
4. K. B. to Q. B. 4th sq.	4. K. Kt. P. one sq.
5. K. Kt. to adv. K. 4th sq.	5. Q. to ad. K. R. 4th sq. chg
6. K. to his B.'s sq.	6. K. Kt. to K. B. 3d sq.
7. K. B. takes K. B. P. chg.	7. K. to Q. sq.
8. Q. P. two sqrs.	8. K. Kt. takes K. P.
9. Q. to K. 2d sq.	9. K. Kt. to ad. K. Kt. 3d sq. chg.
10. K. R. P. takes K. Kt.	10. Q. takes K. R. chg.
11. K. to his B.'s 2d.	11. P. takes P. chg.
12. K. takes P.	12. Q. takes Q. B.
13. K. Kt. to ad. Q. B. 3d. sq. chg.	13. Kt. or P. takes K. Kt.

14. Q. to ad. K. sq. giving check-mate.

Sixth Game.

This is an example of the Muzio gambit. This mode of opening a game is at present very much practised among the leading chess-players in London.

1. K. P. two sqrs.	1. K. P. two sqrs.
2. K. B. P. two sqrs.	2. P. takes P.
3. K. Kt. to K. B. 3d sq.	3. K. Kt. P. two sqrs.
4. K. B. to Q. B. 4th sq.	4. K. Kt. P. one sq.
5. King castles.	5. P. takes Kt.
6. Q. takes P.	6. Q. to K. B. 3d sq.
7. K. P. one sq.	7. Q. takes K. P.
8. Q. P. one sq.	8. K. B. to K. R. 3d sq.
9. Q. B. to Q. 2d sq.	9. K. Kt. to K. 2d sq.
10. Q. Kt. to B. 3d sq.	10. Q. B. P. one sq.
11. Q. R. to K. sq.	11. Q. to Q. B. 4th sq. chg.
12. K. to his R.'s sq.	12. Q. P. two sqrs.
13. Q. to ad. K. R.'s 4 sq.	13. Q. to her 3d sq.
14. K. B. takes P.	14. P. takes B.
15. Kt. takes P.	15. Q. Kt. to B. 3d sq.
16. Q. B. to Q. Kt. 4th.	16. Q. to K. Kt. 3d, offering an exchange of Queens.
17. B. takes Kt.	17. If he should take Q. with Q., you give him check-mate by playing Kt. to ad. K. B. 3d sq.; taking B. with Kt. would be bad, therefore he plays B. to K. 3d sq.
18. Q. to K. B. 3d.	18. Kt. takes B.
19. Kt. to ad. Q. B. 2d. chg.	19. K. to Q. 2d sq.
20. Kt. takes B.	20. P. takes Kt.
21. Q. takes Q. Kt. P. chg.	21. K. to Q. 3.

22. You may draw the game by constantly checking, and keeping adv. K. to Q. 2d or Q. 3d sq., neither of which squares he can quit without losing his knight, by which he would have the worst of the game. If not satisfied with a drawn game, you may at your 22d move play Q. B. P. two squares, having an excellent game. It would take up too much space for us to continue the analysis.

Seventh Game.

This is an example of Damiano's gambit.

1. K. P. two sq.	1. K. P. two sq.
2. K. Kt. to K. B. 3d sq.	2. K. B. P. one sq.
3. K. Kt. takes K. P.	3. K. B. P. takes K. Kt.
4. Q. to ad. K. R. 4th sq. chg.	4. K. to his 2d sq.
5. Q. takes K. P. chg.	5. K. to K. B. 2d sq.
6. K. B. to Q. B. 4th sq. chg.	6. K. to K. Kt. 3d sq.
7. Q. to ad. K. B. 4th sq. chg.	7. K. to K. R. 3d sq.
8. Q. P. two sqrs. chg.	8. K. Kt. P. two sqrs.
9. K. R. P. two sqrs.	9. K. to K. Kt. 2d sq.
10. Q. to ad. K. B. 2d sq. chg.	10. K. to K. R. 3d sq.

11. K. R. P. takes P. giving check-mate.

Eighth Game.

We shall conclude our examples by giving the fifth and last game of the match between the London and Edinburgh Chess Clubs. It is one of the most singular and inte-

resting games on record. It is an example of what is called the "Queen's Pawn Two" Game. The white men represent Edinburgh, the black London.

White.	Black.
1. K. P. two sqrs.	1. K. P. two sqrs.
2. K. Kt. to K. B. 3d sq.	2. Q. Kt. to Q. B. 3d sq.
3. Q. P. two sqrs.	3. Q. Kt. takes P.
4. Kt. takes Kt.	4. P. takes Kt.
5. Q. takes P.	5. K. Kt. to K. 2d sq.
6. K. B. to Q. B. 4th sq.	6. Kt. to Q. B. 3d sq.
7. Q. to adv. Q. 4th sq.	7. Q. to K. B. 3d sq.
8. Kt. to Q. B. 3d sq.	8. K. B. to ad. Q. Kt. 4th sq.
9. Q. B. to Q. 2d sq.	9. Q. P. one sq.
10. K. B. to adv. Q. Kt. 4th sq.	10. Q. B. to Q. 2d sq.
11. Q. to Q. B. 4th sq.	11. K. B. to Q. B. 4th sq.
12. K. castles with K. R.	12. K. castles with K. R.
13. Q. to Q. 3d sq.	13. Kt. to K. 4th sq.
14. Q. to K. Kt. 3d sq.	14. B. takes B.
15. Kt. takes B.	15. Q. B. P. one sq.
16. Kt. to Q. B. 3d sq.	16. Kt. to adv. Q. B. 4 sq.
17. B. to adv. K. Kt. 4th sq.	17. Q. to K. Kt. 3d sq.
18. Q. Kt. P. one sq.	18. K. B. P. one sq.
19. B. to Q. B. sq.	19. Q. takes Q.
20. K. R. P. takes Q.	20. B. to adv. Q. 4th sq.
21. P. takes Kt.	21. B. takes Kt.
22. Q. R. to Q. Kt. sq.	22. Q. Kt. P. one sq.
23. K. R. to Q. sq.	23. Q. R. to K. sq.
24. Q. R. to Q. Kt. 3d sq.	24. B. to Q. R. 4th sq.
25. K. B. P. one sq.	25. K. B. P. one sq.
26. P. takes P.	26. Q. R. to adv. K. 2d sq.
27. P. to K. Kt. 4th sq.	27. R. takes Q. B. P.
28. B. to K. B. 4th sq.	28. R. takes P. at ad. Q. B. 4th sq.
29. B. takes Q. P.	29. K. R. to K. sq.
30. Q. R. to Q. R. 3d sq.	30. K. R. P one sq.
31. B. to adv. Q. B. 2d sq.	31. K. R. to K. 2d sq.
32. K. R. to adv. Q. sq. chg.	32. K. to K. R. 2d sq.
33. R. to ad. Q. B. sq.	33. Q. R. to adv. Q. B. sq. chg.
34. K. to K. R. 2d sq.	34. K. R. to adv. K. sq.
35. K. to K. R. 3d sq.	35. R. to adv. K. R. sq. chg.
36. B. to K. R. 2d sq.	36. B. to adv. Q. B. 3d sq.
37. P. to K. B. 4th sq.	37. B. to adv. Q. 2d sq.
38. P. to K. Kt. 3d sq.	38. B. to Q. R. 4th sq.
39. Q. R. to K. 3d sq.	39. Q. R. to adv. Q. B. 2d sq.
40. P. to adv. K. Kt. 4th sq.	40. K. R. takes B. chg.
41. K. to K. Kt. 4th sq.	41. K. R. P. one sq. chg.
42. K. to K. B. 3d sq.	42. K. R. to adv. K. B. 2d sq. chg.
43. K. to K. 4th sq.	43. K. Kt. P. one sq.
44. R. to adv. Q. B. 2d sq. chg.	44. K. to K. Kt. sq.
45. K. to ad. K. 4th sq.	45. Q. R. to Q. B. 4th sq. chg.
46. K. to adv. K. B. 3d sq.	46. Q. R. takes P. chg.
47. K. takes K. Kt. P.	47. R. to K. B. sq.
48. R. to adv. K. Kt. 2d sq. chg.	48. K. to K. R. sq.
49. K. to adv. K. R. 3d sq.	49. B. to adv. Q. Kt. 4th sq.
50. Q. R. to adv. K. 3d sq.	50. Q. R. to K. B. 4th sq.
51. K. R. to adv. K. R. 2d sq. chg.	51. K. to K. Kt. sq.
52. Q. R. to adv. K. Kt. 3d sq. chg.	52. K. to K. B. sq.
53. Q. R. takes Q. B. P.	53. Q. R. to Q. B. 4th sq.
54. Q. R. to adv. K. B. 3d sq. chg.	54. K. to K. sq.
55. P. to adv. K. Kt. 3d sq.	55. Q. R. to adv. Q. B. 3d sq.
56. P. to K. Kt. 4th sq.	56. B. to K. B. sq. chg.
57. Q. R. takes B. chg.	57. K. takes R.
58. P. to adv. K. Kt. 2d sq. chg.	58. K. to K. B. 2d sq.
69. R. to adv. K. R. sq.	59. R. to Q. B. 3d sq. chg.
60. K. to adv. K. R. 2d sq.	

At this point the London Club resigned the game and lost the match.

It is stated in the report of the match by the Edinburgh committee, that the match, which was played by correspondence, was begun on the 23d of April 1824, and finished on the 31st of July 1828. The first and third games were drawn, the fourth was won by the London Club, and the second and fifth were won by the Edinburgh Club.

METHODS OF GIVING CHECK-MATE.

1. *With a Rook and King against a King.*

Situation of the Pieces.

King at adv. King's 4th sq. King's Rook at its own sq.	King at his second sq.
1. R. to ad. K. R. 2d sq. chg.	1. K. to his sq.
2. K. to ad. K. 3d sq.	2. K. to his Q. sq.
3. R. to ad. K. Kt. 2d sq.	3. K. to Q. B. sq.
4. K. to ad. Q. 3d sq.	4. K. to Q. Kt. sq.
5. K. to ad. Q. B. 3d sq.	5. K. to Q. R. sq.
6. K. to ad. Q. Kt. 3d sq.	6. K. to Q. Kt. sq.
7. R. to ad. K. Kt. sq. giving check-mate.	

2. *With two Bishops and a King against a King.*

Situation of the Pieces.

King at ad. Q. Kt. 4th sq. K. B. at ad. K. B. 4th sq. Q. B. at ad. King's 2d sq.	King at Q. Kt.'s sq.
1. Q. B. to ad. Q. 3d sq. chg.	1. K. to Q. Kt. 2d sq.
2. K. B. to ad. Q. 2d sq.	2. K. to Q. R. 2d sq.
3. K. B. to ad. Q. B. sq.	3. K. to Q. R. sq.
4. K. to ad. Q. B. 3d sq.	4. K. to Q. R. 2d sq.
5. K. to ad. Q. B. 2d sq.	5. K. to Q. R. sq.
6. K. B. to ad. K. Kt. 2d sq. chg.	6. K. to Q. R. 2d sq.
7. Q. B. to ad. Q. B. 4th sq. giving check-mate.	

3. *With a Bishop, Knight, and King, against a King.*

This is perhaps the most difficult check-mate, and, it may also be added, the most beautiful.

Situation of the Pieces.

King at ad. K. B. 3d sq. K. B. at ad. K. B. 4th sq. Kt. at ad. K. Kt. 4th sq.	King at K. R.'s sq.[1]
1. Kt. to ad. K. B. 2d sq. chg.	1. K. to K. Kt. sq.
2. B. to K. 4th sq.	2. K. to K. B. sq.
3. B. to ad. K. R. 2d sq.	3. K. to his own sq.
4. Kt. to ad. K. 4th sq.	

[1] The king cannot be check-mated at this corner of the board. He must be forced over to a corner square, subject to the action of the bishop.

White.	Black.
First Defence.	
	4. K. to K. B. sq.
5. Kt. to ad. Q. 2d sq. chg.	5. K. to his own sq.
6. K. to ad. K. 3d sq.	6. K. to Q.'s sq.
7. K. to ad. Q. 3d sq.	7. K. to his own sq.[1]
8. B. to ad. K. Kt. 3d sq. chg.	8. K. to Q.'s sq.
9. Kt. to ad. Q. B. 4th sq.	9. K. to Q. B. sq.
10. B. to ad. K. B. 2d sq.	10. K. to Q. sq.
11. Kt. to ad. Q. Kt. 2d sq. chg.	11. K. to Q. B. sq.
12. K. to ad. Q. B. 3d sq.	12. K. to Q. Kt. sq.
13. K. to ad. Q. Kt. 3d	13. K. to Q. B. sq.
14. B. to ad. K. 3d sq. chg.	14. K. to Q. Kt. sq.
15. Kt. to ad. Q. B. 4th.	15. K. to Q. R.'s sq.
16. B. to ad. Q.'s 2d sq.	16. K. to Q. Kt. sq.
17. Kt. to ad. Q. R. 3d sq. chg.	17. K. to Q. R. sq.

18. B. to ad. Q. B. 3d sq. giving check-mate.

Second Defence.

	4. K. to Q. sq.
5. K. to ad. K. 3d sq.	5. K. to Q. B. 2d sq.
6. Kt. to ad. Q. 2d sq.	6. K. to Q. B. 3d sq.
7. B. to Q. 3d sq.	7. K. to Q. B. 2d sq.
8. B. to ad. Q. Kt. 4th sq.	8. K. to Q. sq.
9. Kt. to ad. K. 4th sq.	9. K. to Q. B. 2d sq.
10. Kt. to Q. B. 4th sq.	10. K. to Q. sq.
11. K. to ad. Q. 3d sq.	11. K. to Q. B. sq.
12. Kt. to ad. Q. R. 4th.	12. K. to Q. sq.
13. Kt. to ad. Q. Kt. 2d sq. chg.	13. K. to Q. B. sq.
14. K. to ad. Q. B. 3d sq.	14. K. to Q. Kt. sq.
15. Kt. to ad. Q. 3d sq.	15. K. to Q. R. 2d sq.
16. K. to ad. Q. B. 2d sq.	16. K. to Q. R. sq.
17. B. to Q. B. 4th sq.	17. K. to Q. R. 2d sq.
18. Kt. to ad. Q. B. sq. chg.	18. K. to Q. R. sq.

19. B. to ad. Q. 4th sq. giving check-mate.

4. *With a Queen and King against a Rook and King.*

Situation of the Pieces.

King at ad. K. B. 3d sq.	King at K. R. 2d sq.
Queen at ad. K. sq.	Rook at K. Kt. 2d sq.

1. Q. to K. 4th sq. chg.	1. K. to R. sq. or to Kt. sq.
2. Q. to ad. Q. R. sq. chg.	2. K. to K. R. 2d sq.
3. Q. to ad. K. sq.[2]	3. If he should play K. to K. R. 3d, you play Q. to ad. K. B. sq. and at your next move you gain his Rook.

If he should play his R. to your K. Kt. 4th, you play Q. to ad. K. R. 4th sq. checking, and then gain the Rook. Therefore he plays R. to ad. K. Kt. 3d.

4. Q. to K. 4th sq. chg.	4. K. to K. Kt. sq.
5. Q. to Q. B. 4th sq. chg.	5. K. to K. R. sq. or to K. R. 2d sq.
6. Q. to K. R. 4th sq. chg.	6. K. to K. Kt. sq.
7. Q. takes R. chg.	7. K. to K. B. sq.

8. Q. to ad. Q Kt. sq. giving check-mate.

If he had, at his third move, played R. to your K. Kt. 2d, you would have checked with your Q. at K. 4th sq. gaining the Rook.

Again, let his move be..........3. R. to ad. K. Kt. sq.

4. Q. to ad. Q. 2d sq. chg.	4. K. to K. R. sq.

White.	Black.
5. Q. to ad. Q. B. sq. chg.	5. K. to K. R. 2d sq.[3]
6. Q. to ad. Q. B. 2d sq. chg.	6. K. to K. Kt. sq.
7. Q. to ad. Q. Kt. sq. chg.	7. K. to K. R. 2d sq.
8. Q. to K. R. 2d sq. chg.	8. K. to K. Kt. sq.
9. Q. takes R. chg.	9. K. to K. B. sq.
10. Q. to ad. K. Kt. 2d sq. chg.	10. K. to his own sq.

11. Q. to ad. K. 2d sq. giving check-mate.

5. *With a Rook, Bishop, and King, against a Rook and King.*

Situation of the Pieces.

K. at ad. K. 3d sq.	K. at his sq.
R. at Q. B. sq.	R. at Q. 2d sq.
B. at ad. K. 4th sq.	

1. R. to ad. Q. B. sq. chg.	1. R. to Q. sq.
2. R. to ad. Q. B. 2d sq.	2. R. to ad. Q. 2d sq.
3. R. to ad. Q. Kt. 2d sq.	3. R. to ad. Q. sq.
4. R. to ad. K. Kt 2d sq.	

First Defence.

	4. K. to K. B. sq.
5. R. to ad. K. R. 2d sq.	5. R. to ad. K. Kt. sq.
6. R. to ad. Q. B. 2d sq.	6. If he were to play K. to Kt. sq. you would check with R. at ad. Q. B. sq., driving his K. to K. R. 2d; then check with R. at ad. K. R. sq.; then, when he moved his K. to K. Kt. 3d sq. you would check with Rook at ad. K. Kt. sq., gaining his Rook. To avoid this consequence he plays R. to K. Kt. 3d sq. chg.
7. B. to ad. K. B. 3d sq.	7. K. to Kt. sq.
8. R. to ad. Q. B. sq. chg.	8. K to K. R. 2d sq.

9. R. to ad. K. R. sq. giving check-mate.

Second Defence.

	4. R. to ad. K. B. sq.
5. B. to K. Kt. 3d sq.	5. If he were to play K. to K. B. sq., he would ultimately be check-mated, as shown below. At present he plays R. to ad. K. B. 3d sq.
6. B. to ad. Q. 3d sq.	6. R. to ad. K. 3d sq. chg.
7. B. to ad. K. 4th sq.	7. R. to ad. K. B. 3d sq.
8. R. to ad. K. 2d sq. chg.	8. K. to K. B. sq.
9. R. to ad. Q. 2d sq.	9. K. to K. Kt. sq.
10. R. to ad. K. Kt. 2d sq. chg.	10. K. to K. B. sq.
11. R. to K. Kt. 4th sq.	11. K. to his sq.
12. B. to K. B. 4th sq.	12. K. to K. B. sq.
13. B. to ad. Q. 3d sq., or to ad. K. R. 3d sq. chg.	13. K. to his sq.
14. R. to ad. K. Kt. sq. chg.	14. R. interposes.

15. R. takes R. giving check-mate.

Supposing him to have played differently at his fifth move of the second defence, he would still have been check-mated. Thus, 5. K. to K. B. sq.

6. R. to K. Kt. 4th sq.	6. K. to his own sq.
7. R. to Q. B. 4th sq.	7. R. to ad. Q. sq.
8. B. to K. R. 4th sq.	8. K. to K. B. sq.
9. B. to ad. K. B. 3d sq.	9. R. to ad. K. sq. chg.
10. B. to ad. K. 4th sq.	10. K. to K. Kt. sq.
11. R. to K. R. 4th sq.	11. K. to K. B. sq.

12. R. to ad. K. R. sq. giving check-mate

[1] Had he gone to Q. B. sq. he would have been check-mated in fewer moves.

[2] The pieces are now in precisely the same situation as at first, with this difference, that Black has the move. These preliminary moves, therefore, have been made for the purpose of transferring the move from the White to the Black.

[3] If he had interposed his Rook, you would have given him check-mate by playing Queen to King's Rook's 3d sq.

Method of Playing a King and Pawn against a King.

Situation.

White.	Black.
King at his 4th sq.	King at his 3d sq.
Pawn at ad. King's 4th sq.	
1. K. to Q. 4th sq.	1. K. to his 2d sq.
2. K. to ad. Q. 4th sq.	2. K. to Q. 2d sq.
3. P. to ad. K. 3d sq. chg.	3. K. to his 2d sq.
4. K. to ad. K. 4th sq.	4. If he were to play King

to his Queen's square, he would lose the game, as shown below; therefore he plays K. to his sq.

5. K. to ad. Q. 3d sq.	5 K. to Q. sq.

6. If you push the Pawn, he will play King to his own square, and then you must either play your King to adv. King's third square, giving stale-mate, or play your King away from the support of the Pawn; in either of which cases the game will be drawn.

If he had played differently at his fourth move he would have lost the game. Thus,

	4. K. to Q. sq.
5. K. to ad. Q. 3d sq.	5. K. to his sq.
6. P. to ad. K. 2d sq.	6. K. to K. B. 2d sq.
7. K. to ad. Q. 2d sq.	7. K. where he may.
8. P. to ad. King's sq. becoming a Queen.	

Example of a Smothered Mate.

Situation of the Pieces.

	K. at Q. Kt. sq.
K. at K. R. sq.	K. R. at its own sq.
Q. at ad. K. B. 3d sq.	Q. R. at Q. sq.
Kt. at ad. Q. 4th sq.	Q. R. P. at Q. R. 2d sq.
K. R. P. at K. R. 2d sq.	Q. Kt. P. at Q. Kt. 2d sq.
1. Q. to ad. K. 4th sq. chg.	1. K. to Q. R. sq.
2. Kt. to ad. Q. B. 2d sq. chg.	2. K. to Q. Kt. sq.
3. Kt. to ad. Q. R. 3d sq. chg.	3. K. to Q. R. sq.
4. Q. to ad. Q. Kt. sq. chg.	4. Q. R. takes Q.
5. Kt. to ad. Q. B. 2d sq. giving check-mate.	

The following curious problem was suggested by a near relative of one of our most illustrious naval heroes:

Situation.

K. at K. B. 4th sq.	K. at Q. Kt. sq.
Q. at ad. K. B. 2d sq.	P. at Q. B. 2d sq.
K. R. at Q. B. 4th sq.	P. at Q. B. 3d sq.
Q. R. at Q. R. 4th sq.	P. at Q. B. 4th sq.
K. B. at ad. K. B. 4th sq.	P. at Q. R. 2d sq.
Q. B. at ad. K. B. 3d sq.	P. at Q. R. 3d sq.
Q. Kt. P. at Q. Kt. 3d sq.	P. at Q. R. 4th sq.

White engages to check-mate Black with the *Knight's Pawn* in *eleven* moves, without taking any of the black pawns.

It may be done in *ten* moves, thus:

1. Q. to ad. K. sq. chg.	1. K. to Q. Kt. 2d sq.
2. Q. to ad. Q. B. sq. chg.	2. K. to Q. Kt. 3d sq.
3. K. B. to Q. 3d sq.	3 K to Q. Kt. 4th sq.
4. Q. B. to K. R. 4th sq.	4. K. to Q. Kt. 3d sq.
5. Q. B. to K. B. 2d sq.	5. K. to Q. Kt. 4th sq.
6. Q. R. to Q. R. 3d sq.	6. K. to Q. Kt. 3d sq.
7. K. R. to K. 4th sq.	7. P. to ad. Q. R. 4th sq. being his only move.
8. Q. to ad. Q. Kt. sq. chg.	8. K. to Q. R. 4th, his only move.
9. Q. B. to K. 3d sq.	9. P. to ad. Q. B. 4th sq. his only move.
10. P. to Q. Kt. 4th sq. giving check-mate.	

If Black had played otherwise at his sixth move, check-mate would have given in nine moves, thus:

White.	Black.
	6. P. to ad. Q. R. 4th sq.
7. Q. to ad. Q. Kt. sq. chg.	7. K. to Q. R. 4th sq.
8. K. R. to K. 4th sq.	8. P. to ad. Q. B. 4th sq. being his only move.
9. P. to Q. Kt. 4th sq. giving check-mate.	

Sarasin has an express treatise on the different opinions as to the origin of the word *schacchi*, whence the French *échecs* and our *chess* is formed. Menage is also very full on the same head. Leunclavius supposes it to come from *uscoches*, famous Turkish robbers; P. Sirmond from the German *schache*, theft, and that again from *calculus*. He takes *chess* to be the same with the *ludus latrunculorum* of the Romans, but erroneously. This opinion is countenanced by Vossius and Salmasius, who derive the word from *calculus*, as used for *latrunculus*. G. Tolosanus derives it from the Hebrew *scarch, volavit*, and *mat, mortuus;* whence *check* and *check-mate*. Fabricius says a celebrated Persian astronomer, one Schatrenscha, invented the game of *chess*, and gave it his own name, which it still bears in that country. Nicod derives it from *schecque*, or *xeque*, a Moorish word for lord, king, and prince. Bochart adds that *scach* is originally Persian; and that *scachmat* in that language signifies the king is dead. The opinion of Nicod and Bochart, which is likewise that of Scriverius, appears the most probable.

With regard to the origin of the game of chess we are much in the dark. Though it came to us from the Saracens, it is by no means probable that they were the original inventors of it. According to some, it was invented by the celebrated Grecian hero Diomedes. Others say that two Grecian brothers, Ledo and Tyrrheno, were the inventors; and that being much pressed with hunger, they sought to alleviate the pain by this amusement. According to Mr Irwin, it is a game of Chinese invention. During his residence in India he found that a tradition of this nature existed among the Brahmins, with whom he frequently played the game. But according to Sir William Jones, this game is of Hindoo invention. "If evidence were required to prove this fact," says he,[1] "we may be satisfied with the testimony of the Persians, who, though as much inclined as other nations to appropriate the ingenious inventions of a foreign people, unanimously agree that the game was imported from the west of *India* in the sixth century of our era. It seems to have been immemorially known in *Hindostan* by the name of *Cheturanga, i. e.* the four *angás*, or members of any army; which are these, *elephants, horses, chariots*, and *foot soldiers;* and in this sense the word is frequently used by epic poets in their description of real armies. By a natural corruption of the pure Sanscrit word, it was changed by the old Persians into *Chetrang;* but the Arabs, who soon after took possession of their country, had neither the initial nor final letter of that word in their alphabet, and consequently altered it further into *Shetranj*, which found its way presently into the modern *Persian*, and at length into the dialects of India, where the true derivation of the name is known only to the learned. Thus has a very significant word in the sacred language of the Brahmins been transformed by successive changes into *axidrez, scacchi, échecs, chess*, and, by a whimsical concurrence of circumstances, has given birth to the English word *check*, and even a name to the *exchequer* of Great Britain."

The game of chess has been generally practised by the

[1] *Asiatic Researches*, vol. ii. mem. 9.

greatest warriors and generals; and some have even supposed that it was necessary for a military man to be well skilled in this game. It is a game which has something in it peculiarly interesting. We read that Tamerlane was a great chess-player, and was engaged in a game during the very time of the decisive battle with Bajazet the Turkish emperor, who was defeated and taken prisoner. It is also related of Al Amin, the caliph of Bagdad, that he was engaged at chess with his freedman Kuthar at the time when Al Mamun's forces were carrying on the siege of that city with so much vigour that it was on the point of being carried by assault. In a battle between the French and English in 1117, an English knight having seized the bridle of Louis le Gros, and crying to his comrades, "The king is taken!" the king struck him to the ground with his sword, saying, "Ne sçais-tu pas qu'aux échecs on ne prend pas le roi?" Dr Hyde quotes an Arabic history of the Saracens, in which the caliph is said to have cried out, when warned of his danger, "Let me alone, for I see check-mate against Kuthar!" We are told that Charles I. was at chess when news were brought of the final intention of the Scotch to give him up to the English; but so little was he disturbed by this alarming intelligence, that he continued his game with the utmost composure, so that no person could have known that the letter he received had given him information of any thing remarkable. King John was playing at chess when the deputies from Rouen came to acquaint him that their city was besieged by Philip Augustus; but he would not hear them until he had finished his game.

The following remarkable anecdote we have from Dr Robertson in his history of Charles V. John Frederic, elector of Saxony, having been taken prisoner by Charles, was condemned to death. The decree was intimated to him while at chess with Ernest of Brunswick, his fellow prisoner. After a short pause, and making some reflection on the irregularity and injustice of the emperor's proceedings, he turned to his antagonist, whom he challenged to finish the game. He played with his usual ingenuity and attention; and having beat Ernest, expressed all the satisfaction that is commonly felt on gaining such victories. He was not, however, put to death, but set at liberty after five years' confinement.

Chess seems to have been in vogue at the court of Queen Elizabeth. Sir Walter Raleigh used to say that he did not wish to live longer than he could play at chess. Sir Charles Blount, afterwards Earl of Devonshire, having distinguished himself at a tilt, received from that princess a present of a chess-queen of gold enamelled, which he tied round his arm with a crimson riband. This favour from the queen produced a duel betwixt him and the Earl of Essex.

Charles XII. of Sweden was fond of the game; but he was not a successful player, in consequence of his making the king take too active a share in the contest. To this day a chess-king who advances too boldly into the fight is called Charles XII.

In the Chronicle of the Moorish Kings of Granada we find it related, that in 1396 Mehemed Balba seized upon the crown in prejudice of his elder brother, and passed his life in one continual round of disasters. His wars with Castille were invariably unsuccessful; and his death was occasioned by a poisoned vest. Finding his case desperate, he dispatched an officer to the fort of Salabreno to put his brother Juzuf to death, lest that prince's adherents should form any obstacle to his son's succession. The alcade found the prince playing at chess with an *alfaqui* or priest. Juzuf begged hard for two hours' respite, which was denied him; at last, with great reluctance, the officer permitted him to finish the game; but before it was finished a messenger arrived with the news of the death of Mehemed, and the unanimous election of Juzuf to the crown.

We have a curious anecdote of Ferrand, Count of Flanders, who, having been accustomed to amuse himself at chess with his wife, and being constantly beaten by her, a mutual hatred took place, which came to such a height, that when the count was taken prisoner at the battle of Bovines, she suffered him to remain a long time in prison, though she could easily have procured his release.

Two Persians had engaged in such deep play, that the whole fortune of one of them was gained by his opponent. He who played the white was the ruined man; and, made desperate by his loss, offered his favourite wife as his last stake. The game was carried on until he would have been check-mated by his adversary next move. The lady, who had observed the game from a window above, cried out to her husband to sacrifice his castle and save his wife.

The game of chess has undergone considerable variations since it was first invented. We have it on good authority, that among the eastern nations the piece now called the *queen* was formerly called the *vizir* or king's minister, and that the powers of the queen herself were but very small. The chess-boards used by Tamerlane were larger, and contained many more squares, than those at present in use. Carrera invented two new pieces to be added to the eight commonly in use. One of these, which he calls *Campione*, is placed between the king's knight and castle; the other, named *Centaur*, between the queen's knight and castle, has the move of the bishop and knight united. This invention, however, did not survive its author. In another of this kind the two additional pieces are called the *centurion* and *decurion;* the former situated between the king and his bishop, in its move the same with that of the queen, but only for two squares; the latter moves as the bishop, but only one square at a time. This, like the former, died with its inventor. The chess-board of Tamerlane was a parallelogram, having eleven squares one way and twelve the other. In the Memoirs of the late Marshal Keith, we find it related that he invented an amusement something similar to that of chess, with which the king of Prussia was highly entertained. Several thousand small statues were cast by a founder; and these were ranged opposite to each other as if they had been drawn up in an army, making the different movements with them as in real service in the field.

(J. D.)

CHESTER, an ancient city of England, capital of Cheshire; also a county in itself, and market-town. It is beautifully situated on the Dee, 164 miles N.W. from London. It consists of four main streets, and a great number of smaller ones. The whole of the town is surrounded by a wall 7 or 8 feet in thickness; on the summit of which is a walk with parapets on either side, much used as a promenade by the citizens, and which commands fine views of the surrounding country. The wall is very ancient, and is supposed to be of Roman origin. Chester was the Deva of the Romans, and was the permanent station of the twentieth legion. It occupied a very important position in the time of the lords marchers, and was their chief stronghold in the north. In two of the principal streets a very curious arrangement of the houses prevails, by which what are called the "rows" are formed, affording a promenade secure against the uncertainties of the weather. Fronting the pavement there is a row of inferior shops; on the top of these again

there is a broad paved walk, with a row of shops on the inner side, about 16 feet from the front of the lower row; the houses forming the second floor from the ground are then carried over the paved walk, and supported on pillars placed on the front of the lower row; and within this covered gallery are to be found the principal shops of the town. Numerous antiquities are from time to time brought to light, attesting the ancient origin of the place. A great many of the houses are built of timber, and some of them are most quaintly and elaborately carved. There is a very large training college for teachers, which is fast rising into repute. The cathedral is an old Gothic building containing some fine old carved oak, and some interesting monuments. The principal public buildings, besides those named, are the castle, the county-hall, the exchange, the linen, union, and commercial halls, the county jail, and the railway station; which latter is one of the largest and finest in the kingdom, and accommodates the traffic of six important railways. There are also public markets, an infirmary, and a house of industry. Chester has nine parish churches and two chapels of ease, besides numerous chapels belonging to the different dissenting bodies. There is a very fine race-course called the Roodee, just outside the town wall. The Chester race meeting has long ranked among the most important in the kingdom. There are very large works for the manufacture of white-lead, sheet-lead and pipes, and patent shot, giving employment to many hundred workpeople. Shipbuilding is also carried on to a considerable extent. Owing to the silting up of the mouth of the Dee, the shipping trade is not so brisk as it was at one time. Eaton-hall, the magnificent seat of the Marquis of Westminster, is close to the town.

The corporation consists of a mayor, ten aldermen, and thirty councillors. The borough has returned two members to parliament since 1543. Constituency in 1851, 2524. The Marquis of Westminster has the principal political influence. The assessed taxes yield annually L.1259; and the annual value of real property paying income tax is L.24,941. The population of the city in 1851 was 27,776, of whom 13,324 were males, and 14,442 females. There were 5173 inhabited houses, 196 uninhabited, and 35 building. There are weekly markets on Wednesdays and Saturdays, and several very large horse, cattle, and cheese fairs, during the year.

CHESTERFIELD, a municipal borough and market-town of England, county of and 21 miles N. of Derby, on the rivulets Rother and Hipper. It has manufactures of lace, cotton, silk, carpets, hosiery, earthenware, and machinery. The church is an elegant and spacious edifice of the thirteenth century, with a remarkable twisted spire 230 feet high. There are several dissenting chapels, a free grammar and other schools, town-hall, prison, assembly-rooms, theatre, dispensary, mechanics' institute, and savings-bank. In the vicinity are coal, iron, and lead mines. The Chesterfield canal extends from the town to the Trent near Stockwith, 46 miles. The town is governed by a mayor, four aldermen, and twelve councillors. Pop. (1851) 7101.

CHESTERFIELD, *Earl of.* See STANHOPE.

CHESTER-LE-STREET, a village of England, county of Durham, near the Wear, 6 miles N. of Durham. Pop. (1851) 2580. Its Saxon name was Cuncaestre; and from 882 to 995 it was the seat of the episcopal see of Durham. The church, which was formerly collegiate, is a fine old Gothic structure with a tower at its W. end, surmounted by an elegant spire 156 feet high. The manufactures are unimportant, the inhabitants being chiefly employed in the coal mines of the neighbourhood. Lumley castle, the seat of the Earl of Scarborough, is in the immediate vicinity.

CHESTNUT. See HORTICULTURE; PLANTING; TIMBER.

CHEVAL-DE-FRISE, generally used in the plural, *chevaux-de-frise,* a military engine consisting of a large piece of timber traversed with pikes five or six feet long, and pointed with iron; used to defend a passage, stop a breach, or form a retrenchment against cavalry. Chevaux-de-frise were first employed at the siege of Groningen in 1658. The term is French, and literally signifies a *Friesland horse,* the term having been applied either from some conceived analogy between the appearance of the shaggy horses of the country and that of the instrument, or more probably because it was invented in Friesland.

CHEVALIER (from *cheval,* a horse), a French term signifying a knight. In heraldry it denotes a horseman armed at all points, a *cataphract.*

CHEVERON and CHEVERONEL. See HERALDRY.

CHEVIOT HILLS, a mountain range extending from NE. to SW. between England and Scotland, partly in Northumberland and partly in Roxburghshire, but mostly in the former. They afford excellent pasture for sheep, and give name to a valuable and peculiar breed of that animal. The Cheviot peak, 2684 feet high, is in Northumberland, on the borders of Roxburghshire, 8 miles S.W. of Wooler. These hills were the scene of many bloody contests between the English and Scotch, one of which is recorded in the celebrated ballad of "Chevy Chase."

CHEVREAU, URBAN (1613–1701), a learned writer, was born at Loudun in Poitou. He early distinguished himself in the study of the belles-lettres, and was appointed secretary to Queen Christina of Sweden. After spending some time at the court of Denmark, he was employed as counsellor by Charles Louis, the elector palatine; and on the death of that prince he returned to France, where he became tutor to the Duke of Maine. His principal work, the *Histoire du Monde,* Paris, 1686, 2 vols. 4to, he is alleged by some to have taken without acknowledgment from the *Theatrum Universum* of Christian Mathias; but this charge has not been substantiated.

CHEYNE, DR GEORGE (1671–1742), was born in Scotland, and educated under Dr Archibald Pitcairne. After his graduation he settled in London, where he soon became known by the publication of his *Theory of Fevers,* and also of a work *On Fluxions.* In the former of these he advocated the mechanical theory of secretion, in accordance with the doctrines which he had imbibed from his master. Having been twice the victim of an excessive corpulency, which he twice succeeded in subduing by means of vegetable diet, he wrote a book entitled *The English Malady,* in which he has given a variety of curious details in regard to his own treatment, and the dietetic treatment of diseases in general. He had also discussed the same subject in his *Essay on Health and Long Life.* Besides these, he published in early life a treatise on the *Philosophical Principles of Natural Religion,* which was dedicated to the Earl of Roxburghe; and his later writings are uniformly pervaded by a genial spirit of piety and benevolence. He died at Bath, whither he had retired for his health, in 1742.

CHIABRERA, GABRIELE (1552–1637), a famous Italian poet, born at Savona, and educated in the Jesuits' college at Rome. He received invitations from Urban VIII., and many of the Italian princes, to fix his residence in their capitals, but preferred to prosecute the study of poetry in his native place. He wrote four epics, entitled *La Gotiade o delle guerre de Goti, La Firenze, L'Amedeida,* and *Il Ruggiero;* a tragedy, entitled *Erminia,* besides several comedies, dramas, and smaller poems. His works have been frequently collected. For a critical estimate of Chiabrera, see POETRY.

CHIAPA, a state of Mexico. See MEXICO.

CHIAPA DE LOS INDOS, the largest town in the above state, situated in a valley near the banks of the river Tabasco, 20 miles N.W. of Ciudad Real. The inhabitants, amounting to about 15,000, are chiefly Indians, but they are reported to be rich. A great quantity of sugar is

raised in the district. The heat is excessive during the day, but the nights are cool. This place enjoys many privileges, and is rising into importance.

CHIARAMONTE, a town of Sicily, province of and 32 miles W. from Syracuse. It is regularly built, with broad and straight streets. The view from the Capuchin convent is one of the finest in Sicily. The environs produce excellent wine. Pop. 7000.

CHIARI, a town of Lombardy, province of and 12 miles W. from Brescia. It has several churches, an hospital, and considerable manufactures of silk and leather. Pop. 8000.

CHIARI, *Giuseppe* (1654–1727), an Italian painter, the disciple of Carlo Maratti. He was employed in decorating various churches and palaces at Rome.

CHIAROSCURO. See CLARO OBSCURO.

CHIAVARI, a maritime town of the kingdom of Sardinia, capital of a province of the same name, in the division of Genoa, situated on the Gulf of Rapallo, at the mouth of the Sturla, 23 miles E.S.E. of Genoa. Pop. 11,000. The town is well built and flourishing, is surrounded by cultivated hills, and in the vicinity there are many handsome villas. It has many fine edifices, hospital, public library, manufactures of lace and silk twist, and an anchovy fishery. In the neighbourhood there are marble and slate quarries.

CHIAVENNA (*Clavenna*), a small town of Lombardy, province of Valteline, on the right bank of the Maira, 20 miles N.W. of Sondrio. It is a place of considerable trade, being situated at the junction of the great roads over the Splügen and Septimer, between Germany and Italy. Its principal manufacture is silk. Pop. 3500.

CHIAUSI, among the Turks, officers employed in executing the viziers, pashas, and other high functionaries. The orders for this purpose are sent by the grand signior wrapped up in a black cloth; on the reception of which the chiausi immediately perform their office.

CHICAGO, a city of the state of Illinois, North America, situated on S.W. shore of Lake Michigan, at the mouth of the Chicago river. Lat. 42. 52. 20. N.; Long. 87. 35. W. Chicago is the most remarkable city in the states for the rapidity of its increase. In 1830 it was a mere trading station, and in 1840 had only 4470 inhabitants. In 1850 these had increased to 27,620, and in 1855 amounted to no less than 80,000. The city borders on a rich and beautiful prairie extending in different directions for many miles, finely diversified by groves and strips of timber, gardens, and villas. Though the site is low and level, being only a few feet above the lake, there are no marshes or wet lands; and the agitated waters of the lake ensure a salubrious atmosphere. The river Chicago consists of two branches, which unite about two miles from its mouth, forming an extensive and commodious harbour. The city extends along the shore of the lake for about a mile, and inland beyond the bifurcations of the river. The bar at the entrance has been much reduced, and piers have been erected to prevent the accumulation of sand, so that the depth is now sufficient for the largest lake craft and steamers. Chicago is the natural entrepot for the trade between the flourishing state of Illinois and the vast regions watered by the great lakes; and by means of an extensive system of canal and railway communication its commerce reaches from the Atlantic to the Mississippi. Of this system the most important features are—the Illinois and Michigan canal 100 miles in length, extending from the lake to the Illinois river at La Salle, and forming an outlet for the rich products of Kentucky, Missouri, Iowa, and Illinois; two lines of railroad round the bend of lake Michigan, thence continuous to the sea-board at Boston and New York, uniting also with the Indiana and Ohio railroads; lines to the Mississippi river at Galena, Rock Island, Quincy, Alton, Cairo, &c. There are 12 main trunk railways, 2646 miles in length, already in operation or to be completed by 1856, terminating at Chicago, and nearly each trunk has one or more branches; these are, the Michigan Central to Detroit, 208 m.; Michigan Southern to Toledo, 245 m.; Chicago and Fort Wayne, 180 m.; Illinois Central to Cairo, 351 m.; Chicago and Mississippi to Alton, 280 m.; Chicago, Aurora, and Central Military Tract to Quincy, 220 m.; Chicago and St Charles Air Line to Galena, 160 m.; Chicago and Galena to Dubuque, 200 m.; Illinois and Wisconsin to Fond du Lac, 180 m.; Chicago and Rock Island, 180 m.; Chicago and Cincinnati, 280 m.; Lake Shore to Milwaukee, 90 m. In 1842 the value of property in Chicago was assessed at $2,325,240, and in 1852 at $12,035,037. The arrivals of vessels at this port during 1852 were, 366 paddle and 181 screw-steamers, 20 barques, 257 brigs, and 1172 schooners, with an aggregate burden of 545,491 tons. Chicago in 1853 had 7627 dwelling-houses, 1184 stores and places of business, 54 schools, 61 churches, and 196 manufactories.

CHICANE, or CHICANERY, in law, an abuse of judiciary proceedings, tending to delay the cause, puzzle the judge, or impose on a party.

CHICHESTER, a municipal and parliamentary borough, episcopal city, and market town of Sussex, is situated at the foot of a small spur of the South Down Hills on the widest part of the plain to which it gives name. N. Lat. 50. 51.; W. Long. 0. 47. It is distant about 60 miles S.W. from London, and 14 N.E. from Portsmouth. Chichester is a corruption of Cissancester, the castle or stronghold of Cissa, an Anglo-Saxon chief who rebuilt the town after it had been destroyed by his father Ælla. It occupies the site of Regnum, an old military station of the Romans, by whom it is believed the walls which have a circuit of about a mile and a half were originally erected. The town is well-built, and consists of four principal streets, which meet at right angles at a central octagonal cross, reputed to be one of the finest structures of the kind in Great Britain. Of the public buildings most remarkable, there is the cathedral, which is 407 feet in length, 150 in breadth, and is note-worthy as having double aisles; the church of St Paul, a modern Gothic edifice; the guild-hall; the corn-exchange; the market-house; the infirmary; and the museum of the philosophical society. In the cathedral are a number of ancient and curious monuments, besides nine by Flaxman, one of which is in memory of the poet Collins, who was a native of the city. The diocese of Chichester includes the whole county of Sussex except a few parishes which are peculiars, and comprises nearly 300 benefices. The palace of the bishop (whose annual income is L.4220) is in the city of Chichester. The Independents have two places of worship in Chichester, which also possesses National, British, and infant schools for boys and girls. The blue-coat school (with an annual income of L.1300) boards and educates 28 boys. In addition to these there is a grammar-school, founded by Bishop Story in 1497.

Chichester communicates with the sea by means of a short canal. Its registered shipping amounted in 1852 to 38 vessels, with an aggregate of 1806 tons. Its coasting and foreign trade engaged in that same year 450 vessels, with an aggregate of 22,980 tons. Chichester returns two members to parliament. Its registered electors number 757. The city is governed by a municipal corporation, consisting of 6 aldermen and 18 councillors, from among whom the mayor is chosen. Pop. 8662.

CHICKEN-POX, a mild contagious eruptive disease, generally appearing in children. It rarely attacks the same individual more than once.

CHICORY, or SUCCORY, the wild endive, or *Cichorium Intybus* of Linnæus, is a plant that grows wild on calcareous soils in England and most parts of Europe. It was formerly raised to some extent in England as a medicinal herb, but is now almost exclusively employed as a substitute for

coffee. For this purpose the roots are kiln-dried and ground to powder in a mill. Though largely used as a beverage, chicory wants the essential oil and rich aromatic flavour of coffee. It forms, however, a not unpleasant beverage; and its cheapness recommends it to the poor. The quantity raised in England in 1850 is said to have amounted to about 12,500 tons. The mixture of chicory with coffee has given occasion for several special enactments; but by a minute of treasury issued Feb. 25, 1853, the question was finally settled, and the sale of coffee mixed with chicory was legalized—under the proviso, however, that each parcel containing such compound be labelled "Mixture of Coffee and Chicory."—See M'Culloch's *Dict. of Commerce*, Lond. 1854.

CHICLANA, a town of Spain, 13 miles S.E. from Cadiz, containing the residences of many of the Cadiz merchants. Near it is *Medina Sidonia*, supposed by some to be the Phœnician *Asidon;* and about 5 miles S. is the field of Barossa, where the Anglo-Spanish army headed by Sir Thomas Graham (afterwards Lord Lynedoch) defeated the French under Marshal Victor, March 5, 1811. Pop. about 6000.

CHIEF, a term signifying the head or principal part of a thing or person. The word is formed from the French *chef*, from κεφαλή, *caput*, head.

Chief, in *Heraldry*, is that which occupies all the upper part of the escutcheon from side to side. *In chief* imports something borne in this part. See Heraldry.

CHIEFTAIN, the captain or chief of any class, family, or sept. Thus the chieftains of the Highland clans were the patriarchal and feudal heads of their respective clans.

CHIERI, a pleasantly situated and tolerably well built town of Italy, kingdom of Sardinia, Piedmont, province and eight miles S.E. of Turin, on the declivity of a hill, at the foot of which flows a small stream. It has manufactures of silk, cotton, linen, and woollen goods, and about 14,000 inhabitants.

CHIETI, an important and flourishing city of Naples, capital of the province of Abruzzo Citeriore, situated on a hill near the Pescara, 40 miles E. of Aquila. It is the seat of an archbishop, and has a fine cathedral, college, hospital, several convents, and a handsome theatre. Chieti commands a fine view of the surrounding country and the Adriatic, from which it is six miles distant. Pop. 14,000. Its chief productions are corn, wine, oil, silk and woollen goods, &c. It occupies the site of the ancient *Teate*, which gave name to an order of monks in the sixteenth century. It has remains of a large theatre, two temples, a gateway, and mosaic pavement.

CHIGI, Fabio, afterwards Pope Alexander VII., was born at Sienna in 1599. Having been early sent to Rome, he formed a friendship with the Marquis Pallavicini, who recommended him to Pope Urban VIII., and procured his appointment as inquisitor at Malta. He was next sent as vice-legate to Ferrara, and afterwards as nuncio into Germany, where, at the conference of Munster, he had abundant opportunity for displaying his genius for intrigue. Cardinal Mazarin cherished a secret resentment against Chigi, who was soon afterwards made cardinal and secretary of state by Innocent X.; but this resentment was wisely sacrificed to political views. Chigi, after his elevation, laid aside the mask of sanctity, and indulged openly in luxury and voluptuousness. There is a volume of his poems still extant; and the plan of the college Della Sapienza, which he finished and adorned with a fine library, sufficiently attests his fine taste in architecture.

CHIHUAHUA, a state of Mexico. See Mexico.

Chihuahua, a town of Mexico, capital of the state of the same name, lies in a beautiful valley opening towards the north, and hemmed in on the other sides by arms of the Sierra Madre, 4640 feet above the level of the sea. Lat. 28. 38. N., Long. 106. 30. W. The city is regularly built, and the streets are wide and clean, with many handsome and convenient houses, plentifully supplied with water, which is brought to the town by an aqueduct three miles in length. The grand square, three sides of which are occupied by public edifices and stores, and the fourth by the cathedral, has its spacious area adorned with fountains, walks, and benches and pillars of white porphyry. Pop. from 12,000 to 15,000. Near it are many rich but unwrought mines.

CHILBLAIN, a tumour or sore produced by exposure of the extremities to cold; accompanied with inflammation and itching, and sometimes with pain, and even with ulceration. Chilblains are not unfrequently induced by warming the hands and feet too suddenly after exposure to great cold; and hence proximity to the fire should be avoided until the circulation be properly restored. They are generally relieved by moderately stimulating applications; as for instance equal parts of solution of acetate of ammonia, or of vinegar and spirits of wine, or of oil of turpentine and soap liniment. An aqueous solution of alum also is frequently very efficacious, especially if applied after steeping the part affected in hot water.

CHILDERMAS-Day, or *Innocents' Day*, an anniversary held by the Church of England on the 28th of December, in commemoration of the massacre of the children of Bethlehem by order of Herod.

CHILE.

The republic of Chile occupies that long strip of land which lies on the south-western side of South America, extending from S. Lat. 24. to 55. 59.; and from W. Long. 69. to 72. It is bounded W. by the Pacific Ocean, and E. by the Andes, by which it is separated from the Argentine Confederation. On the N. Chile is separated from Bolivia by the extensive desert of Atacama; and it extends southwards to the extreme limits of that archipelago which embraces all the islands between Chiloë and the Straits of Magellan. Reckoning its length from the desert of Atacama to Cape Horn, it comprehends 36 degrees of latitude. Its average breadth is only 150, and where greatest, not more than 210 geographical miles. The superficial area of Chile is computed at 218,925 English square miles, being about 3195 miles more than that of France and Belgium together. Except where the Andes are intersected by ravines, which frequently expand into vales or plains fit for cultivation, these mountains, with their parallel ranges and spurs, occupy a great part of its area.

Physical appearance.

Under the dominion of Spain, the *Capitania-general* of Chile extended from S. Lat. 24. to Cape Horn; but as no settlements were actually formed beyond S. Lat. 44., the length of the Spanish possessions may be estimated at 1400 English miles. The ranges of the Andes, which, from their height and excessive coldness, are uninhabitable, cover nearly one-third of the surface of Chile. Between the Andes and the sea there are two parallel ranges, which decrease in elevation towards the coast, and are connected by several smaller ridges. Many deep basins are thus formed, some of which are filled with water from the melted snows of the Cordilleras; while in others the waters have found an outlet, and have left a fertile table-land, in which pasture may be obtained when the great droughts have destroyed the herbage in the less elevated districts.

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From the foot of the lower range of the Andes the land gradually descends towards the sea, but more precipitously near the shore, which is skirted by a comparatively low tract of country. Even this district, however, is crossed by numerous spurs from the Andes, and presents a series of barren mountain plains, intersected by deep *quebradas*, or fissures, which, during the melting of the snows in summer, are watered by large and rapid streams, and form the only cultivated districts in the country. As rain rarely falls in Northern Chile, except in the two or three winter months, and as the dews are light, the districts between these fissures are almost destitute of vegetation. In the Andes, which separate Chile from the Argentine Republic, there are several passes that can be traversed in safety in summer. The most frequented are those of Dehesa, near Tupungato, to the E. of Santiago; Copiapo, in Atacama; Colgüen, in Coquimbo; the Patas, in Aconcagua; and the Portillo Uspallata.

Geology.

No part of South America has had its geology so well investigated as Chile. Its stupendous mountains, rising in some places to the elevation of 23,900 feet above the level of the sea,—its numerous volcanoes, three of them generally in a state of active eruption,—and its very peculiar geological structure,—make it, with the exception of Peru, the most interesting part of South America.

It may be said that in Chile various geological phenomena are still in active operation. The grand range of the Cordilleras has suffered the most violent rendings and movements both upward and downward. There is the strongest evidence for believing that the parallel ridges which compose the Cordilleras were thrown up at different periods, that they afterwards subsided some thousand feet, were then brought up by a gradual movement, and again, during the old tertiary period, subsided to nearly their previous elevation, to be afterwards raised to their present level by a slow and often interrupted movement.

The Cordilleras and the Andes, though often used indiscriminately, are, in fact, as in Peru, different chains of mountains, running nearly parallel to each other. The former is termed in the south Cordilleras de la Costa (Cordilleras of the Coast), and between it and the Andes are extensive plateaux, which gradually sink in elevation from Central Chile to the S. For instance, Santiago the capital is at an elevation of 1830 feet above the level of the sea; whilst Rancagua, 63 miles further south, is 1558 feet; and Talca, 165 miles still further south, is only 311 feet above the sea.

Although the plain between the southern chains alters so rapidly in elevation, yet the northern chain from Aconcagua to Atacama, rising to a mean elevation of nearly 15,000 feet, displays throughout little variety in its forms; but further S., in S. Lat. 33., it assumes a different appearance, new rocks and formations showing themselves on its surface. Towards Lat. 33., volcanic masses of a modern period are first met with; cones springing up into points, covered with snow and ice, the fires of whose craters have only lately become inactive. There, rising to an elevation of 23,600 feet, is the stupendous mountain of Aconcagua, which has been generally considered as a volcano; but recent observation has ascertained that this is not the case. Although its top is far above the line of perpetual snow, yet frequently no snow is visible for many months on its surface. This is caused no doubt by the extreme dryness of the air. Further S. are Tupungato, 23,000 feet high; Juncal, 19,900; the Maipo Volcano, 19,000; and El Portillo, with its immense escorias, and the volcano of San José, each rising to the height of more than 18,000 feet above the level of the sea.

The whole chain of the Cordilleras, from Tierra del Fuego to Mexico, is penetrated by volcanic orifices, and those now in action are connected in great trains. In the Chilean range there are 23 volcanoes, some of them very ancient, without craters; some with craters, but quite extinct; others in the condition of solfataras; and others, such as Osorno, Villa Rica, and Antuco, in the S., and San José in the province of Santiago, in occasional and fierce action.

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The average width of the country between the Cordilleras and the sea is from 80 to 100 miles. It is crossed by various spur-like chains: the greater part of which, lying south of S. Lat. 31., range nearly N. and S.; but in the northern parts they run in every direction. The cultivated region of Chile may be considered to be between the River Biobio and the port of Coquimbo, that is to say, between seven degrees of latitude; and as the mean width is about two degrees of longitude, consequently the surface is equal to 7350 square Chilean leagues of 25 to a degree, from which must be deducted the part occupied by the Cordilleras of the Andes, forming at least one-third of this surface; therefore the actual part susceptible of cultivation is reduced to 4900 square leagues. However, several of the valleys of Huasco and Copiapo produce considerable quantities of fruit and vegetables.

There is the most positive evidence of the recent elevation of the most northern part of Chile from about 45° S. Lat.; and, indeed, a similar elevation can be traced on to Peru to a distance of about 2000 geographical miles. As the land is generally steep, shells are seldom found at a greater distance than three leagues from the coast; but the pirena, astarte, gryphæa, and turritella have been frequently found at an elevation of 12,000 feet above Huasco and Copiapo. The marks of sea action are evident at a distance of 30 to 40 miles inland, by ancient beaches, and successive and perfectly formed terraces. In Chiloë, shells are found at an elevation of 350 feet; at Concepcion, 625; at Valparaiso, 1300; and at Coquimbo, 252 feet. At Caldera, the port of Copiapo, the present line of the railway, to an elevation of 300 feet above the level of the sea, is cut through thick beds of shells of existing species.

On examining with attention the northern part of Chile, it is seen that there have been five ascensional movements of the coast. Round the Bay of Coquimbo the surface rises like an amphitheatre in five very marked stages, forming concentric terraces. The first terrace, a mile wide, rises to an elevation of about 23 feet,—it consists of sand-duns, and towards the town of Serena, of salt and fresh water marshes, with shells similar to those found on the beach. A steep escarpment leads to the second terrace, about 70 feet above the level of the sea, on which the town of Serena is built, the upper part covering the third terrace at an elevation of 120 feet. The fourth terrace, which is narrow, rises 182 feet above the third; and a steep escarpment leads to the fifth, or upper terrace. Above the town, it is entirely composed of immense masses of rounded shingle, and stretches along the coast, and inland to a distance of 11 miles. About 2 miles from Port Coquimbo, this fifth terrace sinks about 100 feet below the surrounding level; and a few inches below the sandy surface, there is a thick stratum of calcareous matter filled with shells, which forms an excellent building-stone and good lime. On advancing northward, the same terraces are observed. On going up the valley of Huasco to the town of Ballenar, about 37 miles inland, the five terraces are perfectly defined, composed of gravel aggregated together in a matrix of clay. In the neighbourhood of Valparaiso the elevation of the coast is very apparent. On the S. side of that town are numerous headlands, covered with broken shells to an elevation of 230 feet; and even at an elevation of 557 feet very comminuted shells are found, similar to those which exist in the neighbouring sea. The principal species are the patellæ, trochus, crepidulæ, and concholepas, some of which are occasionally to be found at an elevation of 1300 feet.

North of Valparaiso, near to Concon, are immense beds

of the mesodesma-donaciforme, which supply lime for the town and many leagues round. The same fossil shell is found in such abundance near Coquimbo, to the elevation of 80 feet above the sea, that an English smelting establishment at Herradura, $2\frac{1}{2}$ miles from the port of Coquimbo, has frequently purchased nearly 3000 quintals in a week for the purpose of making lime; and at Sangoy, where the same English company has another smelting establishment, the quantity is so great that it is collected and delivered into the works at the low rate of two dollars per cajon of 64 quintals.

From the indications of the action of the sea at different elevations, we may suppose that the process of elevation has been interrupted by long periods of comparative rest; and from the similarity of the distant terraces, no doubt the periods were synchronous over wide spaces of the coast.

Earthquakes.

Chile is very subject to severe earthquakes. They manifest themselves by a quick horizontal, vertical, and sometimes by a sort of rotatory vibration. They generally occur in a linear direction; but at other times partly in circles or in long ellipses. The earthquakes of 1835 and 1851 were of the latter description, the vibrations being propagated with decreasing intensity from a centre towards a circumference. It is affirmed by all miners, that the most severe shocks are not felt in deep mines, although the loud rumbling sound, like a heavy cart passing rapidly along a narrow street, which precedes the shock, is distinctly heard.

It is a very general opinion, that the atmospheric pressure is disturbed on the days when earthquakes occur; but the result of seven years' barometric observations in Chile refutes this opinion, as we have observed the horary variation of the barometer to be rarely affected either before or after earthquakes. Changes of the weather, however, generally succeed earthquakes. Immediately after the great earthquake of February 1835, torrents of rain fell in Concepcion, although in the midst of summer, when rain is nearly unknown. Experience shows that about two desolating shocks may be expected in a century. The intensity of the shocks is supposed to be increased according to the time intervening between them, and the danger to be greatest when the volcanic vents are closed. Although they appear to be simply dynamic phenomena of motion, yet in Chile they have suddenly elevated whole districts above the ancient level. By the earthquake of February 1835, the Isle of Santa Maria was uplifted, the southern end 8, the central part 9, and the northern end 10 feet; but both it and Concepcion subsided a few weeks afterwards, and even lost part of their previous elevation. The sea is generally much agitated during and for a short time after the shocks. During the earthquake which destroyed Concepcion and nearly all the towns in the S. of Chile, two great waves rolled over the town of Talcahuano, and the small penal establishment of Juan Fernandez was nearly washed away; the deep sea, close in shore, was dry for a few moments, and smoke burst from the surface of the water. During a very smart earthquake at Coquimbo, in November 1849, the sea retired about 150 yards, and then rolled back about 12 feet high. An English ship, anchored in 7 fathoms water, in the neighbouring bay of Herradura, nearly touched the bottom from the receding of the sea, which afterwards rolled in like a bore, and the water continued to ebb and flow for an hour and a half after the shock.

Lakes.

The appearance of the country is agreeably diversified by lakes, which are especially numerous in the southern provinces. In some of these, situate near the coast, such as Bacalemu, Cahuil, Vichuquen, and Bollenica, the water is brackish; but in Ranca, Villarica, and the lakes of the interior, it is quite fresh. They generally abound with fish; and are frequented by numerous varieties of aquatic birds. In some districts, and particularly in the Cordilleras, there are valuable thermal springs. The most celebrated for their medical virtues are those of Colina, Cauquenes, Panimavida, and Chillan.

Rivers.

Chile, particularly in its southern division, is abundantly supplied with rivers and streams, which, however, from the nature of the surface, have generally a short and rapid course, and are navigable only for a few miles from their mouths. The Biobio has a course of nearly 200 miles, and though not less than 2 miles in breadth at its mouth, is too shallow for large vessels to enter. It is navigable for river craft as far as Nacimiento, about 100 miles from the sea. The Maule is navigable for river barges for about 20 miles; and the Aconcagua, the Cauten, and the Callacalla (which last is deep enough for large vessels to enter), are considerable streams. All the navigable rivers flow through that part of Chile which is S. of the Maipù, where the rains fall abundantly. They are very rapid, owing to the declivity of the country, which renders them easily available for irrigation; and thus large tracts, which would otherwise be barren, are rendered rich and fertile.

The following table gives the length of the principal rivers, and the provinces through which they flow:—

Names of Rivers.	Province.	Length of course.	Falls into
Biobio	Concepcion and Arauco	94 leagues	Pacific Ocean
Aconcagua	Aconcagua	76 ...	...
Cauten, or Imperial	Arauco	68 ...	...
Maule	Maule	64 ...	...
Cachapoal	Santiago	62 ...	Topocalma
Itata	Concepcion	60 ...	Pacific Ocean
Mataquito	Talca	60 ...	...
Topocalma, or Rapel	Colchagua	56 ...	...
Valdivia, or Callacalla	Valdivia	55 ...	...
Coquimbo	Coquimbo	54 ...	...
Cruces	Valdivia	52 ...	Valdivia
Maipù	Santiago	50 ...	Pacific
Copiapo	Atacama	50 ...	...
Huasco	...	50 ...	...
Ligua	Aconcagua	48 ...	...
Tolten	Valdivia	48 ...	...
Laja	Concepcion	44 ...	Biobio
Loncotoma	Aconcagua	40 ...	Pacific
Bueno	Valdivia	40 ...	...
Limari	Coquimbo	38 ...	...
Mapocho	Santiago	38 ...	Maipù
Vergara	Arauco	36 ...	Biobio
Juncal	Atacama	34 ...	Pacific
Tabolevo	Arauco	30 ...	Biobio

Climate.

In a country like Chile, extending from the tropic of Capricorn to within twelve degrees of the Antarctic circle, and presenting great differences of elevation, considerable variety of climate may be anticipated. Omitting the cold and thinly inhabited region to the extreme south, and beginning with the province of Chiloë, Chile may be divided into three regions, which may be distinguished as the wet region, the corn and wine region, and the dry, or mineral region. The wet region comprehends Valdivia, Arauco, and Chiloe, and is so much exposed to excessive rains, that in Chiloë it is frequently necessary to dry the wheat and barley crops by artificial means. The corn and wine region embraces the eight provinces between Arauco and Coquimbo, and in these rain falls in the months of June, July, and August, with more or less abundance as they approach the S. In April, May, September, and October, showers are more rare and uncertain. In the provinces S. of Talca, the amount of rain being insufficient for agricultural purposes, it is necessary to resort to irrigation. The dry, or mineral region, including Coquimbo and Copiapo, is very warm, and receives only four or five showers in the whole course of the year. These, however, are so fertilizing, that an almost instantaneous change takes

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place in the appearance of the country. In the neighbourhood of the Andes, as well as towards the S., the atmosphere is often cooled by nocturnal frosts. Spring commences in September, summer in December, autumn in March, and winter in June.

The mildness and salubrity of the climate is unsurpassed by that of any other country. The following table shows the average rate of mortality in the different provinces. Most of the observations are confined to the year 1848, but some of them embrace also the average of other years:—

Provinces.	According to observations in	Deaths.
Atacama	1848	1 in 60·6
Coquimbo	1848	1 „ 73·7
Aconcagua	1848	1 „ 60·3
Valparaiso	1848, 1849	1 „ 35·7
Santiago	1848, 1849	1 „ 31·8
Colchagua	1848	1 „ 43·1
Talca	1848, 1850	1 „ 43·2
Maule	1844, 1848, 1849	1 „ 49·9
Nuble	1848	1 „ 80·5
Concepcion	1844–6–7–8–9–50	1 „ 70·1
Valdivia	1848	1 „ 160·4
Chiloë	1848, 1849	1 „ 42·9

From this table it will be seen that Valdivia, in a sanitary point of view, is the most favourably situate of all the provinces; and that Valparaiso and Santiago, in which are the two largest cities, are the worst. The following table shows the average number of births and deaths in the provinces of Valparaiso, Santiago, Talca, Maule, and Chiloë, during the several months of the year:—

Months.	Births	Deaths.
January	1851	1266
February	1609	1011
March	1984	986
April	1829	938
May	2247	1022
June	1539	1099
July	1556	1166
August	1773	1193
September	2614	1166
October	2576	1238
November	2387	1284
December	2287	1402

From this table we learn that the deaths are most numerous in December, November, and January; and fewest in February, March, and April.

Constitution.

The constitution according to which Chile is at present governed was adopted on the 25th of May 1833. By that constitution the sovereignty is declared to reside in the people; but the exercise of its functions is delegated to three distinct powers—the legislative, the executive, and the judicial. The legislative power is committed to the National Congress, which consists of the Chambers of Deputies and Senators. The Chamber of Deputies comprises 57 members, who are elected each for a period of three years, in the proportion of one deputy for every 20,000 inhabitants in the electoral districts. If, as is the case in some of these, the population does not amount to the above-named number, but exceeds 10,000, the same electoral privilege is still conferred upon them.

Suffrage.

According to the eighth article of the constitution, all who exercise the right of suffrage must be twenty-one years of age if married, and twenty-five if unmarried. They must be able to read and write. They must possess immoveable property, or an adequate capital invested in some branch of industry; or they must follow some employment, and the value of these required to constitute an elector shall be declared decennially. By the last decennial law, promulgated in 1849, it is declared that the value of immoveable property must not be less than L.200 in the provinces of Santiago and Valparaiso, that the capital in circulation must amount to at least L.400, and the annual income to L.40. In all the other provinces, the value of immoveable property must not be less than L.100, the capital in circulation at least L.200, and the annual income not under L.20.

The Senate is composed of twenty members, who are chosen by a select body of the electors of each province; every one of whom must have a clear annual income of L.110. This body must be equal to three times the number of deputies representing any particular province; and its members are chosen by the electors themselves from their own number. At electoral contests, the result of the proceedings is transmitted to a body known as the conservative committee, which sits in the capital. After having examined these proceedings, and satisfied themselves that everything has been conducted in accordance with legal forms, they declare the successful candidate.

A senator's term of office is nine years. The house of this branch of the legislature is renewed by thirds. In each of the first two periods of three years seven new senators are chosen, and in the last only six.

Chambers.

The functions of the Chamber of Deputies and of the Senate are partly discharged in concurrence with each other, and partly exclusively. The former body alone possesses the power of accusing the higher officers of government before the Senate for various political offences. It originates all money bills, and propositions relating to the recruiting of the military force of the country. The Senate alone has the right of pronouncing judgment on those public functionaries against whom accusations have been brought by the members of the Chamber of Deputies. It confirms all the ecclesiastical nominations. In certain cases it gives or withholds its consent to the acts of the executive.

In all the other proceedings of the legislature the concurrent voice of the two houses is necessary. Laws for the benefit of the country may originate with either body. When a law has been rejected, or the veto of the president put upon it, it cannot be brought again before the Chambers till the following year. The period during which the Congress sits is limited to the three winter months; but when the affairs before it are of such a nature as to render additional deliberation necessary, the session may be prolonged by the president for fifty days. On the day before the regular session closes, the senators elect seven of their number to form the conservative committee, which replaces the Congress during the period of its prorogation. The duties of this body are, to observe the conduct of the president; to exercise in certain cases conjoint powers with him; and, generally, to see that the laws are duly obeyed.

President

The executive power is committed to the President, who is the supreme chief of the nation and of the administration. He is elected with the same formalities as the senators, and by electors chosen in a similar manner. The office is held for a period of five years; but the president whose term has expired may be immediately re-elected for the same period. On the termination of his second term of office, an interim of five years must elapse before he can be elected a third time. The President possesses certain exclusive powers of a very important nature. He alone can appoint and remove at will not only cabinet ministers, clerks of department, and councillors of state, but also diplomatic ministers, consuls, and the higher provincial officers. He also inducts the higher legal and judicial functionaries; but the nomination of these officers, as well as of the ecclesiastical dignitaries, must proceed from the Council of State. The President has the power of distributing the army and navy according to his pleasure; and when, with the sanction of the Senate, he assumes the command of the national troops in person, he alone is vested

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with the right of bestowing naval and military commissions. In other circumstances, the appointments of this nature which he makes must be approved by the Senate. In periods of tumult and insurrection he can declare the towns and provinces of the republic in a state of siege.

The President is liable to impeachment for mal-administration for a year after the expiry of his authority. During that time he is not allowed on any account to leave the country, except with the permission of Congress. All the other officers of government are subject to the same law; but in their case the time is more limited.

Council of State.

Nearly co-ordinate with the President in the executive department is the Council of State. This body is composed of ministers in the exercise of their functions, of two members of the courts of justice, of an ecclesiastical dignitary, a general, an admiral, a chief of the administration of finances, two ex-ministers or diplomatic agents, and two former provincial intendants, governors of departments, or municipal magistrates, who must all possess the qualifications necessary for the rank of senator. The duties of the Council of State are, to advise the president in the administration of the government, and to act as a check upon him in proceedings which it may consider as injurious to the interests of the country. It proposes the removal of such officers of government as have been guilty of negligence in the discharge of their duties; and settles all disputes with regard to government contracts. It decides all doubtful questions that may arise between the several administrative departments of the government, or between these and the judicial tribunals. The President is also obliged to submit the annual fiscal estimates, and all laws contemplated or enacted by Congress, to the deliberations of this body. Should the advice they give in any particular case be adverse to the laws, they are liable to impeachment by the Chamber of Deputies.

Cabinet ministers.

The administrative department of government is conducted by four cabinet ministers. One presides over home and foreign affairs; another over justice, worship, and public education; a third is a minister of war and marine; and the fourth of finance. The President has no power of enforcing obedience to orders relating to any one of these departments until they have been confirmed by the appropriate minister. The ministers are individually responsible to Congress for the due discharge of all the duties pertaining to their respective branches of the administration, and also for whatever is done by them in common as a cabinet. They are entitled to be present and to take part in all the debates of Congress; but, unless holding at the same time the office of senator or of deputy, they are not allowed to vote in that body. Any of them may be impeached by the Chamber of Deputies for treason against the laws of the state, or for the mal-administration of the duties of his office. An action may be brought against them even by private individuals who have suffered by any of their acts, if the Senate, to whom appeal must in the first place be made, decide that there is sufficient ground for complaint.

Justice.

The tribunals of justice may be divided into three classes. Of these only two are properly judicial in their functions, the third being mainly political. The third class includes five tribunals, of which the Congress collectively and in its separate branches forms three with parliamentary jurisdiction, and the Council of State one with administrative powers. The fifth is the mixed tribunal, which was formed under the treaty with Great Britain in 1839, guaranteeing the mutual right of search in vessels suspected of slave traffic. It consists of a judge, an arbiter named by each party to the treaty, and a notary. In all cases relating to the validity of a capture there is no appeal from its decisions.

The first of the other two classes whose functions are more strictly judicial, comprehends the supreme courts and the three courts of appeal. The supreme court has direct supervision over all the others. The courts of appeal are composed of a certain number of legal ministers or justices, with a corps of special ministers to them in certain cases. These special justices, who form a remarkable feature in the Chilean system of legal administration, are taken from the intelligent classes connected with the military, the agricultural, the mining, and commercial interests of the country. In cases on trial pertaining to their respective interests they sit on the bench, and have an equal voice with the legal judges, both as to the law and the fact. These courts, to which disputed points from all other parts of the country are brought for adjudication, are established in Santiago, Serena, and Concepcion.

The same class comprehends four other tribunals, presided over by judges who, having been advocates, are termed, in contradistinction to the others, *learned* judges. Of these courts, one possesses the right of decision in all cases involving sums of more than L.30, or in which certain government officers are the parties. Its jurisdiction extends also to criminal cases. Another decides, in connection with the provincial intendant, fiscal causes; and its decision cannot be appealed from in any suits under L.40. The third of these courts, which is composed of one learned and of one commercial judge, together with the collector of customs, has the power of giving a final decision in revenue cases involving confiscation. The fourth has jurisdiction in suits for libel. But before there can be any prosecution in such cases, they require to be heard before four judges of the fact, whose duty it is to decide whether there be just cause for carrying them before the seven judges, who finally decide the case. At the second hearing the legal judge presides and decrees the penalty.

There are eleven kinds of inferior tribunals, some having as important spheres of jurisdiction as the lower grades of the superior courts; but differing widely in the nature and extent of their powers. They resemble each other, and differ from the superior courts in this—that the presiding judges are not educated lawyers.

The ecclesiastical and military tribunals, composed respectively of dignitaries of the church and officers of the army, decide in all cases pertaining to their several spheres of duty. The Exchequer Court, over which the chief of that department presides, takes cognizance of suits arising in matters connected with that branch of the administration. The tribunals of commerce consist of members appointed by all the commercial districts except Valparaiso, and exercise jurisdiction in all cases relating to mercantile affairs. The remaining tribunals, composed of the various grades of provincial officers, have under their jurisdiction a great variety of subjects relating to mining, public roads, theatres, some domestic matters, money claims, and the lesser crimes. The Domestic Court consists of five fathers of families, summoned by the political chief of the province or department in which they reside. It hears and decides upon the complaints of minors against their parents, for refusing assent to their marriage. Complaints of this nature are of more importance in Chile than in other countries, as majority is not reached by single men till the age of twenty-five, while it is attainable through marriage at twenty-one.

Provincial administration.

For the administration of its internal affairs, Chile is divided into thirteen provinces, each with subordinate departments, sub-delegations, districts, and two settlements. The names of the provinces are,—Atacama, Coquimbo, Valparaiso, Aconcagua, Santiago, Colchagua, Talca, Maule, Nuble, Concepcion, Arauco, Valdivia, and Chiloë, and of the settlements Magallanes and Llanquihue. Each of these provinces is governed by an intendant, who is nominated by the president, and holds office for three years. The departments are under the control of governors, who hold office for a similar term.

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The intendant generally acts as governor in that department in which the capital of the province is situate, and is, at the same time, mayor of the municipal corporation; but the authority of this body is very limited, as it cannot dispose even of its local funds without the permission of government. The sub-delegations are directed by subdelegadoes, who are appointed by the governors for a period of two years. Their jurisdiction extends only to minor criminal cases, and to civil suits involving sums of between L.8 and L.30; but they have also appellate powers from the decision of the inspector's court in actions for sums under L.2, 8s. The districts are presided over by inspectors, who are chosen by the people, and hold an office similar to that of justice of the peace. They manage also the local postage arrangements. Their decision is final in all suits for sums under L.2, 8s., but they also dispose of cases involving sums as high as L.8, with an appeal, however, to the sub-delegado. The offices of sub-delegado and inspector are compulsory; and those who decline to undertake their duties are liable to fines equal to the sums limiting their respective legal jurisdictions.

Church.

The Roman Catholic religion is the only form of worship recognised by the constitution of Chile; and the profession of any other is strictly prohibited by law. For the purposes of ecclesiastical administration, the country is divided into 4 dioceses (comprehending the archbishopric of Santiago and 3 suffragan bishoprics), and 157 parishes. A home mission, consisting of 2 prefects and of 7 missionaries, is also supported by government at the annual expense of L.4000. Each missionary receives a salary of L.62, 12s. per annum, for which he is expected to say mass daily, and teach reading and writing in the schools. Great efforts have been made to induce the Indians to adopt the religion sanctioned by the state. In the island of Chiloe, which is chiefly inhabited by native tribes, a propaganda has been established for this purpose; and 9 missionaries have been sent to spread the faith among the Araucanian Indians. These attempts have as yet been crowned with little success. Schools have been established for the young; but notwithstanding the liberal donations of clothing and other articles on the part of the priests, the attendance is said to be very small.

In return for her exclusive privileges, the church in Chile yields a large revenue to the public finances. In 1853 the tithes yielded the sum of L.105,388, while all the expenses for public worship amounted only to L.53,385, 4s. In 1854 they amounted to L.120,895; and in 1855, when they were commuted into a property tax, L.151,554. The expenditure in this last year amounted to L.48,417, of which L.23,539 were for building and repairing churches.

Although no form of dissent is professedly allowed to exist in Chile, a tacit toleration has for some years been accorded to an English Episcopal and also to an American Presbyterian chapel at Valparaiso, where the American and English residents constitute a considerable population. Although the attendance at these chapels indicates a religious indifference on the part of the Protestants, the government stands too much in awe of the priesthood to allow them full toleration; as any important concession to the professors of the Reformed faith might lead to a revolution. The power of the Roman Catholic priesthood is particularly manifested in the obstacles by which they endeavour to prevent the marriage of a Protestant and a Catholic. If a Protestant proposes to marry a Roman Catholic Chilena, he must either publicly apostatize from his own faith, or purchase a *dispensa*, by making a liberal present to the bishop of his diocese; and in all such marriages it is made an indispensable condition that the children be educated in the Roman Catholic faith. The same bigotry prevails in the laws which regulate the interment of Protestants, though the stringency of these has of late been somewhat relaxed In Santiago, adjoining the public cemetery, government has allotted a piece of ground as a burying-place for Protestants; and in Valparaiso and Coquimbo the same has been done by private individuals, with the permission of government; while in the churchyard of Talcahuano several Protestants are sleeping peacefully beside their Roman Catholic brethren.

Education.

Much attention is now given in Chile to the important subject of education, and this is in no small degree owing to the exertions of the late president, M. Montt. The first in rank of the educational establishments is the National Institute, composed of two departments—the university, and preparatory section—occupying one large edifice. The university has 15 professors, whose salaries range from L.200 to L.400 a-year; while the average number of students is about 220. No fees are charged, and any one who has the requisite elementary knowledge may attend the classes. It is governed by five deacons, a secretary, and representatives from the faculties of science, philosophy, humanity, medicine, law, political economy, and theology; who are also charged with the superintendence of education in the provinces. The preparatory section corresponds to our grammar or high schools; and here, too, education is free. Those who reside in the school pay L.30 a-year for board. In 1856 the number of scholars was 663, of whom 217 were boarders. The educational staff comprehends a rector, vice-rector, and 26 masters, whose salaries range from L.400 to L.40 a-year. There are also eleven inspectors, whose emoluments vary from L.40 to L.80.

The National Institute costs government about L.9000 a-year. In Santiago government also supports a military academy (annual charge about L.6000), a school for the instruction of mechanics (L.5200), a training school for teachers (L.2500), and a seminary for the education of priests (L.1200). In addition to these, an agricultural school, an academy of painting, an academy of music, a school for the deaf and dumb, and other useful institutions, are all supported at the national expense. A lyceum, on the same plan as the National Institute, is established in every provincial capital, and is supported by local taxation, government grants, and fees from pupils. In these institutions boarders pay an annual sum of L.20, and day scholars L 2, 8s.; but many receive instruction gratuitously. The directly practical branches of education receive the largest share of attention, but the learned languages are not neglected. The lycea of Talca, Concepcion, and Serena possess the privilege of granting degrees in mathematics and chemistry.

Besides these, government supports throughout the country 352 schools, where poor children are taught reading, writing, arithmetic, and the Roman Catholic catechism; the municipal corporations support 96 similar schools; and 315 schools are carried on by private individuals. According to a curious paper published by the minister of public instruction in 1856, there were 3794 children learning Spanish grammar, 1652 learning French, 1392 English, 1315 Latin, 325 German, 1 Greek, 1340 drawing, and 1774 music.

To aid in the diffusion of knowledge, government prints and disseminates all over the country cheap editions of standard authors, chiefly French.

The capital contains also an excellent observatory, a museum, and a public library with about 32,000 volumes.

Government pays for the education of 12,600 boys, and 3430 girls; the municipalities for 3680 boys, and 1470 girls; and those educated at their own expense in private schools amount to 6700 boys, and 3100 girls. The total expenditure of government for educational purposes in 1855 was L.55,560. The salaries drawn by professors and teachers during the same period may be estimated at L.21,000, of which government contributed L.9000, the municipalities L.7000, and the private schools L.5000. The average salary of a schoolmaster in Chile is L.3 per month, the highest L.20 per month. Akin to these statistics it may be added, that government contributes to 12 hospitals annually L.8000; and supports a madhouse (at L.500 per annum), a penitentiary (at L.5000), house of correction (L.1000), a convict establishment in the island of Juan Fernandez (L.1000), besides prisons, a company of French Sisters of Charity, dispensaries, and vaccination establishments.

Literature.

The press of Chile is in an improving and progressive condition. Eight or ten newspapers and one magazine, the *Revista Catolica*, are published in the republic. Of these, the first place is due to the *Mercurio*, both on account of primogeniture and fearless devotedness to justice. The mistakes committed by government and its officials, and the sallies of illiberality and ignorance of the clergy, as shown in their mouthpiece, the *Revista*, are censured in its columns with firmness and dignity; while it is the first to present a tribute of approval to whatever either of these do worthy of praise. The *Ferrocarril*, another daily paper, is fast increasing in popularity; it is cheap, abounds in "town-talk," and presents its

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readers with some very well written articles. Government makes known its decrees and enactments through its gazette, the *Araucano*. The only other paper of note is the *Diario*, published, like the *Mercurio*, in Valparaiso. The literature of Chile is supported by several able writers.

Army and navy.

The army of Chile averages about 2700 men, the militia 40,750, and the invalids 530. The whole of the troops are under the superintendence of general inspectors. Of superior officers there are,—1 lieutenant-general, 5 generals of division, 3 brigadier-generals, 20 colonels, 51 lieutenant-colonels, and 126 captains. But several of these officers are either on the retired list, or engaged in other departments of military service. One brigadier-general superintends the military academy (founded in 1842), in which about 40 cadets receive instruction.

The fleet of Chile, which acquired so much distinction for its exploits under Lord Cochrane, and was then manned chiefly by British or North American seamen, is now composed of the old frigate *Chile* (at present used as a store-ship), 2 brigs, 1 brigantine, 1 barque, and 2 steamers. A naval school was established at Valparaiso in 1845.

The total expenditure of the war department in 1855, or, in other words, the cost of the army, navy, national guard, and pension fund for maimed soldiers and sailors, and their widows and orphans, was L.312,216, 14s. The annual pay of a private in the Chilean service is L.19, 4s., of a lieutenant, L.96; of a captain, L.144; of a lieutenant-colonel, L.336; and of a colonel, L 542. The general-in-chief has a yearly salary of L.1300; generals of division, L.700; and brigadier-generals, L.542.

The pay of a vice-admiral is L 1300 a-year; of the captain of a first-rate ship, L.768; of the captain of a corvette, from L.110 to L.180; and of a midshipman from L.84 to L.110.

Population.

Table showing the Names of the Provinces and Departments, the Amount of their respective Populations, and the Number of those who can Read and Write.

Provinces.	Departments.	Population in 1855. Male	Female	Total.	Able to read.	Able to write.
	MAGALLANES (Colonia de).	88	65	153	—	—
CHILOE.	Ancud	3,505	3,364	6,869	1,109	962
	Chacao	1,515	1,481	2,996	232	209
	Dalcahue	2,861	2,894	5,755	630	511
	Castro	5,356	5,203	10,559	1,806	1,482
	Chonchi	3,437	3,300	6,737	712	591
	Lemui	3,454	3,496	6,950	959	808
	Achao	3,356	3,662	7,018	1,007	865
	Quenac	1,772	1,729	3.501	419	370
	Calbuco	4,344	3,824	8,168	1,250	921
	Carlemapu	1,576	1,457	3,033	565	518
	Total	31,176	30,410	61,586	8,689	7,237
VALDIVIA.	Osorno	6,083	5,145	11,228	747	626
	Union	4,882	4,310	9,192	668	595
	Valdivia	4,652	4,221	8,873	1,908	1,545
	Total	15,617	13,676	29,293	3,323	2,766
ARAUCO.	Laja	12,410	11,997	24,407	2,719	2,314
	Nacimiento	4,820	4,371	9,191	915	709
	Arauco	5,005	4,863	9,868	862	728
	Total	22,235	21,231	43,466	4,496	3,751
CONCEPCION.	Concepcion	6,485	7,701	14,186	3,403	2,927
	Talcahuano	2,391	2,560	4,951	655	587
	Coelemu	12,129	11,556	23,685	2,134	1,911
	Rere	12,671	12,996	25,667	2,314	2,027
	Puchacai	13,140	13,312	26,452	2,348	1,866
	Lautaro	8,114	7,236	15,350	1,351	1,072
	Total	54,930	55,361	110,291	12,205	10,390
NUBLE.	Chillan	35,531	35,919	71,450	6,721	5,954
	San Carlos	14,517	14,825	29,342	2,698	2,465
	Total	50,048	50.744	100,792	9,419	8,419
MAULE.	Cauquenes	27,602	30,447	58,049	4,489	3,792
	Itata	17,212	17,987	35,199	2,332	2,105
	Constitucion	4,328	4,686	9,014	1,179	994
	Parral	8,665	9,637	18,302	1,861	1,366
	Linares	17,484	18,197	35,681	3,124	2,849
	Total	75,291	80,954	156,245	12,985	11,106
TALCA.	Talca	32,488	34.657	67,145	6,507	5,720
	Lontue	6,046	6,248	12,294	804	679
	Total	38,534	40,905	79,439	7,311	6,399
COLCHAGUA.	San Fernando	27,603	30,233	57,836	5,198	4,268
	Curico	36,463	40.277	76,740	6,077	5,122
	Caupolican	28,329	29,799	58,128	6,297	4,960
	Total	92,395	100,309	192,704	17,572	14,350
VALPARAISO.	Valparaiso	25,510	26,903	52,413	14.885	12,721
	Juan Fernandez	162	77	239	41	39
	Quillota	22,919	23,473	46,392	6,022	4,523
	Casa-Blanca	7,036	6,952	13,988	1,611	1,310
	Ferrocarril	2,349	662	3,011	315	305
	Total	57,976	58,067	116,043	22,874	18,898
SANTIAGO.	Rancagua	42,608	41,752	84,360	7.300	6,020
	Melipilla	14,300	14,256	28,556	2,854	2,284
	Victoria	15,704	14,406	30 110	2,592	2,145
	Santiago	61,002	68,471	129,473	33,088	26,689
	Total	133,614	138,885	272,499	45,834	37,138
ACONCAGUA.	San Felipe	11,771	12,979	24,750	3,855	3,532
	Santa Rosa de los And.	12,165	12,789	24,954	2,862	2,284
	Putaendo	10,211	10,494	20,705	2,085	1,638
	Ligua	6,026	5,974	12,000	1,086	846
	Petorca	13,979	15,116	29,095	2,066	1,660
	Total	54,152	57,352	111,504	11,954	9,960
COQUIMBO.	Illapel	11,948	12,788	24,736	2,497	2,111
	Combarbala	5,281	6,201	11,482	711	621
	Ovalle	17,926	19,364	37,290	3,214	2,528
	Elqui	5,042	5,700	10,742	1,821	1,514
	Serena	13,800	12,539	26,339	6,017	5,050
	Total	53,997	56,592	110,589	14,260	11,824
ATACAMA.	Freirina	4,095	2,694	6,789	1,251	1,060
	Vallenar	6,186	5,114	11,300	2,270	1,926
	Caldera	1,703	830	2,533	657	464
	Copiapo	18,842	11,226	30,068	8,217	7,134
	Total	30,826	19,864	50,690	12,395	10,584
	Entire total	712,932	726,188	1,439,120	193,898	153,294

Cities.

The cities and towns of Chile, with the exception of Valparaiso, are built generally upon the same plan. Their most striking peculiarity is, that they are divided into squares of equal size, the sides of which are about 137 English yards in length, and inclose an area of about four acres. Within each of these quadras there are parallel rows of broad and well-paved streets, intersecting each other at right angles. The houses are also built in the form of a square, inclosing one or more courts, into which the various apartments look; and are of timber, bricks, and adobes, which are large bricks formed of mud mixed with chopped straw, and dried in the sun. The unoccupied spaces are in most cases laid out in gardens, and stocked with fruit trees and flowers. In the larger cities great taste and elegance are displayed in the furniture of the houses of the wealthy, the greater part of which is supplied by the principal upholsterers of Paris. Every drawing-room contains its piano from the first London or Paris makers: and as the Chilenas are passionately fond of dancing, a pile of fashionable waltzes, quadrilles, and polkas, is generally seen beside it.

Public buildings.

The most splendid public edifice in Chile is the mint, which is built of brick, at a cost of L.165,000, and contains the apartments of the president of the republic. In ecclesiastical architecture Chile is inferior to most Roman Catholic countries. The majority of the churches are very plain; and the internal decorations, paintings, and images are for the most part of a very paltry description. The Compañia and Santo Domingo, however, display considerable taste. The cathedral church has been designed on a very grand scale; and although still unfinished, has already cost L.340,000. The cathedral of Serena is small, but much admired for the style of its architecture,

which, with the light magnesian limestone used in its erection, is well calculated to resist the dangers arising from the frequency of earthquakes.

In costume the wealthier classes in Chile have discarded the picturesque dress of their Spanish ancestors, and cannot now be distinguished from those of London and Paris.

In complexion the natives present considerable variety. Among the peasantry the Araucanian copper colour still prevails; but in consequence of the large infusion of European blood, a greater variety of shade is to be found in the upper and middle classes. In general their complexion closely resembles that of the natives of Southern France.

Amusements. The amusements of the upper classes are also borrowed from the habits of European society. In the ball-room the dances are those of the Old World, with the exception of the *zambaqueca*, a dance peculiar to the republics of South America, and only danced in Chile at the breaking up of parties when all have become very familiar. In fashionable assemblies the piano is the accompaniment; but amongst the poorer classes its place is taken by the guitar.

Theatrical amusements are well patronized in Chile It contains five theatres, of which the best is in the capital, built at the expense of L.70,000, and capable of containing 2000 people; next in rank is the theatre of Valparaiso, a very commodious edifice; and then those of Copiapo, Coquimbo, and Concepcion. Spanish and French plays, and the Italian opera, are well received in all these, although it must be confessed that much still remains to be done to bring them up to the standard of European excellence. Races and military reviews are common in Chile. The former of these are held on courses about six hundred yards in length; and as the issue of the race depends on a successful start, considerable ingenuity and tact are shown in training the horses to commence with a sudden bound.

Mineral productions. Chile is rich in almost every class of metals; and of late years the silver mines have yielded enormous quantities of ore. The metals at present discovered are gold, silver, copper, lead, antimony, cobalt, zinc, nickel, bismuth, iron, molybdenum, and quicksilver; but the only ores which are worked are gold, silver, copper, and occasionally quicksilver. The latter has now been abandoned in consequence of the low price of mercury, caused by the quantity produced in California. The metals are found in all the series of rocks between granite and trachyte, in veins generally running from N. and N.W. to S. and S.E.; in some places, however, their course is irregular; or they extend E. and W. The auriferous veins run nearly parallel to the grain or imperfect cleavage of the surrounding granite rocks. Gold is found most abundantly in the beds of detritus derived from the degradation of the upper portion of the rocks. Copper ores, containing a small quantity of gold, are generally associated with micaceous specular iron. In the hills of Altruc, about 4 leagues from Rancagua, in the province of Santiago, are the only gold mines worked with any spirit, excepting some new mines near Copiapo, and they are remarkable for the variety of minerals mixed with the gold, such as galena, blende, copper and iron pyrites, and peroxide of iron. These substances are found disseminated in quartz veins running nearly N. and S. Near Illapel are some very poor gold mines, in the beds of the gypseous formation, in altered felspathic clay-slate, which alternate with purple porphyritic conglomerate.

Silver. Until 1832 the only silver mines in Chile were those of Dehesa, San Francisco, San Lorenzo, Sema and San Pedro Nolazco in the province of Santiago, and Arqueros mineral district, about 17 leagues from Coquimbo; but these mines now produce very little silver, and are nearly abandoned for the rich silver mines in the province of Atacama, near to Copiapo. Within a circuit of 25 leagues from Copiapo there are 19 silver mineral districts; the richest are Chañarcillo and Tres Puntas. In Chañarcillo the upper part of the mines produce native silver, iodide, and bromide, associated with chloride of silver, and carbonate of lead. In the "Colorado" mine of Chañarcillo, embolite with native silver is occasionally found. In the mine of San Antonio, in the same district, is found bismuthic silver ore combined with native silver, copper, and arsenic. As the mines become deeper, the silver ores are changing principally into what the natives call "metales frios" (cold ores); these contain different proportions of antimony, sulphur, and one sort a little arsenic. The dark red silver ore is a pyrargyrite, containing sulphuret of silver and antimony, with sometimes a little arsenic. The gray ore contains silver, arsenic, and antimony. Some of the mines in Chañarcillo yield nearly pure silver; the most productive are in the hands of four or five large capitalists. The ground near some of the richest mines is sometimes sold at enormous prices, the price being in some regulated by the probability of rich veins of metal running into it. In Copiapo a regular traffic is carried on in buying and selling "barras" (a twenty-fourth part) in different mines.

A railroad runs from Caldera to Copiapo, a distance of 54 miles, and from that city on to Chañarcillo, a distance of about 50 miles; and a tram-road to the rich mineral district of Tres Puntas (8400 feet above the sea) has recently been completed, by which the miners are now enabled to send down the poorer silver ores which they formerly threw away.

Copper. The mines of copper may be said to occupy the first rank in the productions of Chile. The exports of copper ingots and ores in 1852, according to their market value at the time of shipping them, were equal to nearly L.800,000; in 1854 they amounted to L.864,520; and in 1855 to L.1,211,130. Copper is found in more or less abundance from the province of Santiago to the most northern confines of Chile. It is generally discovered in the lower granitic and metamorphic schistose series. The copper ores found in Chile consist of sulphurets, copper pyrites, oxysulphurets, found in Andacollo, with thin laminæ of native copper, arsenical copper (sometimes called domeykite), found in the Calabazo mine near Coquimbo and in that of San Antonio, near Copiapo, gray copper, red oxide, malachite, azurite, hydrosilicate, or chrysocolla, olivenite, protoxide, and deutoxide. Vanadiate of copper has lately been found in cavities in an arseniophosphate of lead, along with amorphous carbonate of lead and copper, in Mina Grande or La Marquesa, near Arqueros. That rare ore, the muriate of copper, or atacamite, occurs at Remolinos and Santa Rosa in veins in granite. The principal mining districts are Aconcagua, Illapel, and Tamaya, about 40 miles from the coast, and 70 from Coquimbo. This last district is a mountain about 3500 feet above the sea, which produces about 150,000 quintals a-year of various kinds of sulphurets, of a produce from 9 to 64 per cent. Tambillos, 10 leagues from Coquimbo, produces principally poor sulphurets; Runeral, near the river, entirely poor carbonates; Andacollo, carbonates, oxides, oxysulphurets, and native copper; La Higuera, black sulphurets and pyrites; Herradura de Carisal and Huasco, carbonates and sulphurets of low produce. In the Cordilleras above Huasco are some mines containing ores of copper, silver, and lead combined together; but the silver does not exceed 70 marks the cajon of 64 quintals Spanish.

Cobalt. Cobalt is found in the province of Santiago, near the Cordillera called Caro del Volcan; it is an arseniate containing from 18 to 20 per cent. of cobalt. At Tambillos is found glance cobalt, and arsenite or erythrine; the former sort is frequently combined with nickel. The mines have been worked some years, and the ores shipped to England. In Huasco similar ores are found, but the mines have lately been abandoned.

Nickel. Nickel has been found in considerable quantities in a mine in the Cordilleras above Copiapo.

Zinc, &c. The sulphuret of zinc is found in various parts; likewise antimony, lead, manganese, bismuth, mercury, and molybdena; iron ores of every description are very abundant; amongst the latter is coquimbite, or white copperas, and copiapite, or yellow copperas. It is much used by the natives for dyeing, tanning, and in the manufacture of ink.

Gypsum. Gypsum is found in immense beds, particularly in the valley of the Pinquenes, and other places in the province of Santiago. The fine massive variety called alabaster is found at the Salto de Agua, near to Santiago, of a quality nearly equal to that of Italy.

Lapis Lazuli. Lapis Lazuli has been found in the Cordilleras above the province of Coquimbo, but it is impossible to convey large slabs to the coast, and the principal use of the small pieces is to make ultramarine; and as the artificial equals the native in brilliancy of colour and permanency, it is not likely to be of much value.

Coal. In the province of Concepcion, the coal mines are becoming of great importance. At present they are confined to two districts, Coronel and Lota; the former has 12 mines in full work, but the latter not so many. The Concepcion coal is excellent for the manufacture of gas and for domestic purposes;

but for the smelting of copper ores it requires to be mixed with English coal. Its average price at the pit-mouth may be quoted at L.1 per ton; and the average annual produce, when the gasworks of Santiago, Valparaiso, and Copiapo are in full operation, may be expected to amount to 400,000 or 500,000 tons.

Vegetable productions.

The annual value of the agricultural produce is estimated by the government at L.1,481,776; but as rural produce to the amount of L.1,090,000 is exported, we may take it for granted that at least twice the amount exported is consumed in the country, and therefore the more correct estimate will be L.2,180,000. Irrigation is extensively practised, without which the greater part of Chile would be unproductive. The level lands thus watered yield abundantly corn and wine, and rich pasture on which the farmers fatten the cattle bred upon the hilly portions of their estates. These hills are sparingly covered with a peculiar kind of short and wiry grass, which, after one winter of abundant rain, lasts for two seasons, even although the succeeding winter may have been dry.

These arid regions likewise produce the carbon tree, which affords excellent firewood, but is used for nothing else. The carrob tree, which, in defiance of a broiling sun, stretches out his spacious limbs covered with foliage, forming a most delicious retreat to the weary traveller by day as well as by night; the espino (*Acacia cavanea*), inferior to the carrob tree in size, hardness, and durability of its timber; and the great torch thistle, whose long, smooth spines are used by the country people for knitting-needles, and whose interior woody substance, stripped of its fleshy bark, forms the beams and rafters of their cottages. Timber is abundant in all the provinces S. of Santiago, but chiefly in Arauco, Valdivia, and Chiloé, which may be termed the forest region of Chile. There are altogether above a hundred different kinds of indigenous trees, of which not more than thirteen ever shed their leaves. Several have been found serviceable in ship-building; but for purposes of house-carpentry, none afford an adequate substitute for pine. Ornamental woods are scarce, and too soft for the use of the cabinetmaker. The principal timber trees are the Chilean oak, which attains a height of 40 feet; the lingue (*Persea lingue*), 90 feet; the cypress (*Libocedrum chilense*); the patagua (*Tricuspidaria dependens*), 40 feet; the laurel (*Laurentia aromatica*), 60 feet; the luma (*Myrtus luma*), 30 feet; the Araucanian pine, 150 feet; and the alerce, or Chilean cedar (*Libocedrus tetragonia*). The most valuable is the Chilean cedar, a soft but durable wood, and not liable to warp. The trunk is divided into pieces of 8 feet long, and so straight are its fibres that they are split into small boards 6 or 7 inches broad, and about half an inch thick—a single trunk yielding 500 or 600. In Valdivia and Chiloe they form the chief article of export, and are used for purposes of exchange. The roble grows to the height of the English oak, and retaining its soundness in water, furnishes excellent stakes. The bark, when prepared with lime, is used for tanning, and imparts to leather a reddish colour. The timber of the luma bears a closer resemblance to the English oak than that of the roble. The laurel is a tall handsome tree, but its wood is hard, and warps so much that it is only suitable for the coarsest work. The cypress grows to a height exceeding that of the loftiest trees in England. Its wood is of a red colour, and is used for beams, doors, pillars, and ornamental flooring. In the S. of Chile, the quillay tree (*Quillaja saponania*) flourishes in great abundance. A decoction of the bark is of great service in clearing the colours used in dyeing, in cleansing articles of silk and woollen cloth, and as a wash for the hair.

The Araucanian pine flourishes on the high lands S. of the Biobio, and grows in pairs—the female under the foliage of the male. The fruit, which takes two years to ripen, is arranged conically, each cone containing from 50 to 100 nuts, 2 inches long, and which, when cooked, form more delicate eating than chestnuts. Under the governorship of O'Higgins their trunks were used for ship-masts; but at present the expense of bringing them to the coast prevents their being employed as such. In the gardens of Coquimbo, a fruit tree known by the name of the *Lucumo achraes* is much cultivated. Its fruit, which is about the size of a small orange, resembles somewhat a hard-boiled egg, but is too dry and insipid to form a palatable article of food.

The potato, whose introduction into Europe formed an important era in the history of agriculture, is indigenous to Chile, or, as some assert, to Peru. In the equatorial regions of South America this plant was formerly cultivated on the sides of the Cordilleras at an elevation of many thousand feet above the limits of perpetual snow in the latitudes of Europe. It is still extensively cultivated in Chile. Much attention is also bestowed on the production of the French bean. This vegetable is a standard dish with all classes, and is to the Chilean what oatmeal is to the Scotchman.

The supply of the various kinds of fruit is very abundant in Chile. Apples, pears, cherries, strawberries, peaches, figs, oranges, melons, olives, quinces, and pumpkins abound, which, however, compared with those of England, are rather inferior. Yet, where cultivated with care, as in some private gardens in the neighbourhood of Santiago and Valparaiso, they are unrivalled in quality.

Animals.

In Chile the most formidable animal is the puma. On account of its ravages in the farm-yard, it is frequently hunted with dogs, or caught by the lazo. The guanaco roams about among the lower regions of the Chilean Alps in herds numbering from 20 to 100. The vicuña has fixed his abode at a higher elevation. The huamul is not found in such numbers, and is unknown in the Andes beyond the bounds of Chile. Otters, wild cats, foxes, and chinchillas are numerous.

The horses of Chile are inferior in strength and height to those of England, but greatly superior in point of endurance. The mule is the beast of burden, and will carry on an average a load of 355 lb. a distance of 20 or even 30 miles per day. The breed of cattle is good; those of sheep and pigs are fast improving.

Among the birds of Chile the most remarkable is the condor, which is easily recognised by the white ruff encircling its neck. As its wings on an average extend 8 or 9 feet, its flight has a very majestic appearance. Humboldt mentions having seen one flying at the height of 22,000 feet above the level of the sea. They scent an exposed carcase from a great distance, and soon gather round it in immense numbers. The turkey-buzzard is also very common; and when these meet the condors over the same prey, the coveted prize becomes the subject of fierce contest. These two species are most abundant in the northern districts; while eagles, hawks, and owls are more numerous in the S. The only song-birds worthy of notice are, —the tenca, the thrush, the tordo (a kind of blackbird), and the moylloyca (a kind of redbreast); but none of these can rival the notes of our English birds. The tenca is said to emulate the mocking-bird in imitative power. The tapaculo (*Pteroptochus albicollis*), a bird about the same size as the thrush, rarely flies, but runs about with great agility, emitting an odd but cheerful note. The chingol, or sparrow, has gayer plumage than his European representative. Besides these, parroquets, flamingoes, partridges, and woodpeckers abound in several localities. The pelican, the albatross, the penguin, and the shag, of which there are numerous varieties, frequent the shores.

Great varieties of fish are found off the coast of Chile, and of these the pichihuen, which is caught chiefly in the Bay of Coquimbo, is regarded as a choice delicacy. There are abundance of small sweet oysters off the coast of Chiloé; quantities of huge mussels, barnacles, and fissurellæ, off Concepcion; and large clams off Coquimbo; besides sea-eggs, cockles, limpets, &c., which are found in great plenty all over the coast.

Of the reptiles of Chile, the lizards are the most numerous, and they are very harmless. Serpents are found varying from 12 to 30 inches in length. The honey-bee is propagating very fast. Of beetles, there are from 3000 to 4000 species not found in Europe.

Agriculture.

Agriculture as a science is scarcely known in Chile, and everything connected with the farm is still of the most primitive description. The plough is a clumsy one-handed instrument, formed from the crooked trunk of a tree. In using it the peasant grasps its handle in his right hand, while in his left he wields a long sharp-pointed stick to goad on the oxen, which are invariably yoked not by the shoulder but by the horns. The operation of treading out the corn is performed by mares. For this purpose the sheaves are piled up in bundles in the centre of an extensive circus, having an empty space of from 10 to 20 feet between the heap and the inclosure; and some of the bundles being spread over this space a troop of mares are made to gallop over them until all the

grain has been beaten out. Winnowing is performed by throwing up spadefuls of grain into the air on windy days. All the other operations of the farm are performed in an equally unskilful and tedious manner. So rude is the mode of harvesting wheat, barley, and beans, that at least from 6 to 7 per cent. of the produce is lost, and goes to breed swarms of vermin on the farm. The labourers earn from 1s. to 1s. 6d. a-day, with food.

Maize is largely cultivated in all parts of Chile, but not to such an extent as wheat. As the corn plant spreads out into numerous stems, half the quantity of seed used in England is quite sufficient to cover the field with an abundant crop.

The provinces of Aconcagua, Santiago, Talca, Nuble, Maule, and Concepcion, yield annually large crops of wheat, maize, and French beans.

The lands of Aconcagua produce about 50 or 60 fanegas of wheat on every quadra, equal to about 30 or 40 bushels an acre; Santiago from 30 to 35 fanegas on every quadra; Colchagua from 25 to 30; Maule from 15 to 18; Nuble, Talca, and Arauco from 15 to 20; and Concepcion from 8 to 10. The total produce of wheat may be estimated at 1,000,000 quarters, but is increasing annually. The price of wheat has risen considerably of late years. Between 1840 and 1850 the average price was from 18s. to 24s. per quarter; while in 1851 and 1852 the average price ranged from 42s. to 44s.; and in 1856 from 55s. to 65s.

The backward condition of agriculture in Chile is owing to the thinness and natural indolence of the population, and the absence of easy means of transportation. The government has for several years taken vigorous measures to encourage emigration from Europe into Chile, chiefly with the view of promoting the agricultural interests of the country. A great number of German agriculturists have already settled in the province of Valdivia, and every year is making additions to their number. Between 1848 and 1852 a single house in Hamburg sent out more than 1000 individuals. The presence of these industrious settlers cannot fail to exercise a favourable influence on the habits and pursuits of the native population.

Manufactures.

Manufactures are here as yet only in their infancy. In Santiago a cloth factory has been commenced under the protection of government, but hitherto it has produced only the coarser kinds of cloth, such as are used in the army. All the other looms in Chile are worked by the hand, and used in the production of carpets and ponchos, some of which, made of vicuña wool, are of a very fine texture. A large portion of the population wear home-made stuffs, especially woollen. The importation of British goods is, however, increasing; and the facility with which foreign stuffs can be imported has checked the establishment of important manufactures. Coarse earthenware, cordage, combs, leather, saddles, and wooden stirrups, are made in several parts of the country. In Valparaiso and Maule ship-building is carried on. In the cities and larger towns most of the mechanical trades which exist in other parts of the world are pursued.

Commerce.

The commerce of Chile has vastly increased since the time when the country lay torpid under the yoke of Spain. As soon as it had recovered from the unsettled condition caused by the revolution, business of all kinds acquired new energy, and the trade, freed from its oppressive restrictions, extended to the larger ports of the United States and Europe. A few years were sufficient to show a large increase in its export and import trade, and Valparaiso soon rose to be a flourishing port.

In 1855 Chile exported silver, copper, and cobalt, to the value of L.2,063,300; of this amount L.1,211,130 was in copper, L.850,530 in silver, and L.1640 in cobalt. Of wheat the average annual export may be estimated at 95,000 quarters, which, at 50s. the quarter, gives L.237,500; and the average value of the wool exports at L.50,000. The greater part of the jerked beef, ham, fat, butter, and cheese produced in the southern provinces is exported to those in the north, where it is consumed by the miners. Among the minor exports are,—horns, hoofs, rags, and timber.

In return for her various exports, Chile receives from England cotton goods; from France silks and various articles of luxury: and from other countries a variety of articles for domestic use. Chile has reciprocal treaties of commerce with Austria, Brazil, Belgium, Bremen, Sardinia, Denmark, France, Great Britain, Prussia, Sweden, Norway, Tuscany, Hamburg, Lubeck, Oldenburg, the United States, Peru, Ecuador, and the Sandwich Islands. Her commercial relations are most extensive with Great Britain and the British colonies, the imports into Chile amounting in 1852 to L.159,613, and the exports to L.1,093,772. Next in importance is the trade with France, the United States, and California. With the other republics of South America her commercial transactions, which were once considerable, appear to be on the decline.

Table showing the value of the Imports and Exports of Chile for 1855. This Table does not include the value of goods landed in bond and afterwards re-shipped, amounting, for that year, to L.1,566,858. Nationalized merchandise are those foreign goods on which custom dues have been paid:—

Countries.	Value of Foreign Goods Imported.			Total.	Value of Native Produce and Merchandise Exported.		Total.
	Free.	Belonging to Government Monopoly.	Paying Duty.		Native Produce.	Nationalized.	
	L.	L.	L.	L.	L.	L.	L.
France and her Colonies	51,114	...	513,599	564,713	196,958	31,397	228,355
England and her Colonies	380,812	...	931,173	1,311,985	1,802,995	54,489	1,857,484
Germany	27,953	2,856	304,733	335,542	157,836	3,144	160,980
Belgium	3,819	70	77,017	80,906	...	...	...
Holland	17	...	37,463	37,480	...	...	...
Spain and her Colonies	6,188	12,361	60,773	79,322	...	...	...
Sardinia	3,252	...	15,177	18,429	...	...	...
China	11	...	28,859	28,870	...	...	..
Polynesia	1,837	...	1,385	3,222	6,097	6,112	12,209
Australia	1,986	...	326	2,312	532,705	7,077	539,782
North America	165,799	2,399	250,848	419,046	314,622	15,307	329,929
Mexico	39,926	...	2	39,928	10	245	255
California	39,110	...	...	39,110	50,286	4,866	55,152
Central America	6,567	...	19,409	25,976	2,716	4,544	7,260
New Granada	88,999	...	...	88,999	7,134	210	7,344
Ecuador	24,499	425	18,652	43,576	10,869	5,772	16,641
Brazil	32	...	226,689	226,721	41,036	1,072	42,108
Uruguay	...	...	..	...	15,498	612	16,110
Peru	4,490	34,164	107,478	146,132	319,751	115,380	435,131
Bolivia	10,334	...	9	10,343	20,311	12,929	33,240
Argentine Republic	156,700	1,125	26,219	184,044	9,107	21,083	30,190
Ships' provisions	...	...	...	...	34,484	29,463	63,947
Total	1,013,445	53,400	2,619,811	3,686,656	3,522,415	313,702	3,836,117
In 1854 the total was	752,013	37,083	2,696,563	3,485,659	2,655,683	269,748	2,925,431

Chile.

TRANSIT TRADE.

Received.

	1854.	1855.
By Sea	L.4,412,649	L.5,197,785
Across the Andes	184,362	205,191
Total	L.4,597,011	5,402,976

Despatched.

By Sea	L 949,307	1,167,582
Across the Andes	142,680	224,516
Total	L.1,091,987	L.1,392,098

In 1854, 2526 vessels, having an aggregate burden of 752,347 tons, entered, and 2461 vessels, of 729,832 tons, sailed from Chile; and in 1855, 2757 vessels, of 841,842 tons, entered, and 2681 vessels, of 820,024 tons, sailed from Chile. Of those that entered during the latter year, 127,633 tons were English; 54,905 United States; 10,552 French; 7074 German; and 6366 Peruvian. Of those that sailed, 131,530 tons were English; 51,651 United States; 9001 French; 7557 Peruvian; and 7034 German.

The articles of importation that have been increasing most are sugar, tea, coffee, and iron; and as the rate of increase of these articles far exceeds that of the population, it serves to prove that the wealth of the nation is increasing.

The following may be considered as a pretty correct estimate of the value of the annual productions of Chile:—

Silver, copper, cobalt, and gold	L.2,100,000
Coal	300,000
Wheat	2,400,000
Minor products of the country	200,000
Total	L.5,000,000

Revenue.

The revenue of Chile is in a very prosperous condition, exhibiting a surplus of receipts over expenditure in the returns of several years. In 1845 the revenue amounted to L.1,083,169, 13s., leaving, after the necessary outlay, a surplus of L.410,215. In 1849 the revenue, including the surplus from 1848, was L.1,352,210. The surplus of 1849 was L.57,048, and this, together with the receipts of 1851, amounting to L.885,381, 8s., was entirely swallowed up during the revolution of the latter year. With the restoration of peace in 1852, the revenue rose to L.1,096,096, which, with the sum of L.24,000 paid by Peru as interest for its debt, gives an increase of L.234,714, 12s. over the income of the preceding year. In 1854 it amounted to L.1,189,244, and in 1855 to L.1,257,505.

Table of Revenue for 1855.

Customs	L.752,904	15	0
Government monopolies (sale of tobacco and cards)	181,665	15	0
Land-tax	151,754	4	0
Licenses	13,182	12	0
Stamp-paper	15,668	14	0
Mint	12,865	16	0
Post-office	15,464	14	0
Auction duties	1,185	12	0
Peaje	12,578	4	0
Catastro	19,987	0	0
Alcabala	55,570	12	0
Accidental sources[1]	24,677	6	0
Total	L.1,257,505	4	0

The catastro is a duty of 5 per cent. levied upon the sale of lands. The alcabala is a duty of 4 per cent. on the sale and exchange of immoveable property, and of 2 per cent. on the sale of mines. Peaje consists of tolls and pontages, and is levied on cattle, mules, vehicles, &c.

The customs levied at the different ports on foreign goods in 1851 were as follows:—

Valparaiso	L.515,659	1	9
Coquimbo	18,495	3	0
Huasco	5,616	3	3
Copiapo	30,917	9	6
Talcahuano	4,646	14	9
Constitucion	54	8	0
Valdivia	294	14	9
Ancud	830	17	6
Santa Rosa de los Andes	2,487	19	0
Total	L.579,002	11	6

Owing to the civil war of 1851, the ports of Coquimbo and Talcahuano remained closed against all commerce, both foreign and domestic, from the 7th September to the end of December in that year.

The exports of these two ports consequently fell off, as compared with the preceding year, L.59,474, 1s. 6d. in value; and the number of vessels which entered and sailed was only 517 in 1851.

The custom-house returns show a corresponding increase in the amount of duties received.

In 1850 they were	L 474,894	16	4
And in 1851 they were	579,002	11	6
Total	L 104,107	15	2

In 1851 several important restrictions were removed from the customs code of Chile, which had been only partially modified in 1834. The exportation of national produce was then declared free in principle, but a small duty was to be maintained for a short time upon a very few articles. All imports, with the exception of iron, steel, zinc, cotton, mercury, coal, agricultural tools, surgical instruments, and books, are liable to a moderate duty. Jewellery pays 2 per cent.; horses, mules, and dried fruit, 6 per cent.; shoes, linen stuffs, furniture, and various articles used only by the wealthy classes, 30 per cent. The duty on white wine is reduced to 10 reals per dozen, and on red to 8 reals. Teas pay 2 reals the pound. Grain of all kinds is subject to a moveable tariff. As long as the price in the home market does not exceed 16s. 8d. the fanega of 150 lb., foreign grain pays an import duty of 12 reals the fanega; but if the price rises to 20 shillings, the duty falls to 8 reals; and if it exceeds 25 shillings, the import duty ceases altogether.

Chile has lately imitated the postal arrangements of England, and letters are forwarded on a stamp, costing about 2½d., to all quarters of the republic. The number of letters which passed through the post-office of Santiago in 1852 was 71,168.

Government derives considerable profit from its monopoly of tobacco and playing-cards. To prevent the smuggling of tobacco, the authorities are obliged to maintain an expensive establishment of officers along the coast and among the mountains; and so stringent are the laws in regard to the growth of tobacco, that when it springs up, as it does, spontaneously in the court-yards of the houses, the inhabitants are liable to a fine if it be not immediately rooted up. But for these oppressive restrictions, tobacco would undoubtedly rank high among the exports of Chile, and add greatly to the revenue.

Expenditure.

The national expenditure for the year 1855 was thus distributed:—

The Ministry of the Exterior and Interior	L.259,436	2	0
The Ministry of Justice, Public Worship, and Education	184,804	12	0
The Ministry of the Hacienda (Chancellor of the Exchequer)	340,480	2	0
The Ministry of War	312,216	14	0
Total	L.1,096,937	10	0

The first sum includes the salary (L.2400) of the president of the republic, the salaries of the intendants and legations, the sums annually paid to the Indians, the grants to the hospitals, and the money expended in promoting colonization. The second sum includes the salaries of the minister (L.1200), and of the president (L.900) of the supreme court; and the third the salaries of the *employés* of the exchequer, the treasury, the mint, the customs, and the interest of the national debt, which last amounts to L.1,732,595.

Weights and measures.

The weights and measures of Chile are the same as those used in Spain, but according to the decree of January 1848, those of France are to be substituted in January 1858. The largest dry measure of capacity is the fanega, which is subdivided into twelve *almuds*, and contains 5,430,626 cubic inches. The usual corn measure is the half fanega, which is a long parallelopipedon having one of its narrow sides trapezoidal. The imperial bushel contains 2,218,274 cubic inches, so that the fanega of Chile is to the former as 2·448 to 1. The average weight of a fanega of wheat is 157 lb.

The old table of long measure is divided into lineas, pulga-

[1] The accidental sources are rents and sales of government property, fines, interests, discounts, and recovery of bad debts.

Chile.

das, pies, varas, and cuadras, or lines, inches, feet, yards, and quadras. Corresponding exactly in value to troy weight there are the Spanish granos, onzas, and libras,—or grains, ounces, and pounds; and to avoirdupois weight, onzas, libras, and quintales, or cwt. In liquid measure the English quart is equal to 1·022 Spanish cuartillo, and the imperial gallon to 4·089 cuartillos. Gold is bought by the castellano or marco. Its relative fineness is expressed by quillates or carats, 4 granos or grains making one quillate. The weight of the marco is equal to 4800 Spanish grains, or to 7 oz. 7 dwt. and 22 gr. English troy weight. The standard fineness of gold is 21 quillates. The relative fineness of silver is expressed by dineros, the dinero being equal to 24 granos; and the standard fineness of that metal is 10 dineros and 20 granos. The gold and silver coins contain nine-tenths of pure metal, and one-tenth of alloy. The copper coins are quite pure, containing no alloy. Their names, value, and weight may be most conveniently represented by means of the following table:—

					Spanish Granos.		French Grammes.
Gold—Condor.....	=	L.2	0	0	305·540	or	15·253
... Doblon..........	=	1	0	0	152 770	„	7·676
Silver—Dollar..........	=	0	4	0	500·768	„	25
... ½ Dollar........	=	0	2	0	250·384	„	12·500
... 20 Cents-piece	=	0	0	9⅗	100·153	„	5
... 10 Cents-piece	=	0	0	4⅘	50 076	„	2·500
... 5 Cents-piece	=	0	0	2⅖	25 038	„	1·250
Copper—Cent.	=	0	0	0½⅖	200·307	„	10
... ½ Cent.....	=	0	0	0⅕⅖	100·153	„	5

Table showing the relative value of the English Weights and Measures with those of Chile.

MEASURES OF LENGTH.

English.		New.		Old.	
Inch...........	=	2·539954 centimetros....	=	1·09	pulgadas.
Foot...........	=	3·0479449 decimetros...	=	1 09	pies.
Yard...........	=	0·91438348 metros......	=	1·094	varas.
Furlong.... ...	=	2·0116437 metros........	=	240·6545	varas.
Mile............	=	1609·1149 metros	=	12·8349	cuadras.

MEASURES OF SURFACE.

		New.		Old.	
Square yard	=	0·836097 { metro cuadrado..... }	=	1·197	{ varas cuadradas.
Rood...........	=	10·116775 areas..........	=	1447 862	Do
Acre...........	=	0·404671 hectarea......	=	5791·454	Do.

MEASURES OF CAPACITY.

		New.		Old.	
Quart.........	=	1·135864 litros............	=	1·022	cuartillos.
Imperial gal.	=	4·54345797 litros	=	4·089	cuartillos.

DRY MEASURES.

		New.		Old.	
Imperial gal.	=	4·54345797 litros..........	=	0·602	almud.
Bushel.........	=	36·347664 litros............	=	4·497	almudes.
Quarter........	=	2·907813 hectolitros......	=	2 9978	fanegas.

MEASURES OF WEIGHT.

Troy.		New.		Old.	
Grain..........	=	0·065 gramo................	=	1·302	granos.
Pennyweight.	=	1·555 gramos.	=	31·248	granos.
Ounce..........	=	31 091 gramos..............	=	1·0815	onzas.
Pound..........	=	0·373096 quilogramo.....	=	0·81111	libra.
Avoirdupois.					
Ounce.........	=	28·338 gramos.........	=	0·9856	onza.
Pound.........	=	0·4534 quilogramo.........	=	0·98556	libra.
Cwt.............	=	50·7869 quilogramos.........	=	110·38272	libras.
Ton.............	=	1015·65 quilogramos..........	=	22 07654	quintales.

The bushel is equal to 2⅔ almudes, and the quarter (8 bushels) to 21⅓ almudes.

The communication between the several towns of Chile is now greatly facilitated by roads, railways, and steam-vessels. The excellent road from Santiago to Valparaiso was constructed at a great cost by General O'Higgins, when president of the republic. A road, generally kept in good repair, connects the towns of Atacama and Concepcion. A railroad has been already established between Copiapo and Caldera; and in 1852 the president M. Montt laid the first stone on the line (about 90 miles in length) between Santiago and Valparaiso, and it is now rapidly advancing to completion. Another has been commenced between Santiago and Talca; while proposals for others from Serena to the sea, from Copiapo to Tres Puntas, and from Concepcion to Talcahuano, have also been laid before Congress. A line of electric telegraph has also been established between Valparaiso and Santiago.

Chile.

In 1835 the exclusive right of steam navigation between the ports of the republic was granted to a company, which commenced its operations in 1840. A similar privilege was afterwards extended to the same company by the governments of Peru, Ecuador, and New Granada. The communication between England and Chile is maintained by the way of the Isthmus of Panama. Steamers sail between England and Chagres, from which, by travelling across the isthmus, the Pacific is gained in two or three days, and the remainder of the journey continued in steam-vessels. The voyage from England to Chile by this route occupies about thirty or forty days.

History.

The name Chile is supposed to be derived from "Tchili," a word belonging to the ancient language of Peru, signifying "snow." The country first became known to Europeans in the sixteenth century. It was then to a considerable extent under the dominion of the Incas; but had been previously inhabited by certain tribes of Indians of a warlike and ferocious race, who at the period of the Spanish invasion still maintained their independence in a great portion of the country.

In the time of the Inca Yupanqui, grandfather of the monarch who occupied the throne of Peru on the arrival of the Spaniards, and the tenth in succession from Manco Capac, the reputed founder of the Peruvian empire, the first attempt was made by the Incas to extend their dominion over the territory of Chile. Yupanqui, leading his army across the desert of Atacama, and penetrating into the southern regions of the country, made himself master of a considerable portion of it. The permanent boundary of the dominions of this prince is said by some writers to have been determined by the River Maule; while others are inclined to think that the Rapel constituted the extreme limits of the Peruvian empire towards the south. The latter opinion is to some extent supported by the fact, that the remains of an ancient Peruvian fortress, apparently marking the frontier, are still found upon the banks of the Rapel; while no such remains are known to exist in any part of the country situate farther to the south. It is also worthy of remark, that this place of defence has evidently been built in the same manner as the frontier forts of Callo and Asuay, which were in all probability intended to answer a similar purpose in the province of Quito.

All the endeavours that were afterwards made by the Inca to extend his dominions further southward were unsuccessful. The better portion of the country still remained in possession of its native defenders till the arrival of the Spaniards in the year 1535, under the command of Almagro, once the friend and companion of Pizarro. For two years, amid almost unparalleled hardships, this general endeavoured to make head against the natives, who obstinately defended their soil; but at the end of that period he was obliged to retrace his steps over the Andes into Peru. Undaunted by the failure of Almagro, Pizarro resolved to attempt the conquest of Chile. He accordingly sent forward on this expedition 150 Spanish troops, with a body of Peruvian auxiliaries, under the command of Don Pedro de Valdivia, and was preparing to follow in person with a larger force, when he was assassinated in 1541.

Meanwhile Valdivia entered Chile, overran a great part of it, and fighting his way onwards, encamped at length on the banks of the Mapocho, where he founded the city of Santiago, the present capital of the republic. For the period of twelve years he maintained his position in the country. By the end of that time he had penetrated into the southern division of Chile, where, in addition to several other cities, he founded that which is now known by his

name. His life and conquests were at last brought to an end in a desperate engagement with the Araucanian Indians.

After these events, the war continued to be carried on with various success for the long period of 180 years. At the end of that time, however, the Indians had succeeded in altogether recovering their original possessions, and all the cities founded by Valdivia fell into their hands. For another century, however, they were exposed to the constant inroads of the Spaniards, who were unwilling to give up all hope of ultimately conquering the southern part of Chile. At length, in the year 1722, this sanguinary war was brought to a termination by a treaty which defined the River Biobio as the boundary between the Indian and the Spanish territories.

That part of the country which remained in possession of the Indians lay chiefly between the River Biobio and the island of Chiloë. All the territory N. of this river was entirely subject to the dominion of the Spaniards. It was divided by them into thirteen districts or provinces. Most of these provinces were very irregular in size, some of them extending from the Andes to the sea, while others, whose locality was nearer to the mountains, or upon the sea-coast, occupied only about half of that space. In the political contest between Spain and her American colonies, the inhabitants of Chile declared their independence, which, after a contest of some years, was acknowledged by the parent state.

A long period of profound peace followed the treaty which had been concluded with the Araucanians in 1722. During that time, however, changes of great importance were gradually developing. A new and important class of inhabitants had arisen in the country, composed of the Creoles or natives of Chile, who were of Spanish extraction, and who spoke the Spanish language. By a perverse course of misgovernment, the authorities in Spain completely alienated the minds of this class from the mother country. It was unfortunately a maxim with the home government, that the colonies existed only for the sake of Spain. The viceroys, captains-general, and officials of all grades, instead of conciliating the Chilenos, regarded them only as a means of furthering their own aggrandizement. Their insolence and tyranny, persisted in for many years, at length excited against them so bitter a feeling of hatred and discontent, that nothing but the opportunity was wanting to blow into a flame the smouldering fires of rebellion. In 1810 that opportunity occurred, when the mother country was overrun by the armies of France, and no longer able to vindicate her own claims to a national existence. In July of that year the Chilenos took the first step towards asserting their independence by deposing the president Carrasco. A junta, which was then formed, assumed the government, with the expressed intention of conducting it according to the old system. Their real design, at first kept secret, was to declare their independence, and to separate entirely from the mother country on the first favourable opportunity.

In April 1811 the first blood was spilt in the cause of Chilean independence. On the day appointed for the election of members to the National Congress, the Spanish rulers attempted to overawe the leaders and people of Chile, of whose dissatisfaction with their government they were fully conscious. A battalion of royal troops, which had been drawn up in the great square of Santiago, was attacked by a detachment of patriot grenadiers, and routed after considerable loss of life on both sides. In the same year, Don Juan Jose Carrera, a young man of great talents and promise, was nominated by the junta supreme president of the Congress which was now convened, and was at the same time appointed general-in-chief of the army about to be formed.

Hostilities were commenced by the Spanish troops who were sent from Lima, Coquimbo, and Chiloé. In the skirmishes that took place during the early part of the contest, the Chilean troops had generally the advantage.

In 1813 a powerful army, under the command of General Paroja, invaded Chile, but was twice defeated by the republican troops under Carrera. The royalists, however, speedily received large reinforcements; and after a severe contest, Chile was once more obliged to own for a time the sovereignty of Spain. For three years the people submitted to the old system of tyranny and misgovernment, till at length the patriot refugees, having levied an army in La Plata, and received the support of the Buenos Ayreans, marched against the Spaniards, and completely defeated them at Chacabuco in 1817.

The patriots next proceeded to organize an elective government, of which San Martin, the general of the army, was nominated the supreme director. Their arrangements, however, were not completed when they were attacked once more by the royalists, and routed at the battle of Chancharayada with great loss. Betrayed into a fatal security by this success, the royalist troops neglected the most ordinary military precautions; and being suddenly attacked by the patriots in the plains of Maipû, were defeated with great slaughter. It is believed that not more than 500 men escaped from the field of battle. This victory secured the independence of Chile.

The new republic had no sooner vindicated for itself a place among the nations of South America, than it resolved to assist the neighbouring state of Peru in achieving a similar independence. This object it at last effected after a bloody war of six years' duration. No small share of this success, however, is to be attributed to the ability with which Lord Cochrane conducted the naval affairs.

Till 1823 General O'Higgins held the chief directorship at Santiago, but in that year he was compelled to resign in consequence of a popular tumult. For a few weeks, a provisional triumvirate discharged the duties of an executive government. General Freire was next chosen director. During the period of three years in which he held the reins of government, the country was harassed by constant dissensions; and for the four years subsequent to his resignation continued in a state of disorder bordering upon anarchy. From 1826 to 1830 the government was administered by no fewer than six different directors, in addition to a second provisional triumvirate.

In 1828, under the administration of General Pinto, a constitution was promulgated, which had the effect of temporarily reconciling political differences, and calming party spirit.

In 1831, however, when General Prieto was raised to the chief magistracy, a convention was called for the purpose of revising this constitution. The result of its deliberations was the present constitution of Chile, which was promulgated on the 25th of May 1833. Since this period Chile has enjoyed remarkable prosperity; its government has been administered with firmness and regularity, and it has assumed a position among the nations; for, aided by the counsels of his prime minister Portales, General Prieto completely succeeded in restoring order, and in promoting the material prosperity of the republic.

After holding office for ten years, Prieto retired, and was succeeded by General Bulnes, a very distinguished officer of the war of independence. Like his predecessor, he was fortunate in finding an able and intelligent minister to counsel and assist him. Manuel Montt was to him what Portales had been to Prieto, and under his guidance Chile continued its onward march in the path of peaceful prosperity.

The insurrectionary movements which took place in Europe in 1848 extended their influence even to the west-

Chile. ern shores of South America. Imitating the anarchists in Europe, the revolutionists formed clubs, selected emblems, and displayed banners. Their irritation was increased by the fact that for twenty years they had been deprived of all participation in the government. When the time for the presidential election of 1851 approached, they brought forward, as candidate for the presidency, Ramon Errazaris, who had formerly belonged to the conservative party, and who was in every way unfitted for the post to which they wished to advance him. The violence of their measures at length led to serious outbreaks in the province of Aconcagua and the town of Santiago. The government at once took vigorous measures to suppress the disturbances. These places were declared in a state of siege, and order was soon restored.

In 1851 the country still continued in a very agitated condition. General Urriola assumed the direction of the insurrectionary movement. On the 20th of April serious disturbances broke out at Santiago during the solemnities of the holy week, which were not quelled without considerable loss of life. The insurgent chief himself was accidentally killed.

The extreme liberal party next brought forward, as a candidate for the presidency, General Jose Mana de la Cruz, in opposition to Don Manuel Montt, the celebrated minister of the former president. The revolutionary party used every exertion to secure the election of their representative, but Montt was chosen president by the almost unanimous suffrages of the people. Enraged at this result, the revolutionary party resolved to throw every obstacle in the way of his regular inauguration. Insurrection was excited by their agents in the provinces of Coquimbo, Copiapo, and Valparaiso. The south was the principal seat of disturbances; and Serena, the capital of Coquimbo, was in the hands of the insurgents. General Bulnes, the former president, was appointed commander-in-chief. Having met the army of the insurgents at Longomilla, he gained a complete victory over them. A capitulation was then agreed to, the result of which was the full acknowledgement of the established government.

The year 1852 commenced with happier auspices than the former. Peace and prosperity were restored to the country by the firmness and decision of the authorities, aided by the good sense of the general body of the people, who had remained faithful to the cause of order. On the opening of the new Congress in the month of June, the greatest confidence was felt in the wisdom and ability of the government, and the people looked forward to a period of renewed prosperity, which has happily not yet been interrupted. (C. B. B.)

CHILIAD (χιλιας), a thousand; a collection or sum containing a thousand individuals or particulars. Also the period of a thousand years.

CHILIAGON, in *Geometry*, a regular plane figure of a thousand sides and angles.

CHILKA, a lake in Hindustan, at the N.E. extremity of the Northern Circars, which province it separates towards the sea from that of Cuttack. It is about 35 miles in length by 10 or 12 in breadth, and appears to have originated in a breach of the sea over a flat sandy shore. The border of sand, about a mile broad, which separates it from the sea, is not visible, so that the lake has the appearance of a deep bay. It is very shallow, and contains several inhabited islands. On the N.W. it is bounded by a ridge of mountains, forming a continuation of those which extend from the Mahanuddy to the Godavery river, and inclose the Northern Circars towards the continent. It is 40 miles S.W. of Cuttack. The lake communicates with the sea by a narrow outlet, in W. Lat. 19. 42. E. Long. 85. 40.

CHILLAMBARAM PAGODA is situated on the sea-coast of the Carnatic, 8 miles S. of Porto Novo, and 120 S.S.W. of Madras, and is held in high veneration by the Hindus. This structure extends 1332 feet by 936, and is entered by a lofty gateway under a pyramid 122 feet high, built of enormous stones, 40 feet long by five feet, and covered with ornamented plates of copper. In 1781 Sir Eyre Coote made an unsuccessful attack on a garrison in this pagoda, belonging to Hyder, who was defeated a few days after with great loss. E. Long. 79. 45., N. Lat. 11. 27.

CHILLIANWALLA, a town in the Punjaub, Hindustan, on the left bank of the river Jhelum. This place is memorable as the scene of a sanguinary battle fought there on the 13th January 1849, between a British force commanded by Lord Gough, and the Sikh army under Shere Singh. The Sikhs are acknowledged to have displayed extraordinary bravery and skill; nor was there wanting conspicuous gallantry on the part of the British; but though the latter remained masters of the field, victory had been purchased by a fearful sacrifice. The loss of the British amounted to 26 European officers and 731 men killed; 66 officers and 1446 men wounded, making a total of 2269, of whom nearly 1000 were Europeans. The loss of the Sikhs was estimated at 4000. Very severe comments were at the time made on the alleged levity displayed by the British general in having suddenly and apparently capriciously changed his plan of operations, and in suffering himself to be provoked by a few stray shots from the enemy's guns to commence the engagement without due precautions, the result being the above stated calamitous loss. An obelisk erected at Chillianwalla by the British government preserves the names of the officers and men who fell in the action. The town is 85 miles N.W. of Lahore. Lat. 32. 40., Long. 73. 39.

CHILLICOTHE, a city in the state of Ohio, North America, capital of the county of Ross, on the W. bank of the river Scioto, 37 miles S. of Columbus. It is pleasantly situated and well laid out, the streets crossing each other at right angles. It has many fine buildings, and is a place of considerable trade and manufactures. The Ohio canal and several railways pass through the town. Pop. 7098.

CHILLINGWORTH, WILLIAM, an eminent divine of the church of England, was born at Oxford in 1602, and educated at Trinity College, of which he was elected a fellow in 1628. He early made great proficiency in his studies, and distinguished himself especially in divinity, mathematics, and versification. During his residence at the university the controversy between the church of England and that of Rome formed the principal subjects of study and conversation, especially in relation to the king's marriage with Henriette, daughter of Henri IV. king of France: and Chillingworth, chiefly at the instigation of the Jesuit Fisher, was induced to abandon the communion of the Church of England and embrace the Roman Catholic faith. Laud, then bishop of London, hearing of this decisive step, and of his retreat to Douay, corresponded with him on the subject and induced him to return to Oxford and re-examine the whole question. This new inquiry resulted in his return to his former faith. In 1634 he wrote a confutation of the arguments which had induced him to join the communion of the Church of Rome; but, at the same time, the freedom with which he spoke of his difficulties gave rise to a groundless report that he had turned Catholic a second time, and then Protestant again. His return to the communion of the Church of England attracted a large share of public attention, and engaged him in controversy with several distinguished Jesuits. In 1635 he engaged in a work designed as an answer to a book entitled *Charity Mistaken*, by a Jesuit of the name of Mathias Wilson, which furnished him with a better opportunity of confuting the principles of the Church

of Rome, and of vindicating the Protestant religion. It was published under the title *The Religion of Protestants a safe Way to Salvation.* About the same time Sir Thomas Coventry, lord keeper of the great seal, offered him preferment; but Chillingworth declined to accept it, on the ground of his scruples with regard to the subscription of the thirty-nine articles. These, however, he ultimately surmounted; and being promoted to the chancellorship of the church of Sarum, with the prebend of Brixworth in Northamptonshire annexed to it, he complied with the usual subscription. Chillingworth was zealously attached to the royal party; and, in August 1643, was present in Charles's army at the siege of Gloucester, where he suggested and directed the construction of certain engines for assaulting the town. Soon afterwards, having accompanied Lord Hopton, general of the king's forces in the west, to Arundel Castle in Sussex, he was taken prisoner by the parliamentary forces under the command of Sir William Waller, who compelled the garrison to surrender. A sudden illness necessitated his separation from the troops who were returning to London, and he was removed to Chichester, where he died in 1644. His character has been delineated by Anthony Wood, by Archbishop Tillotson, and by Lord Clarendon. His theological and controversial pieces have been often reprinted, and form standard works on the subjects of which they treat.

CHILO, one of the Seven Sages of Greece, and one of the ephori of Sparta, the place of his birth, flourished B.C. 590. He was accustomed to say that three things were very difficult—to keep a secret, to know how best to employ time, and to suffer injuries without murmuring. According to Pliny, it was he who caused the short sentence "*Know thyself*" to be inscribed in letters of gold on the temple of Delphi. It is said that he died of joy while embracing his son, who had been crowned as victor at the Olympic games. The institution of the ephoralty has by some been ascribed erroneously to this sage.

CHILOË, an island on the W. coast of South America, separated from the mainland by the gulf of Ancud, and forming with several smaller islands a province of Chile. See CHILE.

CHILTERN HUNDREDS, a hilly district extending through part of Buckingham and Oxford shires. To this district is attached a nominal office in the gift of the crown, and the person holding it is called the Steward of the Chiltern Hundreds. In former times the steward of these hundreds was an officer appointed by the crown to keep the peace there. As a member of the House of Commons cannot, strictly speaking, resign his seat, he may accomplish that object indirectly by accepting a nominal office under the crown, such as the stewardship of the Chiltern Hundreds.

CHIMÆRA, in *Grecian Fable*, a celebrated three-headed monster, sprung from Echidna and Typhon. The fore part of its body was that of a lion, the middle that of a goat, and the hinder part that of a dragon. It is generally depicted as vomiting forth flames; hence Horace—

——— "*Tremendæ*
Flamma Chimæræ."

This monster inhabited Lycia in the reign of Iobates, by whose orders Bellerophon, mounted on the horse Pegasus, overcame it.

The origin of the fable is most probably connected with the volcano of this name in Lycia, the summit of which was a desolate wilderness and the resort of lions; the middle fruitful and covered with goats; while the marshy ground at the bottom abounded with serpents. Bellerophon is said to have conquered the chimæra because he destroyed the wild beasts on that mountain, and rendered it habitable. Plutarch refers it to some pirates who adorned their ships with the images of a lion, a goat, and a dragon. From this fable is derived the term *chimæra* applied figuratively to any wild or incongruous fancy arising in the mind.

CHIMBORAZO, a celebrated mountain of the Equatorial Andes, in S. Lat. 1. 30., W. Long. 79., and long considered the highest in the known world. It is 21,424 feet high. It was ascended by Humboldt and Bonpland in June 1802 to the height of 19,286 feet; and again by Boussingault in December 1831 to 19,689 feet.

CHIME (Danish *kimer*, to tinkle or toll as a bell), the sound of musical bells struck with hammers; or a set of musical bells struck by hammers acted on by a pinned cylinder or barrel, which is made to revolve by clock-work. These are frequently attached to time-pieces, and so arranged as to produce chimes or tunes at stated intervals.

CHIMNEY (French *cheminée*, from Lat. *caminus*, or Gr. *κάμινος* a forge or fire-place), a structure of brick or stone, containing a funnel or funnels to carry off smoke or other volatile matter from the hearth or fire-place where fuel is burned.

As the subject of chimneys is fully treated both in a theoretical and a practical point of view in other parts of this Encyclopædia, we shall here confine our observations to the historical portion of the subject. (See FURNACE; PNEUMATICS; SMOKE; STOVES; BUILDING.)

Chimneys are of modern invention, and were only introduced into England in the reign of Elizabeth, though it appears they were employed in Italy considerably earlier. Octavio Ferrari, however, endeavours to prove that they were in use among the ancients. On this subject Beckmann has written an elaborate dissertation, from which we extract some observations, in order to show the grounds on which he founds his opinion that this convenience is of modern invention.

When the triumviri, says Appian, caused those whom they had proscribed to be sought for by the military, some hid themselves in wells, and others, as Ferrarius translates the words, in *fumaria sub tecto, qua scilicet fumus e tecto evolvitur.* The true translation, however, in Beckmann's opinion, is *fumosa cœnacula.* The principal persons of Rome endeavoured to conceal themselves in the smoky apartments of the upper story under the roof, which in general were inhabited only by poor people; and this seems to be confirmed by what Juvenal expressly says, *Rarus venit in cœnacula miles.*

Those passages of the ancients which speak of smoke rising up from houses, have with equal impropriety been supposed to allude to chimneys. Seneca says, "Last evening I had some friends with me, and on that account a stronger smoke was raised; not such a smoke, however, as bursts forth from the kitchens of the great, and which alarms the watchmen, but such an one as signifies that guests have arrived." The true sense of these words undoubtedly is, that the smoke forced its way through the kitchen windows. Had the houses been built with chimney funnels, there could be no cause for alarm; but as the kitchens had no convenience of that nature, an apprehension of fire, when extraordinary entertainments were to be provided, seems to have been well founded; and on such occasions people were stationed in the neighbourhood to be constantly on the watch to extinguish the flames in case a fire should happen. There are to be found in Roman authors many other passages of a similar kind; such as that of Virgil,

Et jam summa procul villarum culmina fumant;

and the following words of Plautus, descriptive of a miser:

Quin divûm atque hominum clamat continuo fidem,
Suam rem periisse, seque eradicarier,
De suo tigillo fumus si qua exit foras.

Aristophanes, in one of his comedies, introduces his old man, Polycleon, shut up in a chamber, whence he endeavours to escape by the *chimney.* This passage may readily be explained, when we consider the illustration of the scholiasts, by a simple hole in the roof, as Reiske has supposed; and in-

deed this appears to be the more probable, as we find mention made of a top or covering (τηλια) with which the hole was closed.

It has been said that the instances of chimneys remaining among the ruins of ancient buildings are few, and that the rules given by Vitruvius for building them are obscure; but it appears that there exists no remains of ancient chimneys, and that Vitruvius gives no rules, either obscure or perspicuous, for building what, in the modern acceptation of the word, deserves the name of a chimney.

The ancient mason-work still to be found in Italy does not determine the question. Of the walls of towns, temples, amphitheatres, baths, aqueducts, and bridges, there are some, though very imperfect remains, in which chimneys cannot be expected; but of common dwelling-houses none are to be seen, except at Herculaneum, and there no traces of chimneys have yet been discovered. The paintings and pieces of sculpture which are preserved afford as little information, for nothing can be perceived in them which bears the smallest resemblance to a modern chimney.

If there were no funnels in the houses of the ancients to carry off the smoke, the directions given by Columella, to make kitchens so high that the roof should not catch fire, were of the utmost importance. An accident of the kind, which the author seems to have apprehended, had almost happened at Beneventum, when the landlord who entertained Mæcenas and his company was making a strong fire in order to get some birds the sooner roasted.

——————— Ubi sedulus hospes
Pæne arsit, macros dum turdos versat in igne;
Nam vaga per veterem dilapso flamma culinam
Vulcano summum properabat lambere tectam.

Had there been chimneys in the Roman houses, Vitruvius certainly would not have failed to describe their construction, which is sometimes attended with considerable difficulties, and which is intimately connected with the regulation of the plan of the whole edifice. He does not, however, say a word on the subject; neither does Julius Pollux, who has collected with great care the Greek names of every part of a dwelling-house; and Grapaldus, who in later times made a collection of the Latin terms, has not given a Latin word expressive of a modern chimney.

Caminus, as far as we have been able to learn, signified first a chemical or metallurgic furnace, in which a crucible was placed for melting and refining metals; secondly, a smith's forge; and, thirdly, a hearth on which portable stoves or fire-pans were placed for warming the apartment. In all these, however, there appears no trace of a chimney. Herodotus relates, that a king of Libya, when one of his servants asked for his wages, offered him in jest the sun, which at that time shone into the house through an opening in the roof, under which the fire was perhaps made in the middle of the edifice. If such a hole must be called a chimney, our author admits that chimneys were in use among the ancients, especially in their kitchens; but it is obvious that such chimneys bore no resemblance to ours, through which the sun could not dart his rays upon the floor of any apartment.

However imperfect may be the information which can be collected from the Greek and Roman authors respecting the manner in which the ancients warmed their apartments, it nevertheless shows that they commonly used for that purpose a large fire-pan or portable stove, in which they kindled wood, and, when the wood was well lighted, carried it into the room, or perhaps they filled it with burning coals. When Alexander the Great was entertained by a friend in winter, as the weather was cold and raw, a small fire basin was brought into the apartment to warm it. The prince, observing the size of the vessel, and that it contained only a few coals, desired his host, in a jeering manner, to bring more wood or to fetch frankincense; giving him thus to understand that the fire was fitter for burning perfumes than to produce heat. Anacharsis, the Scythian philosopher, though displeased with many of the Grecian customs, praised the Greeks, because they shut out the smoke, and brought only fire into their houses. We are informed by Lampridius, that the extravagant Heliogabalus caused to be burned in such stoves, Indian spices, and costly perfumes, instead of wood. It is also worthy of notice, that coals were found in some of the apartments of Herculaneum, but neither stoves nor chimneys.

It is well known to every scholar, that the useful arts of life were invented in the East; and that the customs, manners, and furniture of eastern nations, have remained from time immemorial almost unchanged. In Persia, which Sir William Jones seems to have considered as the original country of mankind, the methods employed by the inhabitants for warming themselves have a great resemblance to those employed by the ancient Greeks and Romans for the same purpose. According to De la Ville, the Persians make fires in their apartments, not in chimneys as we do, but in stoves in the earth, which they call *tennor*. "These stoves consist of a square or round hole, two spans or a little more in depth, and in shape not unlike an Italian cask. That this hole may throw out heat sooner, and with more strength, there is placed in it an iron vessel of the same size, which is either filled with burning coals, or a fire of wood and other inflammable substances is made in it. When this is done, they place over the hole or stove a wooden top, like a small low table, and spread above it a large coverlet quilted with cotton, which hangs down on all sides to the floor. This covering condenses the heat, and causes it to warm the whole apartment. The people who eat or converse there, and some who sleep in it, lie down on the floor upon the carpet, and lean with their shoulders against the wall, on square cushions, upon which they sometimes also sit; for the *tennor* is constructed in a place equally distant from the walls on both sides. Those who are not very cold put their feet only under the table or covering; but those who require more heat may put their hands under it, or creep under it altogether. By these means the stove diffuses over the whole body, without causing uneasiness to the head, so penetrating and agreeable a warmth, that I never experienced any thing more pleasant. Those, however, who require less heat let the coverlet hang down on their side to the floor, and enjoy without any inconvenience from the stove the moderately-heated air of the apartment. They have a method also of stirring up or blowing the fire when necessary, by means of a small pipe united with the tennor or stove under the earth, and made to project above the floor as high as is judged necessary; so that, when a person blows into it, the wind, having no other vent, acts immediately upon the fire like a pair of bellows. When there is no longer occasion to use this stove, both holes, that is to say, the mouth of the stove and that of the pipe which conveys the air to it, are closed up by a flat stone made for that purpose. Scarcely any appearance of them is then to be perceived, nor do they occasion inconvenience, especially in a country where it is always customary to cover the floor with a carpet, and where the walls are plastered. In many parts these ovens are used to cook victuals, by kettles placed over them. They are employed also to bake bread; and for this purpose they are covered with a large broad metal plate, on which the cake is laid; but if the bread is thick and requires more heat, it is put into the stove itself." (See *History of Invent* ii. 88.)

Beckmann further observes, that the oldest account of chimneys is to be found in an inscription at Venice, which relates that, in the year 1347, a great many chimneys were thrown down by an earthquake. It would appear, however, that in some places they had been in use for a considerable time before that period; and De Gataris, in his history of Padua, relates, that Francesco de Carraro, lord of Padua, came to Rome in 1368, and finding no chimneys in the inn where he lodged, because at that time fire was kindled in a hall in the middle of the floor, he caused two chimneys like those which had *long* been used at Padua to be constructed by masons and carpenters, whom he had brought along with him. Over these chimneys, the first which had ever been seen at Rome, he affixed his arms, and these still remained in the time of De Gataris, who died of the plague in 1405. (See Stoves.)

CHINA.

China Proper is an extensive country of Eastern Asia, situated on the borders of the Pacific, and extending from 20. (or, if the island of Hainan be included, from 18.) to 41. N. Lat., and from 97. to 123. E. Long. Its length from N. to S. is estimated at 1474 miles, and its greatest breadth from W. to E. at 1355 miles; area, 1,348,870 square miles. It is thus about eight times the size of France, and eleven times that of Great Britain. The coast line is upwards of 2500 miles in length. The Chinese empire, however, comprises a vast extent of territory, lying between 20. and 56. N. Lat., and 70. and 144. E. Long. It comprehends not only China Proper, but also Manchooria, Mongolia, Turkistan, and Thibet, having in all an area of 5,300,000 square miles. It is bounded on the E. and S.E. by the Pacific Ocean with its branches, the Sea of Japan, the Yellow Sea, Chinese Sea, and the Gulf of Tonquin; on the N. for 3300 miles by Asiatic Russia; W. and S.W. by Independent Tartary; and on the S. by Tonquin, Laos, and Birmah.

The name China is unknown in the country itself, but seems to have come to us through the Malays, Hindus, or other Asiatic nations, by whom the terms Chin, Tsin, Tchina, &c., are used to designate this country. It is most probably derived from Tsin, the name of a powerful family in China, whose chief first obtained complete sway over all the other principalities about B.C. 250, and whose exploits rendered him famous in India, Persia, and other Asiatic states. The Chinese themselves have many names to designate the country which they inhabit. One of the most ancient of these is *Tien Hia*, *i.e.*, beneath the sky, meaning the world; another, almost as ancient, is *Sz'Hai*, *i.e.*, (all within) the four seas; a third, and now the most common, is *Chung Kwoh*, or middle kingdom, from an idea that it is situated in the middle of the earth. They also frequently call their country after the name of the reigning dynasty.

The whole surface of China may be divided into the mountainous country, the hilly country, and the Great Plain. This last occupies the N.E. part of the country, extending S. as far as the Yang-tse-kiang, and is about 700 miles in length, with a breadth varying from 150 to nearly 500 miles. Its area is estimated at 210,000 square miles, and it is thus seven times greater than the plain of Lombardy. The most interesting feature of this plain is the enormous population which it contains, amounting, according to the census of 1812, if we take the six provinces that lie wholly or for the most part within it, to 177,000,000 persons, and being thus the most densely populated of any part of the world of the same size. The soil in the northern part is dry and sandy, destitute of trees, but producing millet, wheat, and vegetables in abundance; that lying near the coast in Kiang-su is low and swampy, covered with numerous lakes, and intersected by many water-courses. This portion of the plain is extremely fertile, and furnishes large quantities of silk, tea, cotton, grain, and tobacco for the consumption of the other provinces. Proceeding inland, the soil becomes more dry and firm, but is well watered and fertile. The eastern portion of the plain is traversed by the Grand Canal, which serves not only to facilitate communication, but also to drain and irrigate the adjacent country.

The mountainous region comprehends more than one-half of the whole country, and may be said to extend from the meridian of 112°, and N. of the Yellow River from that of 114°, westward to the borders of Thibet. All this immense tract of country is covered by mountains and valleys; the former usually steep and rugged, the latter watered by numerous streams, and very fertile. The mountain chains which constitute the eastern edge of the high table-land of Eastern Asia, lie within the western boundary of China. These chains send off several branches eastward, which gradually subside into low hills as they proceed towards the coasts. The chief of these are the Nan-ling, or southern mountains, and the Pe-ling, or northern mountains. The Nan-ling, which constitutes the most extensive mountain system in China, branches off from the northern edge of the Yun-nân highlands, and runs eastwards, passing about 150 miles to the N. of Canton; it then takes a north-eastern direction through Fokien, and terminates in Che-keang. N. of Canton is the Mei-ling Pass, by means of which goods are transported from Canton to the interior of China. The second principal chain of mountains is the Pe-ling, which passes eastward through the provinces of Shen-see and Honan to about 113. E. longitude, when it turns to the S.E., and soon after terminates in a range of hills. Each of these chains send off numerous offshoots in different directions. Many of the mountains in the W. of China reach the limit of perpetual snow.

The hilly portion of the country lies to the E. of 112. E. longitude, and S. of the Yang-tse-kiang. It constitutes the most picturesque portion of China; the hills having generally gently sloping sides, which are carefully cultivated, while their summits are crowned by plantations. They are frequently laid out in terraces for the cultivation of rice. The valleys between the hills in some places expand into considerable plains.

The rivers of China are her chief glory, and it is to them principally that she is indebted for that fertility of soil by which she is enabled to maintain her vast population. The principal of these are the Hoang-ho, or Yellow River, and the Yang-tse-kiang, which rank among the greatest rivers in the world. They both rise in the high table-lands of Eastern Asia, pursue tortuous but generally easterly courses, and, though at one time their waters are more than 1100 miles apart, they discharge themselves into the sea within about 110 miles of each other. They are respectively about 2500 and 3000 miles in length, and have each a great number of affluents. Besides these there are an immense number of other rivers which fall into the sea or into lakes.

The lakes of China are numerous, but few of them are of great extent. The largest is the Tong-ting-hou, which is about 220 miles in circuit. It receives the waters of many considerable rivers, and discharges itself into the Yang-tse-kiang. The Po-yang-hou, another lake of great

dimensions, which discharges its surplus waters into the Yang-tse-kiang, is noted for the beauty of its surrounding scenery. All the lakes and rivers are well stocked with fish.

The coast of China, S. of the promontory of Shan-tung, is generally bold and rocky, except at the points where the Yellow River and the Yang-tse-kiang empty themselves into the sea. The province of Pekin is a sandy flat, and the gulf which skirts it is extremely shallow, so that large ships cannot approach within many miles of the shore. The whole coast is said to abound in safe and commodious harbours.

As to the origin of the Chinese, various hypotheses have been given out by different authors. By De Guignes and Fréret, arguing from the communications of the Jesuits, they were supposed to be derived from a colony of Egyptians; by the earlier Jesuits they were set down as a tribe of the Jews; and by Sir William Jones as the descendants of the Cshantrya or Military Caste of Hindus, called Chinas, "who," say the Pundits, "abandoned the ordinances of the Veda, and lived in a state of degradation." With submission to such high authorities, we should as soon think of deriving the trunk of a tree from its branches, as the people of China from any of these. That they are not Egyptians, the ingenious Pauw has most clearly and satisfactorily demonstrated, by proving that in no one iota does there, or ever did there, exist one single resemblance. As little similarity is there between them and the Hindus: no two people, indeed, could possibly differ more than they do in their physical and moral character, in their language, and in their political and religious institutions. The colour of the Hindu is ebon black or a deep bronze, that of a Chinese a sickly white or pale yellow, like that of a faded leaf, or a root of rhubarb; the features of a Hindu are regular and placid, those of a Chinese wild and irregular, constant only in the oblique and elongated eye, and the broad root of the nose; the Hindus are slaves and martyrs to religious ordinances, the Chinese have superstitions enough, but, strictly speaking, no religious prejudices; the Hindus are divided into castes, the Chinese know of no such division; the historical records of China go far beyond the time that these supposed Chinas of Sir William Jones peopled the country, the Hindus have not a page of history; the language of Hindustan is alphabetic, that of China a transition from the hieroglyphic to the symbolic, and there is not the slightest analogy in the colloquial languages of the two countries.

Dr Marshman has set the question, as to any similarity between the Sanscrit and Chinese languages, completely at rest. The priests of Buddh, who were permitted to enter China in the first century of the Christian era, endeavoured, with their religion, to introduce the Sanscrit alphabet, or series of sounds represented by the Devanagari character; and this series being placed at the head of Canghe's Dictionary, induced Dr Marshman to suppose that there might be some connection between the Chinese and the Sanscrit languages. Had he, however, read the preface to that dictionary, he would have seen that the compilers announce it as a system brought from the West, which the learned of China could never be prevailed on to adopt. This Hindu series of alphabetic sounds did not, however, mislead him; he was fully aware that a pure, unchangeable, monosyllabic language could not arise out of a polysyllabic one; that a language which admitted of no change from its original monosyllabic root, but retained it in its primitive form, whether employed as a noun, a verb, or a participle, could not have been derived from another language whose dhatoos or roots, by a complicated mechanism, assumed a hundred different shapes; nay, whose inflections, in some instances, are so numerous, as to produce more than a thousand modifications of an idea from one radical word. In addition to all this, when he reflected that there were in the Sanscrit alphabet four or five sounds which the organs of a Chinese could not by any possibility enunciate, he found it utterly incompatible to associate the two languages together, and was confirmed in his idea by the test of facts. He took the Ramayuna, which is supposed to be the most ancient poetry in the Sanscrit language, and the *Shee-king* of the Chinese. In ten pages of the former, containing four hundred and fifty-nine words, he found only thirteen monosyllables, and of these thirteen, seven do not occur in the *Shee*, nor are any two of them used to express the same idea in both languages. He next took four pages of the Mahabharu, in the Bengalee dialect, containing two hundred and sixty-five words, in which he found only seven monosyllables, and of these, *three* only were Chinese.

Proceeding in the same manner, he proves, what was scarcely necessary, that there exists not the most distant resemblance between the Chinese and the Hebrew languages. In examining the speech of Judah to Joseph, in the 44th chapter of Genesis, he finds it to contain two hundred and six words, in which there occur sixteen monosyllables; but of these, seven only are Chinese words. In Abraham's intercession for Sodom, out of two hundred and thirty words, ten only are monosyllables, and of these, four are Chinese. Again, in the maledictory prophecy of Noah, relative to his grandson Canaan, in twenty-six words there is but one monosyllable. It would be most absurd, therefore, to conclude that the Chinese derived their language from the Hebrew, when one word only occurs out of twenty-nine, as in the first example, one out of fifty, as in the second, or one in twenty-six, as in the third; and he thinks it more rational to infer, that as it is neither derived from the Sanscrit nor the Hebrew, it is an original language invented by themselves. Neither is there any resemblance to be found in the manners, customs, physical character, or religious creeds, of the two people. There is, in fact, a colony of Jews in China, whose entrance can be traced beyond the Christian era; who use the Hebrew language; who abstain from swine's flesh, the great article of Chinese food; use circumcision, and celebrate the passover, neither of which the Chinese know anything about; and it may, therefore, fairly be concluded that they are neither Jews, Hindus, nor Egyptians, but an original people, who have kept themselves more unmixed with other nations than any people existing on the face of the earth. (Barrow's *Travels in China;* Marshman's *Clavis Sinica.*)

Probable origin.

Pauw, and some other writers, are of opinion that they proceeded originally from the heights of Tartary. It is, in fact, obvious enough that the Tartars and Chinese are one and the same race; and the only question seems to be, whether the latter, guided by the mountain-streams, descended from the bleak and barren elevations of Tartary, which, bulging out of the general surface of the earth, have been compared with the boss of a shield, to the fertile plains and temperate climate of China; or, whether the former are swarms sent off by an over-abundant population, and driven into the mountains. The former supposition will be regarded, perhaps, as the more probable of the two. In all the institutions which the change from a pastoral to an agricultural state would necessarily require, the ancient manners and customs of the Hyperborean Scythians, as described by Herodotus, are still discernible among the Chinese. A Chinese city is nothing more than a Tartar camp, surrounded by mounds of earth, to preserve themselves and cattle from the depredations of neighbouring tribes, and the nocturnal attacks of wolves and other wild beasts; and a Chinese habitation, the Tartar tent, with its sweeping roof supported by poles, excepting

that the Chinese have cased their walls with brick, and tiled the roofs of their houses. When the famous barbarian Gengis-khan made an irruption into the fertile plains of China, and took possession of a Chinese city, his soldiers immediately set about pulling down the four walls of the houses, leaving the overhanging roofs supported on the wooden columns, by which they were converted into excellent tents for themselves and horses. Yet such is the facility with which Chinese and Tartars amalgamate, that although this celebrated barbarian could neither read nor write any language, he listened to the advice of the conquered, became sensible of the change of situation in which he found himself, did every thing he could to repair the errors he had committed, and both he and his successors left good names behind them in the annals of the country. In like manner, the present Mantchoo Tartars, who lived in tents, and subsisted on their cattle and by hunting, immediately accommodated themselves to the manners, the customs, and the institutions of China, preserving nothing of their own, not even their religion, and scarcely a vestige of ancient superstitions, that does not coincide with those of the Chinese—one of the most singular of which is, their agreement in the birth of man and of the serpent-woman, and the universal use and estimation of the ancient Scythian emblem of the dragon. Next to the Chinese, the Turks seem to have preserved most of the character and customs of the ancient Scythians from whom they sprung; and the Turks are Tartars. Some German author has pointed out a similarity between the Turks and Chinese in seventeen different customs; he might have extended the parallel to more than twice that number. (*Recherches sur les Chinois*, par M. de Pauw.)

Antiquity and history.

It has long been objected in Europe against the authenticity of the early part of Chinese history, that it abounds with absurd fictions and irreconcilable contradictions, and that it sets up a chronology and cosmogony at variance with the sacred writings, and the generally received opinions of mankind. This, however, is not the fact with regard to Chinese history in its pure and original state, divested of the reveries of Fo or Buddh, which the priests of this sect imported with their religion, and found means to propagate among the vulgar. The Hindu periods of the creation and destruction of the universe,—the miraculous conceptions, and all the absurd stories of gods, demi-gods, and heroes, are scouted by the learned of China. The period they assign for the commencement of their civilization is perfectly consistent with the time when, according to holy writ, the great catastrophe befel the earth; and though they are unable to establish the truth of the early part of it by any concurring contemporaneous histories of other countries, yet neither can any extraneous authority be produced to contradict theirs; the probability, therefore, of the truth or falsehood must rest on the internal evidence of their own history, and the manner in which that history has been compiled, preserved, and handed down to posterity.

We may take it for granted, that when the Emperor Kaung-hee summoned to Pekin the most learned men of the empire, for the purpose of translating into the Mantchoo language an abridged history of China, from the earliest times, those annals only were consulted which were considered as most authentic, namely, those which are compiled and published by the college of *Han-lin*. Père Mailla was one of those missionaries who viewed the Chinese less through the eye of prejudice than most of the Jesuits. He was employed by the emperor in making a survey of the empire, which cost him and his colleagues the labour of ten years; he passed forty-five years of his life in the country, and generally about the court, during which time he made himself perfectly acquainted with the Mantchoo and the Chinese languages. When, therefore, Kaung-hee undertook the laudable design of giving to his Mantchoo subjects an authenticated history of China in their own language, Père Mailla conceived the idea of proceeding *pari passu* with a translation of the same work into French; and having lived to complete this Herculean labour, it was published at Paris, after many difficulties and delays, by the Abbé Grozier, in fourteen large quarto volumes, under the title of *Histoire Générale de la Chine*.

The history of China commences, in fact, at a period not much more than 3000 years before the birth of Christ, by describing the little horde from which the Chinese had their origin, to be in as barbarous and savage a state as can well be imagined; roving among the forests of *Shen-see*, just at the foot of the Tartar Mountains, without houses, without any clothing but the skins of animals, without fire to dress their victuals, and subsisting on the spoils of the chase, on roots and insects. Their chief, of the name of *Yoo-tsou-she*, induced them to settle on this spot, and they made themselves huts of the boughs of trees. Under the next chief, *Swee-gin-shee*, the grand discovery of fire was effected by the accidental friction of two pieces of dry wood. He taught the people to look up to *Tien*, the great creating, preserving, and destroying power; and he invented a method of registering time and events, by making certain knots on thongs or cords twisted out of the bark of trees. Next to him followed *Fo-hee*, who separated the people into classes or tribes, giving to each a particular name; discovered iron; appointed certain days to show their gratitude to heaven, by offering the first fruits of the earth; and invented the *Ye-king* or *Koua*, which superseded the knotted cords. Fo-hee reigned 115 years, and his tomb is shown at Tchin-choo, in the province of Shen-see, at this day. His successor, *Chin-nong*, invented the plough; and from that moment the civilization of China proceeds by rapid but progressive steps.

As the early history of every ancient people is more or less vitiated by fable, we ought not to be more fastidious or less indulgent towards the marvellous in that of China, than we are towards Egyptian, Greek, or Roman history. The main facts may be true, though the details are incorrect; and though the accidental discovery of fire may not have happened under Swee-gin-shee, yet it probably was first communicated by the friction of two sticks, which at this day is a common method among almost all savages of producing fire. Nor is it perhaps strictly correct that Fo-hee made the accidental discovery of iron, by having burnt a quantity of wood on a brown earth, any more than that the Phœnicians discovered the mode of making glass by burning green wood on sand; yet there is nothing improbable, either in the one or the other, that these two processes first led to the discovery of both. And if it be objected against the history, that the reign of a hundred and fifteen years exceeds the usual period of human existence, it should be recollected, at the same time, that such an instance is as nothing, when compared with those contemporaneous ones recorded in biblical history. Thus, also, considerable allowances are to be deducted from the scientific discoveries of Chin-nong in botany, when we read of his having in one day discovered no less than seventy different species of plants that were of a poisonous nature, and seventy others that were antidotes against their baneful effects.

The next sovereign, Hoang-tee, was an usurper; but during his reign the Chinese are stated to have made a very rapid progress in the arts and conveniences of civilized life; and to his lady, See-ling-shee, is ascribed the

honour of having ﬁrst observed the silk produced by the worms, of unravelling their coccoons, and working the fine filaments into a web of cloth. The tomb of Hoang-tee is also kept up to this day in the province of Shen-see.

From these few recorded facts, out of a multitude stated by Chinese historians, we think it may be inferred that, at a very distant period, and at the earliest dawn of civilization, a small horde of Tartars, descending from their elevated regions, seated themselves on the plains of Shen-see, at the foot of the mountains; and, under the guidance of a succession of intelligent chiefs, changed the pastoral and venatorial life for one more stationary, and at length became cultivators of the soil, and spread themselves over the fine fertile region now known by the name of China. (*Hist. Gén. de la Chine*, par P. Mailla.)

Authenticity of their history examined.

Some doubts have been entertained with regard to the authenticity of that part of Chinese history which relates to the reign of the first three sovereigns, *Fo-hee*, *Chin-nong*, and *Hoang-tee*, which is supposed to have been contained in a book called *San-fen;* and of the five following reigns, ending with the joint government of *Yao* and *Chun*, as detailed in another work named the *Ou-tien.* Of the first of these works the Chinese avow that nothing is known; and all that remained of the second was an imperfect fragment preserved by being inserted at the head of one of their most ancient and valued books, called the *Shoo-king*, of which we have a translation, or rather a bad paraphrase, by Père Gaubil. This fragment relates chiefly to the reign of *Yao* and *Chun.* The rest of the *Shoo-king* contains an abridged history of the empire, from the joint reign of these two sovereigns down to the time of Confucius, being a compilation by this celebrated sage. The authenticity of the *Shoo-king* must, however, depend on two circumstances; first, whether it is the same that was composed by Confucius; and, secondly, whether the materials which this sage possessed were authentic. If he really had copies of the *San-fen* and *Ou-tien*, the *Shoo-king* may fairly be classed with the history of Herodotus, with whom Confucius was contemporary,—the Chinese historian having the additional advantage of previous written records. But, admitting this to have been the case, there is still an awkward and suspicious chasm in the history of China, the cause of which draws largely on our faith. The Emperor Che-whang-tee, of the dynasty of *Tsin*, after reducing into subjection the provinces which had revolted, conceived the mad scheme of destroying all the writings of the empire, under the idea of commencing a new set of annals with his own reign, in order that posterity might consider him as the founder of the empire. Some sixty years after this barbarous decree had been carried into execution, his successor, desirous, as far as might be possible, to repair the injury, held out great rewards to those who could produce any part of the annals of the empire, more especially the hundred chapters of the *Shoo-king.* After some time, a copy of the *Shoo-king* was procured in this manner. All ancient writings, and those of Confucius in particular, were comprised in short sentences, forming a kind of poetry, not unlike the Proverbs of Solomon; and they were in the memory of most persons then, as they are now, who had any pretensions to literature; but sixty years having been suffered to elapse before any encouragement was held forth for the revival of letters, most of those who had known the *Shoo-king* were either dead, or so old as to have lost the recollection of it. At length, however, a man named Foo-seng, of the age of ninety and upwards, was discovered, who, in earlier life, could repeat the whole of the *Shoo-king* by heart. To this man the historiographers of the empire were sent; but he was unable to write, and his articulation was so imperfect, that the parts of it which he recollected could only be obtained through the medium of his daughter, who, having received the words from her father, repeated them to the historians. In this way they proceeded until twenty-nine of the books or sections of the *Shoo-king* had been committed to writing, which Foo-seng had comprehended in twenty-five; but here they were compelled to stop, the infirmities of Foo-seng not allowing him to proceed. A document thus obtained did not pass for genuine among the learned; yet all were eager to procure copies of it, in order to compare such passages as each might recollect to have heard their fathers repeat. The early annals of China, however, do not rest solely on this record. Half a century after this, a prince of Loo, in pulling down an old building (some say the house in which Confucius lived), to erect on its site a temple in honour of that philosopher, discovered in one of the walls an imperfect copy of the *Shoo-king*, with two other works of Confucius. They were much devoured by the worms, and written in a character which had gone out of use. The learned men were assembled to collate this newly discovered copy with that taken from Foo-seng's recollection, and it is said that they did not materially differ, except in the division into chapters. They therefore proceeded in deciphering the remaining part of the characters, and, after much time and labour, obtained twenty-nine complete articles, in addition to the twenty-nine recollected by Foo-seng, making the fifty-eight chapters of which the *Shoo-king* at the present day is composed.

The story is told by Chinese writers with some variations; but it is a common saying, that "both the ancient and modern *Shoo-king* were taken from the wall of a house." According to some, the old man Foo-seng hid a copy of the book within the wall of his house, and, to avoid the rigour of the persecution that was carried on against men of letters, put out his own eyes and affected idiotism. The whole story, however, is not very consistent, and it has been conjectured that it was invented as a salvo to the mortified vanity of the Chinese, who were unable to make out a connected series of annals from a high antiquity; and that, in fact, Confucius was the first regular historian of the empire, and probably the person who first led them on rapidly to a state of civilization. One thing at least is perfectly well ascertained; no writings of any description prior to those ascribed to Confucius exist in China. Where the *Shoo-king* terminated, Confucius commenced his own annals, called the *Tchun-iou*, which carried down the history of the empire to his own time; and of this work a copy had been secreted by one of the historiographers. Many other manuscripts were from time to time brought in, from which were selected all that belonged to the history of the empire, by a commission, of which *Tse-ma-tsin* was placed at the head; after his death his son *Tse-ma-tsien* completed this great work, which is still extant, about a century before the Christian era, and its author is considered and known by the name of the *Restorer of History.* From that period to the present time there seems to be no reason to doubt the authenticity of Chinese history, or to accuse it of undue partiality. The history of a dynasty is not made public from authority, until that dynasty has ceased to reign; and it does not appear that any injustice is done or attempted by the succeeding dynasty. Some of the atrocities of Gengis-khan are related on his first incursion into China, but ample justice is done to him and to his successors; and the present Tartar dynasty, in publishing the annals of that of *Ming*, whom they displaced, does not appear to have done it any violent injustice. This event occurred under the eye of several European missionaries then resident in the capital; and, by their concurring testimonies, the affairs of the empire were left, as the Chinese state, to priests,

and eunuchs, and jugglers; and it is favourable to the character of the college of Han-lin, that, for the sake of accuracy, the history of the dynasty of Ming was retarded for some time, by the Chinese members refusing to allow the Tartar race, then on the throne, the title of *imperial*, until the last remaining prince of the family of Ming should be extinct; but the Tartars insisted on dating the commencement of their own dynasty from the day they were in possession of Pekin, to which at length the Chinese members were reluctantly compelled to assent. In the instance of Gengis-khan they were most successful. The name of this marauder does not appear in the list of Chinese emperors, nor those of the two next in succession, Ogdai-khan and Menko-khan, though their exploits are amply detailed in Chinese history. The Mongoo dynasty commences only with Kublai-khan, who was not declared emperor till the death of the last remaining branch of the family of *Song*. Their account of these Tartars is probably very correct. They had neither treasure to pay their troops, nor magazines of provisions for their subsistence. They lived by the chase and by plunder, driving before them large herds of cattle, whose flesh served them for food when other supplies failed, and their skins for clothing. They put to death men, women, and children, without compunction, plundering the towns and villages through which they passed, and carrying off the young women; and when the Chinese took up a strong position in the passes of the mountains, it was the practice of Gengis-khan to seize all the old men, women, and children of the neighbouring country, and drive them forward at the head of his army, and thus, approaching the Chinese under cover of their own friends and relations, succeed in coming upon them without their being able to strike a single blow; and it is added, that, had it not been for the remonstrances of a Chinese who had united his fortunes to those of the invaders, Gengis-khan had determined to put to death all the agriculturists, for ploughing up the ground, and destroying the grass on which his numerous cavalry was to be subsisted.

As their history relates solely to the internal events and transactions of the empire, and as their policy has been to exclude all communication with foreign nations, we have no means of verifying the facts that are related; but it is in favour of their accuracy to find a fact recorded in the progress of a revolution brought about by a change of dynasty, which is also related by an European traveller, who was himself a party in the transaction, and who is worthy of implicit credit in all that he states to have fallen under his own knowledge and observation. Marco Polo states, that *Sian-foo* was taken by the Mongoos after a siege of three years, chiefly by means of machines made by his father and uncle, which hurled stones of three hundred pounds in weight; and it is recorded in the history of China, that the city of Siang-yang held out against the troops of Kublai-khan for four years, but was at length reduced by means of certain machines for hurling stones of an extraordinary weight, constructed by one *Alhaya*, who had travelled to China from the western countries.

Another instance of the fidelity of the Chinese historians is affirmed by the faithful traveller Marco Polo. It is recorded that Kublai-khan adopted the Chinese manners and customs, and gave encouragement to the arts and sciences, commerce and manufactures; that he opened the ports of China to all foreigners; that he sent embassies and expeditions to almost every part of the world, and received tribute from the sovereigns of Pung-kia-la (Bengal), Soo-ma-ta-la (Sumatra), and Mal-la-kia (Malacca); subdued Corea, but failed in his expedition against Japan, or, as they call it, Je-pun-quo, the kingdom of the rising sun; all of which will be found related in Marco Polo, whose accuracy in relating what was told him appears in another Chinese book called *Fo-quo-kee*, a history of the kingdom of Fo, giving an account of the temples of India, visited by a Ho-chang or priest in the fourth century, in which, among other things, is noticed the yells and musical strains made by invisible spirits in the great desert of Sha-moo, to frighten and bewilder the traveller; a fable repeated by Marco Polo, in speaking of the same desert, nine hundred years afterwards. (*Hist. Gen.*; Morrison's *Dictionary*; Marco Polo.)

Government.

But whether the ancient history of China be true or false—whether Yao or Chun were real or fictitious personages, and Confucius the real author of the religious, moral, and political maxims ascribed to these sovereigns, the Chinese at least entertain no doubts on the subject; and on these maxims are all their institutions founded, as we find them existing at the present day. In all these institutions may be discovered the traces of a primeval state of society. The leading features of the government still wear the stamp of the first rude attempts to restrain savage man within the pale of social life; paternal solicitude and protection on the part of the chief, obedience and service on that of the people. The same principles which their history states to have regulated the pastoral tribes of Fo-hee on the plains of Shen-see, four thousand years ago, actuate the measures of the Chinese government of the present day. A few modifications of the ancient patriarchal system have served to convert tribes of hunters and shepherds into a nation of agriculturists, and to keep them so; for of all governments which the history of the world has made known, none has had that permanency and stability which China has enjoyed. Like other governments, the machine may occasionally have been enlarged; a few wheels may have been added, its movements sometimes disturbed, its operations impeded, and a spring or a wheel injured or destroyed; but the damage has soon been repaired, and without altering or improving the principles of the construction. Rebellion, revolution, and foreign conquest, have occasionally removed old families from, and placed new ones on, the vacant throne, and for a moment disturbed the movements of the machine; but a little time has generally restored the usual harmony of its operations. It becomes, therefore, an object of interest to inquire, on what principles, and by what practice, the largest mass of population which in any age or country has been united under one government, has been kept together in one bond of union, for a period of time extending far beyond that at which the history of the earliest European nations may be said to commence. It has assuredly not been owing to the superior virtues of its princes, for China has had its Neros and Caligulas as well as Rome; nor to the superior virtues of the people, for Chinese morality consists more in profession than in practice; and yet the affectation of superior virtues in the one, and of moral sentiment in the other, has gone far in giving support to the system of government, and securing the permanency of the ancient institutions of the country.

Ancient usage, universally appealed to, is almost the only rule of conduct, and the only limitation or control prescribed to the executive authority vested in the monarch. The public voice is never heard, but the public opinion is sedulously courted by the sovereign, and conveyed to every part of the empire through the medium of the *Pekin Gazette*. This vehicle of imperial panegyric is published daily; it is sent forth into all the provinces, and read in all the public taverns and tea-houses. It is one of the most powerful engines of state; and a series of this paper would explain the nature of the government

better than all the moral maxims of antiquity on which it is supposed to be founded. Through it are all the measures of the government, or rather of the sovereign, communicated to the public. If he fasts or feasts, promotes or degrades, levies or remits taxes, feeds the hungry, clothes the naked, rewards virtue or punishes vice, or, in short, whatever laudable action he may perform, it is announced in this state paper, with the motives and the reasons that may have given rise to it. All imperial edicts of a special nature, after being addressed to the proper tribunal or other authority, are promulgated in the *Pekin Gazette.* The papers presented before the General Council, and decided upon or examined by the emperor, are published or noticed in this Gazette, which contains nothing but what relates to the emperor or the supreme government. In the provinces thousands of persons find employment by copying and abridging the Gazettes for readers who cannot afford to purchase the complete edition. To falsify any of the papers therein contained is a crime punishable by death.

The grand leading principle of this patriarchal government is to place the sovereign at as great a distance from the people, and as far removed from mortality, as human invention could suggest. They not only style him the "Son of Heaven," but believe him to be of heavenly descent; and this superstitious notion appeared in a manner sufficiently remarkable, by the obstacles thrown in the way of the present Manchoo dynasty, on account of their family not being able to trace their descent farther back than eight generations; a defect of ancient origin which was considered by the Chinese as a great reproach. Kaung-hee, aware of their prejudices, caused the genealogy of the Tartar family to be published in the Gazette. It stated that "the daughter of heaven, descending on the borders of the Lake Poulkouri, at the foot of the White Mountain, and eating some red fruit that grows there, conceived, and bore a son, partaking of her nature, and endowed with wisdom, strength, and beauty; that the people chose him for their sovereign; and that from him were descended the present Son of Heaven, who filled the throne of China." And this explanation wiped away the reproach, and fully satisfied the subjects of the "celestial empire."

In the capacity of sovereign, the Emperor of China is supposed to sustain two distinct characters. The first is that of a high priest, in which he, and he alone, mediates and intercedes with heaven for all the sins and misdeeds of his people. In this character he alone can officiate at solemn feasts, when Heaven is to be propitiated by suitable oblations. He not only has the merit of all the prosperity that the empire enjoys; but he also affects to consider public calamity as the consequence of some act committed, or some duty neglected by him. When, therefore, insurrections, famines, earthquakes, or inundations, afflict the people, he affects the deepest humility, appears in the meanest dress, strips the palace of its ornaments, and suspends all the court amusements; but even in this state of humiliation he is held up as the peculiar object of heaven's attention, whether it be to punish or to bless.

His second character as sovereign of the empire is that of "the father and mother of his people." In this character it is supposed that his subjects bear the same relation to him that he stands in towards *Tien* or heaven. His ministers or magistrates execute his will, and are supposed to be placed as agents between him and the people, in the same manner as heaven has its agents to regulate the divine decrees on earth; but all power, honour, offices, and emoluments, emanate from him alone, and are revocable at his pleasure. His prerogative is undefined and undivided, unrestrained by any written law, and checked only by ancient custom, stronger even than law. "Heaven," says Confucius, "has not two sons, earth has not two kings, a family has not two masters, sovereign power has not two directors—one God, one emperor," not for China alone, but for all the earth, the rest of the sovereigns being considered as his vassals. This doctrine was boldly avowed on the occasion of Lord Amherst's embassy, when the ceremony of prostration was demanded, not as a mere ceremony, but as the sign and seal of vassalage, and on this ground was of course resisted.

This self-created universal autocrat is not only the fountain of all honour in his wide dominions, but of all mercy. He is held upon all occasions as the mediator for his people, stepping in between the sentence of the law and the execution of it, and with a fatherly tenderness remitting a certain portion of the punishment which the law awards, and which the magistrate has no power to dispense with. If a magistrate instructs the people, it is in the name of the emperor; if he flogs them for a misdemeanour, he remits a certain number of blows as the emperor's grace; he orders his ministers to attend at all times to the complaints of the people; and, that none may be denied access to the chief magistrate of the district, a gong or drum is suspended at the outer gate of his dwelling,—but woe be to him who ventures to sound it without substantial reason; the emperor's grace would not save him from at least a dozen strokes of the bamboo. Navarette says that the judge's drum at Nankin is covered with the hide of an elephant, and the drum-stick, a huge piece of timber, is slung by strong ropes from the roof of the house. This poor Jesuit had a ready credulity to receive all for truth which the Chinese told him.

The name of the sovereign, however, rarely appears but in an amiable light; the people hear of him only as distributing rewards, punishing oppression, relieving the distresses of the poor, opening the public magazines in times of scarcity, and remitting all taxes where the state of the treasury will afford it. Thus it appears, that Kien-lung, having received a report from the board of revenue that a balance remained in the treasury of seventy millions of ounces of silver, issued an edict, by which he exempted all his people from one year's taxes. This is all very good, and so is the whole theory of this arbitrary government, as delivered in the following rescript, which the minister of Timour-khan put into the hands of this sovereign; indeed, were the practice but conformable with it, we might call it truly Utopian. 1. Study with eager attention the will of heaven. 2. Be careful to tread in the steps of your ancestors, and to imitate their virtues. 3. Cease not to show your respect and gratitude to the august parents who gave you birth. 4. Watch over your people with a fatherly fondness. 5. In the exercise of sovereign power preserve an upright heart and an elevated soul. 6. Be moderate in your pleasures. 7. Drink little wine. 8. Do not lavish your treasures. 9. Extend your benefits to men of merit. 10. Make your justice formidable to criminals. 11. Drive from your presence knaves and flatterers. 12. Cherish upright and sincere men, and receive with temper their wise remonstrances. 13. Study the character of those you employ, and proportion their employments to their talents. 14. Regulate your time to your occupations, so that they may suit each other. 15. Let not a day pass without studying the maxims of the ancients. And he concludes by observing, that by putting in practice these fifteen precepts, he would secure to himself a happy reign, and to his people prosperity and the blessings of peace.

In Kaung-hee's declaration on the appointment of his successor, a short time previous to his death, he observes, that "the true way for a sovereign to perform his essen-

tial duty towards heaven and the memory of his ancestors, is to procure for his people peace and plenty; to make his own happiness consist in the happiness of the people, and his own heart the heart of the whole state;" and he adds, "although since I have occupied the throne, I cannot say that I have succeeded in changing the bad customs, and reforming the morals of my people; although I may not have been fortunate enough to give plenty to every family, or the necessaries of life to every individual; yet I may venture to assert, that during my long reign I have had no other view than to procure for the empire a solid peace, and to render all my people satisfied in their respective conditions. During my whole reign I have caused the death of no one without a sufficient reason. I have never ventured upon any useless expense to be defrayed from the public treasury; it is the blood of the people. I have drawn nothing from it that was not necessary for the subsistence of the army, and for relieving the calamities of famine," &c.

The ancient and established maxims of filial piety, form, however, the grand basis of the Chinese government. Every son is supposed to hold the same relation to his father that the people do to the sovereign; and the same unnatural and unwarrantable power which is given to the father over his children could not consistently be withheld from the emperor. No wickedness or unnatural treatment can, on the part of the parent, relieve a son from his duties. The merit of every good action performed by the son is ascribed to the education given to him by the father, but the son bears his own disgrace. In like manner, the sovereign receives the whole merit of the country's prosperity, but his ministers incur the disgrace of all its misfortunes. To be consistent in thus placing the young and vigorous at the mercy of the old and feeble, the emperor affects to pay the same homage and obedience to his mother that are due from children towards their parents. The effect of this state morality, destructive of all real sentiment, is that of rendering every man a slave to some other, and establishing a system of tyranny, which descends in an uninterrupted chain from the emperor down to the meanest peasant. But this is not the worst: every man distrusts his neighbour; because every man is known to assume a character that does not belong to him, and constantly to act the hypocrite in public.

The jealousy and suspicion which prevails, from the sovereign on the throne to the lowest of the magistrates, evince how little they trust to the fine maxims of morality, by which, it is pretended, the throne is supported and the happiness of the people secured. No magistrate, for instance, can hold an employment in a district where he has relations; he cannot marry in that district; he cannot purchase lands in it: if his father or his mother should die, he must immediately resign his employment, to fulfil the duties which a son owes to his parents, and which cease not with life; and, at all events, he is removed at the end of three years. No two relations within the fourth degree can sit together at the same board. In each of the six boards which sit in Pekin there is a censor, who has no deliberative voice, but listens to their discussions, makes his remarks, and, like our speaker in the House of Commons, keeps them in order, refers to precedents, and the like. He is supposed to be the confidential servant of the sovereign, whom he informs of what is going on, and what are the sentiments of the several members. These six censors may be considered as imperial spies, and they form an extraordinary board called *Too-tche-yuen*, whose chief business is that of dispatching their visitors or sub-censors to all parts of the empire, to examine into and report upon the conduct of the several officers, and to discover whether any and what abuses are alleged against them; and, to complete the system of espionage, persons are invited to send up informations against the officers of government, all of which are registered in this extraordinary tribunal.

In this precarious situation, a magistrate may consider himself fortunate if he escapes the shafts of private malice, or retires from office without having incurred disgrace, or some more serious punishment, for the commission of some fault, or the dereliction of some duty; for, where the offices of state are open to the lowest of the people, when possessed of the requisite qualifications, the candidates for employment become so numerous, that every trifling fault is laid hold of to create a vacancy; and these frequent removals and degradations fall in precisely with the system of the government, which is to break down all connection between the officers and the people, and to turn the respect and veneration of the latter exclusively to the sovereign. On the same principle, it is supposed that the extortions and malversations of officers high in the government are frequently winked at, until, at a proper season, the hand of power lays hold of the treasure corruptly obtained, and gets rid, in a legal manner, of the whole family of the delinquent. It is true, a magistrate in China is tried by his brother magistrates; but when the sovereign is the accuser, as is generally the case where an officer of state is the accused, the result is pretty certain. The favourite and principal adviser of the late Kien-lung was brought to trial by his imperial master, Kia-king, on charges of the most frivolous nature, as that of having walked through the middle gate, which is alone reserved for the emperor, having a pearl in his possession larger than any belonging to the imperial family, &c.; but the object was answered; he was condemned to death, his whole property, which was immense, confiscated, and all his relations dismissed from their employments, and banished into Tartary. We may form a tolerably correct opinion of the manner in which the criminal courts administer justice in cases wherein the emperor is personally concerned, from the trials that took place in consequence of the attempt that was made to assassinate the late Emperor Kia-king. He announces to the public a revolt, takes blame to himself, abuses his ministers for their negligence, to which he ascribes his misfortune, and ends his proclamation in a strain of self-reproach and great hypocritical humility. As the greater part of the handful of rebels who attempted to storm the palace were killed in the act, and the rest that were taken put to death, some by beheading, others by a slow and lingering process, some hacked and mutilated in the public market-place, and others "cut into ten thousand pieces," it might be supposed that here the business ended. No such thing. The emperor, in his proclamation, denounces a particular sect, which once caused a revolt in four provinces, that took eight years to subdue; hence the country magistrates, to make amends for the carelessness of the ministers, persecuted all sects, and, among others, the Christians. One of the magistrates had the courage to send to the capital a spirited remonstrance, in which he stated that many innocent persons had been brought to trial, tortured, and suffered death; that numbers were unjustly confined, or passed from court to court, after being put to the torture under pretence of preparation for trial; and that they were finally liberated, without trial, after their health was destroyed and their property wasted. The whole document exhibits a melancholy picture of abuses in the administration of the criminal jurisprudence of this supposed virtuous and humane nation.

The administration of the government is conducted by six departments, to each of which there is a president and a certain number of members, forming so many boards, similar to those of our admiralty and treasury boards; and the six presidents form a distinct board of themselves,

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which, with certain princes of the blood, may be called the extraordinary council of the state. Each board sends out its appropriate officers to every part of the empire, with and from whom it has to correspond and receive reports; abstracts of which, and of all its proceedings, are daily laid before the emperor by one of the *co-laos* or presidents, whom he generally selects as his favourite and confidential minister and adviser. The respective duties of these boards are so interwoven with the laws of the empire, that a brief view of the laws will best explain the nature of the executive governments. (Grozier and Du Halde's *Hist. of China; Mém. sur les Chinois;* Macartney's *Journal;* Staunton's *Authentic Account of an Embassy,* &c.; Barrow's *Travels in China.*)

Laws.

When Pauw observed that China was governed by the whip and the bamboo, he was not aware of the theoretical application of these instruments, especially the latter, to the whole code of civil and criminal law. The remark was not meant to extend beyond the practical application of these machines to the human body, which, it must be owned, are effectual aids towards the establishment of a strict police, and that they are freely enough administered in keeping the peace among the lower orders; but their use in this way is by no means so extensive as is generally supposed, and as the letter of the law would seem to imply. This great empire may, notwithstanding, be aptly enough compared to a great school, of which the magistrates are the masters, and the people the scholars. The bamboo is the ferula, and care is taken that the child shall not be spoiled by sparing the rod. The bamboo, however, is not used merely for flogging the people. In the fundamental laws of the empire it forms the scale by which all punishments are supposed to be proportioned to the crimes committed, and which are carefully dealt out by weight and measure; and here also we recognize the work of an ancient people in a rude state of society. In a small family, or a community consisting of a certain number of families, it may just be possible to "adapt the penalties of the laws in a just proportion to the crimes against which they are denounced;" but the continuance of such a system in an overgrown commonwealth affords no proof of refined or extensive notions of jurisprudence. Punishment, as an example to deter others from the commission of crimes, would seem, indeed, to be less the object of Chinese legislation than that of satisfying the claims of rigid justice: to wipe off a certain degree of crime by the infliction of a proportionate degree of suffering.

The code of laws called the *Leu-lee* has undergone several changes by different dynasties, but the principle of the laws has remained the same. This book is to China what Burns's *Justice* is in England, and is familiar to all who have any pretensions to literature. "The magistrates and the people," says the Emperor Sun-chee, "look up with awe and submission to the justice of these institutions." An European will regard them with different feelings. The frequency and the severity of corporal punishments, if literally inflicted, would be shocking and disgusting; but, as Sir G. Staunton has observed, "there are so many grounds of mitigation, so many exceptions in favour of particular classes, and in consideration of peculiar circumstances, that the penal system, in fact, almost entirely abandons that part of its outward and apparent character" The same observation will apply to the penalty of death, which appears to be affixed to crimes of even a comparatively slight nature; for if we are to judge from the very small number of criminals that are said to be executed annually, capital punishments must be rarely inflicted. According to the *Pekin Gazette,* the number of criminals executed in 1828 was only 789. This, however, may in some measure be explained by the fact, that, while in ordinary cases the executions are postponed until the autumnal assize, when the emperor revises and confirms the sentences of the provincial governors, in such as robbery with murder, highway robbery, piracy, rape, &c., executions may take place immediately, without being referred to the emperor, and these in all probability never find their way into the *Gazette.*"

The number of blows to be inflicted with the bamboo may not only be considered as the measure or scale of crimes, but as regulating also the mode or practice of punishment. The letter of the law, severe as it may appear to be in denunciation, is more lenient in execution. Thus, ten blows of nominal punishment are practically reduced to four, and 100 to 40; and, in many cases, these blows are redeemable by fine.

This bamboo, that makes so conspicuous a figure in the Chinese code, is limited by law to two sizes; the larger 5 feet 8 inches in length, $2\frac{2}{4}$ inches broad, and 2 inches thick, weighing $2\frac{2}{5}$ pounds; the smaller the same length, 2 inches broad, and $1\frac{1}{3}$ thick, weight about $1\frac{5}{6}$ pound.

The cangue, or more properly the *kia,* is a wooden collar for the neck, 3 feet long, 2 feet 9 inches broad, weighing, in ordinary cases, 33 pounds.

The iron chain, by which all criminals are confined, is 7 feet long, weighing $6\frac{2}{3}$ pounds; besides which they use wooden handcuffs and iron fetters.

Various kinds of torture of the hands, feet, ancles, &c. are made use of to extort evidence or confession; but it is not permitted to put the question by torture to those who belong to any of the eight privileged classes, in consideration of the respect due to their character; nor to those who have attained their seventieth year, in consideration of their advanced age; nor to those who have not exceeded their fifteenth year, out of indulgence to their tender youth; nor, lastly, to those who labour under any permanent disease or infirmity, out of commiseration for their situation and sufferings. The eight privileged orders spring out of, 1. imperial blood and connections; 2. long service; 3. illustrious actions; 4. extraordinary wisdom; 5. great abilities; 6. zeal and assiduity; 7. nobility of the first, second, and third rank; 8. birth; all of which, excepting the first, seventh, and eighth, have not, in fact, any existence. Their chief privilege consists in not being liable to be tried for any offence, without a specification of the crime being laid before the emperor, and his express commands issued for that purpose.

There are five degrees of punishment.

The first degree is a moderate correction inflicted with the lesser bamboo, "in order that the transgressor of the law may entertain a sense of shame for his past, and receive a salutary admonition with respect to his future conduct." This correction extends from ten to fifty blows; the first, in practice, reduced to four by the emperor's grace; the last never exceeds twenty blows.

The second class of punishments extends from sixty to a hundred blows, of which from twenty to forty are actually inflicted.

The third division is that of temporary banishment to any distance not exceeding 500 *lee* (about 150 miles), "with the view of affording opportunity of repentance and amendment;" and it extends from one to three years' banishment.

The fourth degree of punishment is that of perpetual banishment, which is reserved for the more considerable offences, and extends to the distance of 2000, and even 3000 *lee,* with 100 blows of the bamboo.

The fifth and ultimate punishment which the laws ordain is death, either by strangulation or decollation.

At the head of the code are placed ten offences of a *treasonable nature:*—1. *Rebellion,* defined an attempt to violate the divine order of things on earth; 2. *Disloyalty,*

an attempt to destroy the imperial palaces, temples, or tombs; 3. *Desertion* to a foreign power; 4. *Parricide*, or the murder of parents, uncle, aunt, grandfather, or grandmother; 5. *Massacre*, or the murder of three or more persons in one family; 6. *Sacrilege*, or stealing from the temples any sacred article, or any thing in the immediate use of the sovereign; 7. *Impiety*, or negligence and disrespect of parents; 8. *Discord in families*, or a breach of the legal or natural ties, founded on connections by blood or marriage; 9. *Insurrection* against the magistrates; 10. *Incest*, or cohabitation of persons related in any of the degrees to which marriage is prohibited. And these crimes are stated to be placed at the head of the code, from their being of so heinous a kind, that, when the offence is capital, it is exempted from the benefit of any act of general pardon, and that the people may learn to dread and avoid them.

Offences committed by officers of government, which, in ordinary cases, are punishable by the bamboo, are commutable for fine or degradation, according to the number of blows to which they are nominally liable. Thus, if publicly offending, instead of sixty blows, they forfeit a year's salary; and instead of a hundred, lose four degrees of rank, and are removed from their situation. If the offence be of a private nature, the punishment is doubled. The only male descendant of parents or grand-parents, who are aged and infirm men, if his age exceeds seventy, and youths under sixteen, are entitled to the indulgence of commuting the punishment awarded by law. Women, too, may have the sentence of banishment remitted, on payment of a fine; and when convicted of offences punishable with the bamboo, "they are permitted to retain a single upper garment while the punishment is inflicted, except in cases of adultery, when they shall be allowed the lower garment only."

The following table exhibits a scale of pecuniary redemption, in cases not legally excluded from the benefit of general acts of grace and pardon. They are not necessarily redeemable; but, by edict of Kien-lung, may be made so upon petition.

Rank of the Party offending.	Sentence.	Pecuniary Commutation.
		Oz. of Silv.
An officer above the 4th rank	Death by strangulation or decollation.	12,000
——— of the 4th rank......		5000
——— of the 5th or 6th rank		4000
——— of the 7th or any inferior rank, or a doctor of literature..........................		2500
A graduate or licentiate.........		2000
A private individual.............		1200
An officer above the 4th rank	Perpetual banishment.	7200
——— of the 4th rank......		3000
——— of the 5th or 6th rank		2400
——— of the 7th or any inferior rank, or a doctor of literature..........................		1500
A graduate or licentiate........		1200
A private individual.............		720
An officer above the 4th rank	Temporary banishment, or blows with the bamboo.	4800
——— of the 4th rank......		2000
——— of the 5th or 6th rank		1600
——— of the 7th or any inferior rank, or a doctor of literature..........................		1000
A graduate or licentiate........		800
A private individual.............		480

There is every reason to believe that these pecuniary commutations of banishments bring considerable sums into the treasury.

The *Ta-tsing-leu-lee* embraces an epitome of the whole system of government, and of civil and criminal jurisprudence. Besides the introductory part, which contains a general view of the laws, the code consists of six principal divisions, corresponding with the six supreme boards or departments by which the general administration of the empire is conducted. Thus, the *first division* of the code relates to that part of the *civil law* which falls under the cognizance of the *Lee-pou*, or the department which examines candidates for employment, and nominates to appointments, subject to the approbation of the emperor. This division consists of two chapters; the first defining the duties and regulating the offices of the several magistrates, the rule of hereditary succession, and the penalties attached to malversation. The second book relates chiefly to the conduct of the provincial magistrates. The capital offences classed under this division are, great officers of state presuming to confer appointments by their own authority, and without the sanction of the emperor; undue solicitation of hereditary honours; all cabals and state intrigues among the officers of government; collusion between the provincial magistrates and the officers of the court; addressing the emperor in favour of any great officer of state, which is construed into a treasonable combination, subversive of legitimate government; destroying edicts or seals of office; all of which, however, fall within the class of redeemable punishments, which are not excluded from any general act of grace or pardon.

The *second division* of the code relates to the *fiscal laws*, which are placed under the cognizance of the *Hoo-pou*, or financial department. They are various, and relate, 1. To the enrolment of the people, personal service, levying of taxes, punishment of persons deserting their families, care of the aged and infirm. 2. The law of holding, mortgaging, selling, &c. lands and tenements. 3. Regulations respecting marriages and divorces. 4. Respecting public property, the coinage, the revenue, the public stores. 5. Duties and customs, smuggling, false manifests, &c. 6. Private property, the law of usury, of trusts, &c. 7. The regulations concerning sales and markets; monopolizing and fraudulent traders; false weights, measures, and scales; manufactures not conformable to the fixed standard, &c. The section concerning marriages and divorces is brought under this division of the code for no other reason, it would seem, than to regulate the descent and distribution of property. The law allows seven justifiable causes of divorce: 1. Barrenness; 2. lasciviousness; 3. neglect of her husband's parents; 4. talkativeness; 5. thievish propensities; 6. envious and jealous temper; 7. inveterate infirmity. But, in spite of any or all these causes, a wife cannot be divorced if she can plead any of the three cases: 1. having mourned three years for her husband's parents; 2. her husband having become rich since the time of her marriage; 3. the wife having no parents living to receive her.

The *Le-pou*, or board of rites and ceremonies, takes cognizance of all offences committed under the *third division* of the code, which is subdivided into two sections, and relates, 1. To the *sacred rites*; the administration of the prescribed ritual; the care of altars, sacred terraces, and the tombs; unlicensed forms of worship; magicians; leaders of sects; and teachers of false doctrines. 2. To miscellaneous observances respecting the palaces, the emperor, his equipage, and furniture; to the public festivals and days of ceremony; sumptuary laws relative to dress and habitations; celestial observations and appearances; regulations for funerals and country festivals.

The *fourth division* contains the laws by which the military are governed, the direction and superintendence of which are placed under the department of state called the *Ping-pou*. It consists of five sections. The first relates to the protection of the palace, and of course to the person of the emperor; the duties of the imperial guards; examination of passports, &c. The second is entitled the *government of the army*, and may be considered as the mutiny act, or articles of war, of China. Every neglect of duty, disobedience of orders, and want of discipline; fraud, embezzlement, desertion, are punished with extreme severity; and many of the offences herein specified are capital. The third section relates to the *protection of the frontier*, a most important consideration with this suspicious government; the fourth prescribes regulations respecting the horses and cattle belonging to the army; the fifth for the expresses and government posts, the post-horses, messengers, and horses employed in the conveyance of dispatches.

The *fifth division* contains the code of criminal law administered by the *Hing-pou* or criminal tribunal, which supplies the judges or assessors to all the other departments. It consists of eleven sections. The first, entitled *robbery and theft*, awards punishments for every species of robbery or theft that could well be devised; extorting property by threats; obtaining it under false pretences; kidnapping and selling free persons as slaves; disturbing graves, &c. The second relates to *homicide*, and may be considered as a most singular, if not successful, attempt to discriminate the exact proportion of guilt, for the same offence, in different persons, or different degrees of offence in the same person, according to the situation and circumstances of the offending parties. In every case of preconcerted homicide, the original contriver is condemned to die by decapitation, the accessaries by strangulation; accessaries to the intention, but not to the fact, are punishable with one hundred blows and perpetual banishment. Those who murder, with intent to rob, are beheaded, without distinction between principals and accessaries. Parricide subjects all parties to suffer death by a slow and painful execution; the attempt to commit parricide is death by decapitation. Slaves attempting to murder, or actually murdering their masters, are liable to the same punishment. A husband may kill his wife if caught in the act of adultery, and also her paramour; and a thief may be put to death if taken in the act of robbing a house; but, in either case, it would be murder if put to death after being seized. The preparing of poisons, and rearing of venomous animals, are capital offences. Practitioners of physic, or barbers (for they have no surgeons), who puncture with the needle, giving drugs, or performing operations contrary to the established rules and practice, and thereby killing the patient, are guilty of homicide; but, if proved to have been merely an error in judgment, the offence is redeemable by fine, but the doctor and the barber must quit their professions for ever; if the medicines, however, were given intentionally to kill or injure the patient, the practitioner must suffer death by decapitation. All persons guilty of killing in an affray, though without any express or implied design to kill, whether the blow be given with the hand or the foot, with a metal weapon or instrument of any kind, shall suffer death by strangulation. There is a clause, however, by which any person killing another in play, by error, or purely by accident, may be permitted to redeem himself from the punishment of killing or wounding in an affray, by the payment of a fine to the family of the deceased person; but the case of *pure accident* is very carefully defined and exemplified. It must be one "of which no sufficient previous warning could be given, either directly, by the perception of sight and hearing, or indirectly, by the inferences drawn from judgment and reflection."

In the third section, entitled "quarrelling and fighting," there is a minute and circumstantial detail of blows given under every conceivable case and situation, and in every possible relation in which the parties could stand towards each other. It fixes the periods of responsibility for the consequences of a wound; it awards the penalty of death on a slave who shall strike his master; on a son who shall strike his father or mother; on a grandson who shall strike his paternal grandfather or grandmother; on a wife who shall strike her husband's father, mother, paternal grandfather or grandmother; but if a father, mother, paternal grandfather, or grandmother, shall chastise a disobedient child or grandchild in a severe and uncustomary manner, so that he or she dies, the party so offending shall be punished only with one hundred blows, which, in reality, are no more than forty; and when any of the aforesaid relations are guilty of killing such disobedient child or grandchild designedly, the punishment shall be extended to sixty blows and one year's banishment. A parent may at any time sell his children to any one except strolling players and professors of the magic art. This distinction which the law makes between the parent and child, and the almost unlimited authority which is given to the former over the latter, would lead one to conclude, that, if the crime of infanticide be not sanctioned, it is at least connived at, by the government. There is every reason, however, to believe that the extent of it has been grossly exaggerated, and that the greater part of infants taken up in the streets of large cities by the police have died in the birth, and been laid out to avoid the expense of burial; or been exposed alive, with the view of their being taken care of as adopted children, or conveyed to hospitals for the reception of deserted children.

In the cases above stated, the child murdered is supposed to have been *disobedient*, which is a crime of the deepest dye, as affecting the principle on which the whole system of government is founded; and, from section 294, it is evident that killing a son, grandson, or slave, under any circumstances, with the aggravation of imputing his death to an innocent person, is not a capital offence. "Whoever is guilty of killing his son, his grandson, or his slave, and attributing the crime to another person, shall be punished with seventy blows, and one and a half year's banishment." But "a child or grandchild who is guilty of addressing *abusive language* to his or her father or mother, paternal grandfather or grandmother; a wife who is guilty of addressing abusive language to her husband's father or mother, paternal grandfather or grandmother, shall, in every case, suffer death, by being strangled." They must, however, themselves complain, and themselves have heard the abusive language. In like manner, a slave is liable to capital punishment for addressing abusive language to his master.

The fifth book relates to indictments and informations of all kinds; the sixth to cases of bribery and corruption, and seems to contain provisions against bribery in almost every shape which it can be supposed to assume. It is not easy, however, to reconcile these apparent appropriate provisions with that systematic corruption which, under the less odious name of presents, is prevalent in every department of the administration of public affairs and public justice in China. There is a scale of punishment for the value of the bribe received, from one ounce of silver to 120 and upwards; the first entailing sixty blows, the last death by strangulation, when the object is in itself lawful; but, if unlawful, an ounce of silver incurs seventy blows; and eighty ounces and upwards, death by strangulation. That they all take bribes is well known; yet it

appears by a note in the original (*Leu-lee*), that, in the thirty-third year of Kien-lung, a governor of a city in the province of the capital was tried, and sentenced to suffer death, for taking a bribe of 7000 ounces of silver to stop proceedings in a case of disorderly conduct and contempt of court; though, finding himself unable to accomplish the object, he had returned the money. In like manner, there are so many provisions against extortions and corrupt practices on the part of great officers of state and their families, that it might be supposed no such practices could exist. The last section of this book is curious, as affording a proof of the care with which the imperial prerogative is fenced round. " All military officers of government, whether stationed at court or in the provinces, are prohibited from receiving presents of gold, silver, silk-stuffs, clothes, wages, or board-wages, from individuals in any of the three principal ranks of hereditary nobility" (mostly related to the royal family and other Tartar chieftains). Any breach of this law deprives them of their rank and employment, and renders them, moreover, liable to the punishment of one hundred blows, and remote perpetual banishment. The second offence of this kind is capital.

The seventh book awards punishment for frauds and forgeries, falsification of the imperial seal or imperial almanac, counterfeiting the current coin of the realm, seducing persons to transgress the laws, &c. The eighth is entitled incest and adultery. Criminal intercourse with an unmarried woman, though by mutual consent, is punishable with seventy blows; with a married woman eighty blows; deliberate intrigue with either, with one hundred blows; a rape with death by strangulation; and criminal intercourse with a girl under twelve years of age is punishable as a rape. Adultery with the wife of any civil or military officer is death; but civil or military officers committing adultery with the wife of a private individual is degradation, one hundred blows, and wearing the cangue for a month. In all ordinary cases of adultery among the people, the punishment is one hundred blows, and the cangue for a month. An unnatural crime forcibly committed, or committed on boys, is punishable as a rape; but by mutual consent the parties are punishable only with one hundred blows, and the cangue for a month. In all cases of criminal intercourse, the law is more severe towards the woman than the man, and towards slaves than freemen. " All civil or military officers of government, and the sons of those who possess hereditary rank, who shall frequent the company of prostitutes and actresses, shall be punished with sixty blows;" which is, in fact, no punishment at all, as the blows, in reality, are reduced to twenty, and redeemable for a mere nominal sum, not exceeding two or three shillings.

The ninth book is entitled miscellaneous offences, among which is that of gaming; any person convicted of which is punishable with eighty blows. Yet in every street and corner, and in the very temples, the lowest of the people may be seen daily, and every hour of the day, playing at cards, dice, or a sort of game resembling chess. Accidental incendiaries are flogged and fined, according to the consequences of the fire they have occasioned; and wilful incendiaries are punished with death, provided it be proved that the fire was occasioned with a view of plunder. Stage-players and musicians are prohibited from representing emperors, empresses, famous princes, ministers, and generals of former ages, on pain of receiving one hundred blows for every breach of this law. Yet, as these are the favourite and most usual exhibitions, it may be presumed that this law is obsolete. There is, indeed, a saving clause, which says that, " by this law, it is not intended to prohibit the exhibition on the stage of fictitious characters of just and upright men, of chaste wives, and pious and obedient children; all which may tend to dispose the minds of the spectators to the practice of virtue."

The tenth and eleventh sections contain regulations with regard to arrests and escapes, imprisonment, judgment, and execution.

The *sixth* and *last division* contains the laws and regulations respecting the public works, which are placed under the superintendence of the department of state called the *Cong-poo*, or board of public works. It has only two sections; the first relating to public buildings, and the second to the public roads. From the first it appears, that this board has also the superintendence of the public manufactures of the state, such as military weapons, silks, stuffs, porcelain, &c.; and that if any private individual be convicted of manufacturing for sale, silks, satins, gauzes, or other stuffs of this nature, according to the prohibited pattern of the *lung* (dragon), or the *fung-whang* (phœnix), he shall incur the penalty of one hundred blows, and the goods so manufactured be forfeited to the state. This book, and the next, concerning the keeping in repair of the public roads, embankments, and bridges, contain a number of regulations and petty penalties for neglect and malversation, that are beneath the dignity of legislation, and fitted rather for the subjects of deliberation in a parish vestry. Indeed, the whole body of Chinese law, civil and criminal, consists of such minute meddling with all the common concerns of life as to be utterly unfit for any practical application, except to such mere machines as the Chinese are, for whom it seems to be admirably suited to answer the intended purpose. Nothing can more clearly exhibit this great multitude of human beings as an inert and sluggish mass, without a heart, and without one single idea of the liberty and independence of the human mind, than the minute and paltry regulations under which it has voluntarily submitted to be bound and shackled for so many thousand years.

After all, there is reason to suspect that this minute measuring out of punishments by a scale, in order to adapt them to their respective degrees of criminality, is pregnant with the most gross injustice; and that, where so much pains are ostentatiously displayed to deal out justice by weight and measure, there is so much less of it in the execution. Many examples might be cited in confirmation of this opinion, but a few will suffice. In the eleventh volume of the *Chinese Memoirs*, Père Amiot gives a curious account of a master mason that died by an accidental blow of the bamboo, while under a flogging by order of an officer of the household of a prince of the blood, whose house he was rebuilding in Pekin. As culpable homicide is death by the law of China, the officer bribed one of the mason's labourers, for ten ounces of silver, and the promise of a respite, to take the blame on himself, as the consequence of a quarrel; and, for three ounces of silver, two or three of the labourers were to give evidence to that effect. The man was tried, and condemned to suffer death on the day of general execution in autumn. On the morning of that day, or the evening preceding, it is the custom, it seems, to bring up all the prisoners under sentence of death to be interrogated by the *co-laos*, or principal ministers of the crown; and, on this occasion, the heart of the bricklayer's labourer failing him, he discovered the whole transaction. The offending officer was immediately tried; and, coupling his original offence with the aggravated one of exposing an innocent person to suffer death, was sentenced to die by a slow and painful execution. Nor was this all; the judges and assessors of the court, who had originally tried the offence, were each degraded one rank, and mulcted of their salary and emoluments. This is given by Père Amiot as an instance of Chinese justice;

China.

but it tells as strongly the other way; for, if such gross iniquity, committed in open day, and in the presence of a multitude, was thus connived at at the very fountain-head, what may not be expected at a distance, where the stream is still more muddy? That government can have no high notions of justice or morality which winks at, and sometimes encourages, a criminal to find a substitute, even when the punishment accorded to the crime is death. There is much truth, as many can testify, in the severe remark of Pauw—" Le juge veut faire une exécution, et il lui faut un patient; or il prend celui qui se présente." In the case of an English seaman, tried for the murder of a Chinese, when they failed in their endeavours to procure a black slave, or a criminal of Macao, or a sick person on the point of death, to execute,—not to satisfy justice, for it was an accidental death in a scuffle, but to satisfy the criminal court of Pekin, to which they had unluckily for themselves appealed; they had recourse to one of the meanest and most paltry expedients that ever disgraced a civilized government. " All the proceedings," says Sir G. Staunton, " were founded on a story fabricated for the purpose,—a story in which the Europeans did not concur, though asserted to have done so; which, in fact, the Chinese magistrates themselves, or the merchants under their influence, invented,—which the Chinese witnesses, knowing to be false, adopted,—and which, lastly, the sovereign himself appears to have acquiesced in without examination." Under such a government, the laws are either a dead letter, or may be so perverted that, under their sanction, the innocent may be made to suffer, and the guilty escape punishment.

In addition to all this, that horrible system of visiting the crimes of the guilty upon the heads of the innocent, which pervades all the despotic governments of the East, is also practised in China, in all cases of rebellion and treason; though it is not carried so far as among the Hindus, who, not content with cutting off a whole family, swept away whole towns and villages in which treason had appeared, as a terrible example to prevent other villages from harbouring traitors. Such are the dreadful effects of despotism, and the miseries inflicted on innocent families, where the people have no voice in the government; such a government is always more ready to punish than to protect. (*Ta-tsing-leu-lee*, translated by Sir G. Staunton.)

Prisons.

The condemned criminals for ordinary offences are kept in prison till autumn, when they are all executed in every part of the empire on a particular day. In general, the prisons are described as spacious, neat, and clean. Navarette, who was himself confined in one of them, says that they have large airy courts for the prisoners in the daytime; that overseers are always present to quell any noise or disturbance; and that they contain temples for the priests to resort to. The priests, he says, make a harvest in the prisons, as those whose trials were pending were constantly consulting the priests as to the issue, and they became the more religious the nearer the day of trial approached. Criminals are kept in chains, and always apart; so are the women kept separate from the men; and the missionary observed so little gallantry on the part of the men, that though there were gratings in the doors of the women's cells, the Chinese never once visited them. A very different picture, however, is given of the state of the prisons, and the prostitution of the females confined in them, in the province of Canton, from better authority than Navarette,—an official report to the emperor on the state of the prisons. The scenes of depravity herein exhibited are horrible beyond description.—(*MS. Report.*)

The durability of a system so arbitrary, and an administration so corrupt, is not a little owing to the incessant and indefatigable vigilance of the police; to the absence of all political meetings or societies, and of all discussions respecting public measures; to the gradation of obedience throughout every class of society, inculcated by precept, by example, and by the bamboo; and certainly not a little to that spirit of national industry, which is the grand preserver of national tranquillity.

Revenue.

It is almost impossible to arrive at even an approximation to the amount of the public revenue and expenditure of the Chinese empire. A large proportion of the taxes is paid in grain, silk, and other products, the market value of which varies from year to year. Each province is required not only to support itself, but to furnish annually a certain amount for the support of the emperor and his court. Some of the provinces, however, fail in raising enough even for their own outlay; and it is well known that his majesty is continually embarrassed for want of funds. The amounts given, by various authors at different times, of the revenue of China are so discordant, that little reliance can be placed upon them. In 1587 Trigault, a French missionary, stated it at 20,000,000 taels, or about L.6,600,000 sterling; in 1655 Nieuhoff estimated it at 108,000,000 taels, about L.36,000,000. Twelve years later, Magelhaens reckoned it at about L.4,000,000. Towards the close of the eighteenth century it was given by Sir George Staunton at L.66,000,000, of which sum, however, little more than a fifth was transmitted to Pekin. Dr Medhurst, on the authority of original sources, gives the revenue as follows:—

Sent to Pekin.				
Land-tax in money.........taels	31,745,966	=	L.10,581,955
Land-tax in grain.............shih	4,230,957	=	4,230,957
Customs paid in money.......taels	1,480,997	=	493,666
Kept in Provinces.			
Land-tax in money...........taels	28,705,125	=	9,568,375
Grain ....shih	31,596,569	=	31,596,569
Total		..	L 56,471,522

From this it will be seen, that in proportion to the population the taxes are very light, amounting only to about 3s. $3\frac{1}{2}$d. per head; and if we reckon only that which is sent to Pekin, namely, L.15,206,378, it will not amount to much more than 10d. per head. The principal source of revenue is the land-tax, which is a very light impost, amounting not, as some suppose, to one-tenth, but, according to Medhurst, more usually to one-fiftieth or one-hundredth of the produce. There are also taxes on pledged articles, and more particularly a heavy impost on salt. In a country like China, which has few or no resources beyond itself, a limited foreign commerce, and few manufactures; where the consumers are fully equal to the capabilities of the soil, and where every production is hastily devoured by a needy population; there is little left for a government to glean, or, to use a Chinese phrase, to squeeze out of the already exhausted pockets of the people. The long peaceful state of the country is, no doubt, in some measure to be attributed to the people being lightly taxed. The extraordinary sources of revenue that are resorted to in times of war or bad harvests are,—sale of offices and honours, temporary increase of duties, and demands for contributions from wealthy merchants and landholders. The first is that most generally resorted to, and is naturally that most agreeable to the great body of the people. The mines of gold and silver, pearl fisheries in Manchooria and elsewhere, and such like sources, furnish an important addition to the imperial revenue. The expenditure almost every year exceeds the revenue, but how the deficiency is made up is not very clear. In 1832 the emperor stated, that the excess of disbursements was 28,000,000 taels (L.9,300,000); and in 1836 it was still greater, and offices and titles to the amount of 10,000,000 taels (L.3,300,000) were put up for sale to supply it.

Religion.

There are three religious systems in China,—the state religion, at the head of which is the emperor, and those of

Tao-tse and Buddha. In the state religion the emperor is believed to be the sole vicegerent of the Supreme Being upon earth. He is the only individual that can stand between Heaven and the people, having the same relation to the former that the latter are supposed to bear to him. The people have no sabbatical institution, no congregational worship, no external forms of devotion, of petition, or thanksgiving, to the Supreme Being. The emperor being high priest performs the sacred duties according to the ancient ritual, and at certain fixed periods. Religion, as a system of Divine worship, as piety towards God, and as holding forth future rewards and punishments, can hardly be said to exist among the people. The emperor alone officiates at all the solemn ceremonies for propitiating Heaven or expressing a grateful sense of its benefits; and as "sacrifices and oblations can only be acceptable to Heaven when offered up with humble reverence, and a pure and upright heart," he prepares himself for such occasions by fasting and abstinence, and acts of benevolence and mercy to his subjects.

The equinoxes are the periods when the grand sacrifices in the temple dedicated to Heaven, within the precincts of the palace, are offered up; and every kind of business in the capital, all feasts, amusements, marriages, funerals, must be suspended during the ceremony, the moment of which is announced to the people by the tolling of the great bell in Pekin.

A ridiculous dispute was carried on with great vehemence between the Jesuits and other sectaries of the Catholic religion, whether the emperor did not offer his sacrifices and oblations to *Tien* as the visible and material heaven, and whether the Chinese were not atheists, at the head of whom he was the officiating high priest. There is not an expression in their ancient book of rites that warrants such a supposition. The *Lee-kee* describes the *Tien* as having neither voice, nor smell, nor figure, substance, nor dimentions; it gives him the attributes of omnipotence, omniscience, and ubiquity, and considers him as rewarding the good and punishing the bad; that public calamities are the instruments he employs to excite in the sovereign, and through him in the people, a reformation of morals. The names by which the sovereign power is known in their writings are,—*Whang-tien*, the illustrious heaven; *Chang-tee* the Supreme Ruler; *Tien-tee*, heaven and earth; *Che-chung*, the first and the last (Alpha and Omega); *Ken-puen*, root and branch.

All ranks, however, from the emperor downwards, are full of absurd superstitions. The imagination of untutored man, not easily comprehending a power so almighty and universal, created a number of inferior spiritual beings as the harbingers and agents of his will; and these spiritual agents, which the Chinese call *Quei-shin*, are invisible attenuated beings, some white and good, the advocates of men, others black and wicked, the punishers of sin; and these "illustrious subjects of the Great Ruler" are supposed to preside over the five seasons of the year, over mountains and rivers, over the hearth and the door of the house, and influence all the concerns of men. To these spirits certain duties are prescribed, and certain oblations offered; the men usually bring wine, the women tea; but these are private ceremonies and heartless duties; the devotion of religion is totally wanting; and in such a state it is not surprising that the doctrines and the practices of the sects of Tao-tse and of Fo should captivate the vulgar, and seduce them to a religion that spoke more strongly to the senses. It would seem, indeed, that the establishment of some popular religion is unavoidable, and that of Fo may, on this ground, be encouraged by the government, though it derives little or no support from it. The ancient religion of China entertained the idea of spiritual beings; but they never clothed them in a corporeal form. In the time of Confucius their temples were without images; their guardian gods and their evil genii were mere imaginary beings, to which they neither gave form nor substance; but when the priests of Fo found their entrance into China, they brought with them all the follies and absurdities of the doctrine of Buddh, and grafted them on the superstitions of the Chinese. They filled their temples with all manner of images, each having its peculiar virtues and peculiar influences, and levied for each a tax on the credulity of the people. In some of these temples are not fewer than three hundred sainted personages,—monstrous figures, as large as, and frequently many times larger than, human beings. Their bells and their beads, and burning of incense and tapers,—their images and their altars,—their singing and processions, were well calculated to seduce the populace, who had no outward forms of any religion. So strong was the resemblance of the interior of a temple of Fo, the dress of the priests, and the ceremonies of devotion, to those of the church of Rome, that one of the Catholic missionaries says, it seemed as if the devil had run a race with the Jesuits to China, and having got the start of them, had contrived these things for their mortification.

The Tao-tse are of Chinese origin, and sprung up under the very nose of Confucius, about 500 years before Christ. Their tenets resemble those of Epicurus; they pretend to magic and alchemy, to consult oracles, and to deal with demons; and they keep old women, who are regarded as a kind of witches. The priests of Fo came from Upper India into China, by invitation from a weak emperor, between the 60th and 70th year of the Christian era. Their tenets resemble the Pythagorean. They kill no living animal, and eat no animal food, lest they might partake of a relation or friend, whose soul had taken up its abode in the animal; and they believe that the human soul, in its transmigration through an infinity of corporeal existences, becomes purified and perfect, and at length is reunited to the Deity, from whom it originally emanated. They consider the consummation of felicity to consist in the annihilation or total suspension of every faculty of the soul, leaving a void for that of Fo to occupy. Arrived at this stage, the devotee soon dies from exhaustion and want of food; his body is burnt, the ashes put into eight urns, upon which a tower of nine roofs and eight apartments is built, and an urn placed in each apartment; and this is said to have been the origin of the numerous tall pagodas that appear in every part of China. It is pure Shamanism, which may be traced from the Caspian Sea to Japan; from the Saghalien Oula to the Persian Gulf. The priests profess the most sublime notions of virtue, and many of them are said to practise the most refined piety; prayers, fastings, austere and rigorous punishments for the sins of others; chastity, abstinence, penitence, contempt of bodily suffering, to secure for the indestructible soul a better abode in the circle of its transmigrations.

Some of the Catholic missionaries, however, have represented the priests of Fo as living in all manner of vice and luxury; but the testimony of unprejudiced travellers is against them, and even several of the Jesuits speak highly in their favour, saying that, in their moral doctrines, there is little to reprehend; that they inculcate benevolence, humility, reciprocal kindness, command over the passions, and tenderness towards the brute part of the creation. But it may be questioned whether the priests of Fo or Tao-tse act upon any fixed principles. Some of them, for instance, refuse to drink wine, others to eat garlic and onions; some practise celibacy, and profess perpetual continence; others have several wives and concubines. It is quite certain that neither of them are much

respected by the government. Their protection or persecution depends on the caprice or feeling of the ruling sovereign. At one time we find their temples demolished, the materials employed for the public buildings, the bells and brazen statues melted down into money, and the priest, by an imperial edict, reduced to the rank of the people. One emperor persecutes the Ho-chang of Fo, and encourages the Tao-tse. He drinks the beverage of immortality, and dies soon after; his successor eradicates the Tao-tse for poisoning the sovereign, and sanctions the worship of Fo. At present the number of temples dedicated to Fo, and of the priests attached to them, is incalculable. They not only occur in every city, town, and village, but are erected on a small scale in private houses, in which priests are employed, though not generally, to instruct the children of the family. One emperor observed that there were not fewer than 100,000 priests of Fo, and as many priestesses; and that the wisest policy would be to make them marry and get children for the good of the state; that a religion which imposed restraint on the natural passions given to man was undeserving of any regard. No temple can be built without special permission; and they are always used for state purposes by the officers of government, for foreign ambassadors, &c. in their journeying through the country.

The Christian missionaries were long exposed to the same capricious conduct; at one time tolerated or caressed, at another time persecuted or put to death. But after the peace was concluded, permission was obtained to build churches and chapels at the five ports open to Europeans, and all penalties against those Chinese who might profess the Christian religion were annulled. Missionaries found beyond the limits of these towns were not to be chastised or put to death, but to be delivered up to the consuls of their respective countries.

The people are ready enough to embrace any of these religions; but the emperor and his court, and all the officers and magistrates, adhere to the ancient religion, as laid down by Confucius, though there is an obvious leaning of the present Tartar dynasty towards that of Fo or Buddh, which is that of the Lamas of Thibet. The great temple at Gehol, the summer residence of the Tartar sovereigns now on the throne, is named Poo-ta-la (Buddhlaya), the residence of Buddh; but ostensibly he professes and performs the rites of the ancient religion of China; and, at the appointed times, in the capacity of high priest, testifies his gratitude to heaven by offering up the fruits of the earth, and the flesh of certain animals considered as the most useful, as the horse, the ox, the sheep, the hog, the dog, and the domestic fowl. At such times all labour is suspended, the public offices and courts of justice are shut up, and a general festival prevails throughout the whole empire. The vernal ceremony of the emperor holding the plough, is rarely had recourse to in modern times.

The magistrates perform their devotions in the temple or hall dedicated to Confucius; and the usual oblation to his memory is that of a hog, as being the most useful animal known. The ceremonies are performed before a tablet placed on a pedestal, on which is written the name of the philosopher; and at the foot of the pedestal a grave is dug to receive the hair and offals of the animal, in order that no part of it may fall to unworthy purposes. To this temple every magistrate, on entering upon his office, goes with his official brethren, and, in their presence, after the usual homage to the emperor, professes himself a grateful adherent of the doctrines of the illustrious master, which ceremony amounts to the taking of the oaths of fidelity and allegiance to the sovereign. Père Intorcetta, in his treatise *Du Cultû Sinensi*, has translated the whole ceremony from a Chinese author. It is very curious, and bears a marked resemblance to the Catholic ceremony of high mass. They burn incense, pour out libations of wine, chant solemn hymns, accompanied with instruments, read aloud a panegyric on his memory, prostrate themselves before the tablet; and then proceed to feast on the oblations, and to drink each of the "cup of felicity." (Intorcetta *de Cultu Sinensi.*)

The common festival of all savage nations is the time of full moon; and the common people of China are still barbarous enough to hold this festival, by keeping up a noise and riot the whole night. But the grand festival in which all China partakes is that of the new year, when families visit each other, exchange mutual compliments and presents, and abstain from all labour for several days. Every Chinese, however poor, contrives at this time to treat himself and his family with new dresses. His house is newly painted; and tablets of paper, variously shaped, adorn the walls of his apartments. On new-year's day every Chinese strictly watches his own conduct, and every thing that befals him, being persuaded that whatever he does on that day will influence his conduct during the whole year. An universal holiday prevails; all labour is suspended; and nothing but feasting, rejoicing, music, and firing of crackers, prevail, from the midnight preceding the first day of their new year to the ninth day following. During this period all is joy and festivity; yet, in this general scene of mirth and conviviality, to the credit of the Chinese it ought to be noticed, that instances of intemperance or inebriety rarely occur.

The festival of the new year is followed by another of a similar kind, which is called the festival of the lanterns. It commences two days before, and continues two days after, the first full moon of the new year. All China is then in a blaze. Every house and every village, all the shipping on the canals and rivers, every Chinese, however poor, contrives to light up his painted lantern on these days. Transparencies in the shapes of birds, beasts, fishes, and all kinds of animals, are seen darting through the air, and contending with each other; some with squibs in their mouths, breathing fire, and others with crackers in their tails; some sending out sky-rockets, and others rising into pyramids of party-coloured fire; and others again bursting like a mine with violent explosions. A Chinese knows not why, nor makes any inquiries wherefore these things are; it is an ancient custom, and that is enough for him. The inscriptions on these lanterns would seem to point out its religious origin. The most common runs thus, *Tien-tee, San-Sheai, Van-lin, Chin-tsai,* "Oh, heaven, earth, the three limits, and thousand intelligences, hail!" (Barrow's *Travels in China;* Macartney's *Journal;* Du Halde and Grozier.)

The basis, however, of the ancient Chinese religion, and which forms as it were the link that connects it with the government, is the obedience which children owe to their parents, and the respect which is due from the young to the aged, and from the living to the dead, in the strict observance of which all other virtues are concentrated; for these are not to be considered as moral duties only, but as political and religious ordinances. Every family of condition endeavours to build a temple to the memory of its ancestors; and all persons not lost to every sense of duty and devotion visit the tombs of their parents on a certain day in the spring of the year. Never were institutions more innocent in their intention, more blameless in practice, more amiable in their object, or better calculated to produce beneficial results, by recalling pleasing recollections, subduing the passions, and bringing the mind to that calm and tranquil state to which the memory of departed parents usually disposes it. The love and tenderness of departed parents are among the

best impressions of the human mind; "Bind them," says Solomon, "continually about thine heart;" yet the bigoted Dominicans quarrelled with the Jesuits for allowing their Neophytes to honour the memory of departed relations. They represented it as a crime to pluck away the grass and weeds that might have grown around a parent's tomb, and to scatter flowers on a relation's grave; to meet together, and regale themselves with those dainties of which the deceased would have been partaker if alive; fulfilling thus the precept of Confucius, which inculcates the same respect to the dead as if they were living. To support his parents while alive, to bury them decently when dead, to visit their graves at the appointed time, are three indispensable duties of a pious son, by which he proves his gratitude, his sorrow, and his veneration.

There are few families of which some member, in a series of years, has not risen to rank and fortune. Such a one is particularly careful, in obedience to the precept in the ancient book of rites (*Lee-kee*), before he builds a palace, to erect a temple to the memory of his ancestors. To this temple, at particular seasons, all the branches of the family repair together, old and young, rich and poor, high and low, the first officer in the state and the day-labourer. Here all distinction for the time is laid aside, save that of age, which is always reverenced; and he over whose head has passed the greatest number of years takes the precedence in making the oblations, and at the subsequent entertainment given at the expense of the more wealthy members of the family. From five to ten thousand persons sometimes meet together on such occasions.

Whether it be the effect of superstition or of real feeling, or be considered as a religious duty, no people observe so much external attention to the memory of the dead as the Chinese. They even move their coffins from the place in which they have been interred, if the situation be gloomy or the ground swampy. Everywhere in China may coffins be seen exposed on the surface of the ground, because the surviving relation has not been able to fix upon a propitious spot to raise the tomb for its reception. These coffins are generally made of wood sufficiently thick to plank a first-rate man of war. A Chinese usually keeps his coffin by him in the house as a piece of furniture. He contemplates with pleasure the *angusta domus* which is to receive his last remains, and he tries it on just as he would try on a new coat. They believe in a future state of rewards and punishments; but their notions on this head are so vague, and mixed up with those of the Buddhists and Brahmins, that it is difficult to say what were the precise tenets of the ancient sages respecting a future state of existence.

Among the religious superstitions of the Chinese, partly native and partly exotic, may be ranked the almost universal observance of lucky and unlucky days, which are duly registered in the imperial calendar. No marriages, no funerals, no contracts, in short, nothing of importance, must be undertaken on an unlucky day. Even his imperial majesty must be governed in his movements by the Board of Astronomers. Another universal superstition is the *fung-shui*, *wind* and *water*, which relates to the exact line in which the roof of a house must be placed, in order to preserve its own security and its owner's prosperity. The Chinese conceive that a peculiar virtue resides in the odd numbers: thus they reckon *three* powers—heaven, earth, and man; *three* lights—the sun, moon, and stars; the *three* relations—a prince and his ministers, a father and son, a husband and wife. *Fo* has his *three* precious ones, and the *Tao-tse* their *three* pure ones, in which the Jesuits discovered the Holy Trinity. The temples of these sectaries have *three* quadrangular courts, the buildings around which contain the *three* classes of spirits, celestial, terrestrial, and infernal. They reckon *seven* ruling powers—the sun, moon, and five planets; *nine* is as efficient and mysterious a number as among the Hindus, but *five* appears to be the number which is supposed to exert the most extensive influence. The *five* great virtues frequently spoken of in the ancient classical books are, *charity*, *justice*, *good manners*, *prudence*, and *fidelity*. They reckon *five* domestic spirits; *five* elements; *five* primitive colours; *five* seasons of the year, over which are *five* presiding spirits; *five* planets; *five* points of the compass; *five* sorts of earth; *five* precious stones; *five* degrees of punishment; *five* kinds of dress, &c. (*Hist. Gén. de la Chine*; *Mém. Chin.*; Intorcetta *de Cultu Sinensi*; Morrison's *Dict.* &c.)

Language.

It is perhaps impossible for the Chinese themselves to determine what portion of their present mixed religion and superstitions belongs to their ancient institutions, and what has been borrowed from other people. This, however, is not the case with their language. Their speech, and the character in which it is written, have maintained their primitive purity, and may be considered as exclusively their own. This language, more than any thing besides, stamps them as an original people. It has no resemblance whatsoever to any other language, living or dead, ancient or modern. It has neither borrowed nor lent any thing to any other nation or people, now in existence, excepting to those who are unquestionably of Chinese origin. The written character is just now as distinct from any alphabetical arrangement, as it was some thousands of years ago; and the spoken language has not proceeded a single step beyond the original meagre and inflexible monosyllable. Our countrymen have at length fathomed this hitherto mysterious, and, as it was supposed, unattainable language, the acquirement of which had long set at defiance all the talents and industry of foreigners, and was said to employ the whole life-time of the natives: to them it is owing that we are now able to give some intelligible account of it. In fact, those insurmountable difficulties turn out to be altogether visionary. The laudable industry of Dr Marshman and Dr Morrison has supplied us with grammars and dictionaries of this singular language. They have not only placed the treasures within our reach, but given us the key to unlock them, though in an uncouth and unsystematic manner; a defect, however, which has been, in a great measure, remedied by the labours of others. As the subject is almost new in this country, we shall endeavour to give as concise and comprehensive a view of it as our limits will admit, and such as may not only convey a correct notion of the singular nature and construction of the written character, but may be of some use to those who shall engage in the study of it.

The philologists of China speak of knotted cords, twisted from the inner bark of trees, being made use of originally to register events; but as this period is carried back to the fabulous part of their history, it only deserves notice from the remarkable coincidence of a nation having been discovered many thousand years afterwards on a different continent, and the antipodes almost of China, who were actually in the practice of using the same means for the same purpose. The second step towards the formation of a written character, by the invention of the *quoa* or diagrams of Fo-he, is perhaps entitled to as little consideration as the knotted cords. As a language they must have been too complicated, and the supposed use of them too refined, for a people in so rude a state as the Chinese represented themselves to have been in the time of that chief. It is generally thought that the written character was first suggested in the reign of Hoang-tee, the third from Fo-he, and that the figures on a tortoise's back first gave the idea. Dr Morrison says that a person named

China.

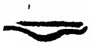
Paou-she, who lived about the year of the world 2900, is considered as the father of letters, and that nine tenths of his characters were hieroglyphic; he means to say, rude representations of the thing signified, which, in point of fact, may be considered as the first attempt of all uncivilized people to express their ideas to the eye. At a later period we find several accounts of alterations and new suggestions in the characters, one making them to imitate the lines of the dragon, another the flowing lines of worms and snakes, a third the prints of birds' feet, a fourth of leaves, branches, roots, &c.; all of which would appear to be nothing more than so many attempts to reduce the rude figures of objects to a more convenient and systematic form for general utility. Enough still remains on ancient seals, and vases for sacred purposes, to show the original state, or nearly so, of the Chinese characters, and to trace the changes that have taken place from the *picture* to the present *symbol*. These ancient characters are to be met with in numerous Chinese books; and a collection of them is contained in Père Amiot's *Lettre de Pekin*, from which the following are extracted. They are called the *Kou-wen*, and are the most ancient characters that are known.

 a dragon.  a lion.  an ox.

 an elephant.  a tortoise.

 a fish.  a house.  a branch of a tree.  a window.  a bow.

 to shoot. A multitude of similar description is to be found in books of philology, being obviously the rude representations of the several objects they are meant to express.

From these rude imitations of objects Chinese writers trace the progressive steps to a more abbreviated and convenient form: Thus,  the sun, is now 日.  the moon, now 月.  a mountain, now 山.  a mouth, now 口.  a field, now 田.  a horse, now 馬.  the eye, now 目.  the ear, now 耳.  a chariot, now 車.  a boat, now 舟.  a sheep, now 羊.  a bow, now 弓. The dragon is still a complicated character 龍, and the tortoise 龜.

The qualities of objects could only be marked down by arbitrary signs or symbols, which, however, when once settled by convention, were equally expressive with the pictorial resemblances of those objects. Many modifications, however, such, for example, as crooked, straight, above, below, great, little, &c. were capable of being expressed to the eye by particular characters, appropriate to their modifications.

一 one, 二 two, 三 three, 亅 hooked, 冖 covered, sheltered, protected, &c.; but symbolical representations of this kind could not be sufficiently numerous to embrace all the qualities and modifications of objects.

The first attempt at a regular system of classification of the characters which the Chinese had invented for expressing their ideas, is stated to have been that of dividing them into nine classes, called the *Lee-shoo*, and afterwards into six, called the *Lieou-ye*.

1*st* Class contained all those which had been reduced from the rude picture of the object to a more simple form; as the sun, moon, a man, a horse.

2*d*, Those which pointed out some property belonging to the object; as great, small, above, below.

3*d*, The combination of two or more simple objects or ideas to produce a third, resulting from their union.

4*th*, Those whose names, when sounded, were supposed to imitate the sound of the objects expressed by them.

5*th*, Those which give an inversion of the meaning by inverting the character; and all those used in a metaphorical sense.

6*th*, This class seems to include all those characters that are merely arbitrary, and which cannot be brought under any of the preceding divisions. We shall explain these classes by examples.

This ill-digested and obscure arrangement was soon abandoned for another not much better, namely, that of classing the characters according to their sounds or names. As these names were all monosyllables, and as each monosyllable began with a consonant, with very few exceptions, and ended with a vowel or liquid consonant, the number of such monosyllables was necessarily very limited; by our alphabet, the whole of them might be expressed in about 330 syllables; but as necessity taught the Chinese to employ in early life the organs of speech and hearing, in acquiring a greater nicety than most nations have any occasion for, they were able to swell the number of their monosyllables, by means of intonations and accentuations, to about 1200 or 1300. As soon, therefore, as the number of characters exceeded the number of words, it is evident that any *verbal* arrangement must be attended with uncertainty and confusion; if, for instance, they had 10,000 characters and only 1250 words, the same word must be applied to eight different characters; and as the latter now, in Kaung-hee's Dictionary, exceeds 40,000, each syllable in the Chinese language must, on an average, represent thirty-two different characters; and, in point of fact, there are syllables that give the same name to sixty or eighty different characters.

It is difficult to conceive, therefore, without the assistance of an alphabet, how they could possibly contrive to class the characters in a dictionary according to their *names*, and by what means they could ascertain the name of a character which speaks only to the eye. To discover this, they seem to have had recourse to three different methods. The first was to place at the head of a list of cha-

racters, having the same sounds, some common well-known character, and to mark them severally with their respective intonations. The second method was that which is still used in all their dictionaries. It consists in writing after the character whose sound is sought for, two common characters, of which the initial sound of the first, added to the final sound of the latter, produces a third; as from the *m* of *moo* and the *ing* of *tsing*, is compounded the third or new monosyllable *ming;* and, in the same way, from *ting* and *ke* would be formed *te*, &c. The two characters, so employed, are called *tse-moo*, or "mother characters," and the third produced from them *tsé*, or "the child." The third method was, by means of a modified Sanscrit alphabet, or series of sounds, which was introduced into China since the Christian era, by some priests of Buddh, "to give currency," says one writer, "to the books of Fo." This system is described in the introduction to Kaung-hee's Dictionary, though it is never used, and but very little understood. The Chinese, indeed, reprobate the idea of changing their beautiful characters for foreign systems, unknown to their forefathers. "It appears to me," says one of their writers, "that the people of *Tsan* (Thibet, from whence they derived the system of initials and finals) distinguish sounds; and with them the stress is laid on the sounds, not on the letters. Chinese distinguish the characters, and lay the stress on the characters, not on the sounds; hence in the language of *Tsan* there is an endless variety of sound, with the Chinese there is an endless variety of the character. In *Tsan*, the principles of sound excite an admiration, but the letters are destitute of beauty; in China, the characters are capable of ever-varying intelligible modifications, but the sounds are not possessed of nice and minute distinctions. The people of Tsan prefer the sounds, and what they obtain enters the ear; the Chinese prefer the beautiful character, and what they obtain enters the eye." And the Chinese are right; for, unless with their character they gave up their monosyllables, they might almost as well have no written language at all; as, if written alphabetically, it would be wholly unintelligible. The written character assists their meagre monosyllables, an alphabet would completely destroy them. The written character, however, has probably been the means of fixing the spoken language in its primitive monosyllabic form, as the least change or inflexion of the spoken language must at once and for ever destroy the connection between it and the written character; and this connection, by the way, is no mean proof of the antiquity of the present symbols. (Pref. to Morrison's *Dictionary;* Barrow's *Travels in China.*)

These symbols are now reduced to a regular and complete system, which renders the study of the language comparatively easy. A certain number of characters have been selected, which the Chinese call *Tse-poo*, "superintending or directing characters," and sometimes *Shoo-moo*, or the "eyes of the book," which, considering them as composing an index to the book, is no bad name. The Jesuits have given them the name of *keys*, and sometimes *elements* or *radicals*, there being no character in the whole language, into the composition of which some one or other of them does not enter. This number, according to the classification now in general use, consists of two hundred and fourteen, and they are divided into seventeen chapters or classes; beginning with those keys or elements that are composed or formed of *one* stroke of the pencil, and ending with those (of which there is only one) composed of seventeen strokes. Plates CLXX. CLXXI. CLXXII. comprehend the whole of these keys or elements, with their several names and significations. When these two hundred and fourteen keys or elements have once become familiar to the eye, there is no great difficulty in detecting them in any of the characters into which they may enter, and without some one or more of which no character can be formed. They will be found to stand more frequently on the left side than on any other part of the character, though they also take their stations sometimes on the right, sometimes in the middle, frequently at the top, and occasionally at the bottom; but a little practice and a ready knowledge of these keys will point them out at once. Thus, in

1. 便 *peen*, "convenient," the key, 亻 *jin*, "man," is on the left.
2. 助 *tsoo*, "to assist," has the key, 力 *lee*, on the right.
3. 全 *tseun*, "the whole," has the key, 入 *joo*, at the top.
4. 兵 *ping*, "a soldier," has the key, 八 *pa*, at the bottom.
5. 愛 *gai*, "to love," has its key, 心 *sin*, in the middle of the compound.

The dictionaries are divided into seventeen sections, headed respectively by the seventeen classes or keys, commencing with that class which has its keys of one stroke, and ending with that which is composed of seventeen strokes. The characters which each key governs, or to which it serves as the index, are also divided into classes, according to the number of strokes they contain, beginning at *one*, and proceeding regularly to the greatest number that any one is found to contain, *exclusive of the key;* and this number, together with the key character, being marked at the top of every page in the dictionary, affords a clue by which any character in the language may be turned to immediately, having first ascertained the *key*, and the number of strokes in the remaining part of that character. Thus, in the above examples, the character *peen* will be found under the key *jin*, and in the *seventh* section, there being *seven* strokes exclusive of the key; in the second, under the *fifth* section of the index *lee;* the third under the *fourth* section of the index *joo;* the fourth under the *fifth* section of the key *pa;* and the fifth under the *ninth* section of the index *sin*.

This classification of the characters is extremely simple and easy; the chief object of it would appear indeed to be, like the Linnæan system, that of giving facility to the finding in the dictionary the character that may be wanted. The nature of Chinese symbols admitted, however, of a more beautiful, perfect, and philosophical arrangement, and might, indeed, have been made the most rational and complete system of pasigraphy or universal character that has yet been attempted. It would seem, indeed, that the Chinese had this idea once in view; but, either through ignorance, pride, or caprice, they have entirely marred the plan, and nearly lost sight of it altogether. In the original adoption of the *shoo-moo*, or "book's eyes," namely, the *poo* or keys, they selected no less than 479 to serve as indices to the characters, the whole of which were marshalled under nine divisions. The *first* had a few only, consisting of a single line. The *second* embraced celestial objects, as the sky or firmament, the sun, moon, stars, clouds, rain, thunder. The *third*, terrestrial objects, as

earth, water, metals, hills, rivers; the *fourth*, man, and all the animal functions; the *fifth*, moving things, including all the rest of the animal creation; the *sixth*, the vegetable world; the *seventh*, productions of art and human industry; the *eighth*, miscellaneous; and the *ninth*, characters of a double genus, whose classification could not well be ascertained. Though this was a complicated, and in some degree an arbitrary classification, yet it comprehended a principle which, if it had been adhered to in simplifying the arrangement of the characters, the Chinese might have challenged the world to produce so beautiful and so philosophical a language as their own. This system, called the *Leu-shoo*, is that stated by Dr Morrison to have been invented by *Paou-she*.

After this the 479 keys or elementary characters were reduced to 214, and the characters themselves arranged under six divisions, as before mentioned, the nature of which will be best explained by a few examples to each; and they will tend to show how much more might have been accomplished in this practical approach to an universal character.

1st Class. The rude representation of the object may now be considered as no longer existing; but this class consists generally of simple characters, and almost all the great objects of nature are found among the keys or elements which enter into their composition: this may be called the Imitative Class.

2d Class. Under this class are comprehended those characters which point out the quality or property of an object, as 上 *shang*, above. 下 *shea*, below. Thus also 一 *ye*, one, is used to represent unity, concord, and the like; 丨 *kuan*, straight, upright; 亅 *qûay*, hooked; and generally characters whose meaning can be extended, in a metaphorical sense, as far as the object represented would admit of being so applied; as, for instance, a line drawn through a square thus, 中, signifies *middle*, or any thing divided into two parts; while the same character, in a figurative sense, expresses moral rectitude, good dispositions, and so forth. This class may therefore be called the figurative.

3d Class. Under this class might have been ranked all those compound characters which, if the numbers were properly selected, would have given that peculiar beauty and expression to the language which, even in its clumsy and imperfect state, the Chinese still pretend to feel, by employing significant characters, each of which should be connected with the idea to be conveyed by their union. One half of the language, at least, might have been thus composed, and might have presented a series of symbols, every one of which would have been intelligible to the eye; whereas not one sixth part at the most, some say not one tenth, of the compounds, have any relation to their component parts. A few examples will serve to show how much might have been done by attending to a philosophical composition of the compounded characters. Thus, 亻 *jin*, man, and 言 *yen*, word, forms the compound 信 *sin*, sincere: 日 *je*, the sun, and 月 *yué*, the moon, 明 *ming*, splendour: 中 *tchung*, middle, and 心 *sin*, heart, 忠 fidelity: 亻 *jin*, man, and 田 *tien*, a field, 佃 *tien*, a farmer: 田 *tien*, a field, and 力 *lee*, strength, 男 *nan*, male kind: 耳 *eul*, the ear, and 止 *tchei*, to stop, 耻 *chee*, shame: 口 *koo*, mouth, and 金 *kin*, gold, 唫 *kin*, volubility of speech: 言 *yen*, word, and 寺 *shee*, temple, 詩 *shee*, verses, poetry: 分 *fen*, to divide, and 貝 *pei*, riches, 貧 *pin*, poverty: 囗 *yu*, an enclosure, and 人 man, 囚 *cheu*, a prisoner: 禾 *ho*, rice, and 口 *koo*, mouth, 和 comfort: 一 *ye*, one, and 大 *ta*, great, 天 *tien*, heaven or God: 竹 *tcheou*, a bamboo, and 即 a slap, 節 *chee*, to govern: 喬 *keu*, high, and 馬 *ma*, horse, 驕 *kheu*, proud.

4th Class. The characters arranged under this class are such as embrace both the *meaning* of the object and the *sound* it is supposed to utter; and it includes objects animate and inanimate. The characters are all compounded of one of the elements to express the genus, added to one imitative of the sound uttered by the object. Thus, 氵 *shuee*, water, added to 工 *koong*, forms the character 江 *kyang*, which denotes a rapid stream, expressive, as they say, of water rushing with violence; and 可 *ho*, a river, with 氵 *shuee*, water, makes the compound 河 *ho*, a river, the name of which is said to imitate the sound. To this class may also be added those objects in the animal kingdom whose generic character

can be expressed by one of the elements, and the species by some other character that shall convey its name merely by the sound of the latter character. If, for instance, to the generic character, *bird*, be added another character whose name and sound is *go*, the new compound will also be named *go*, and will signify a goose; if to the same character *bird* be added another named *ya*, the compound will be also *ya*, and will signify a *duck;* if to the generic character *tree*, be added the appellative *pe*, the compound will be named *pe*, and signify a cypress; with *tao*, it will be called *tao*, and signify a walnut tree; and with *lieou* it will retain the name of *lieou*, and signify a willow. In this class may also be comprehended all foreign names written in the Chinese characters, to which, in order to mark them as destitute of meaning, they usually annex on the left side the character signifying *mouth*. Thus the English word *strong* would require three characters, *se-te-lung*, and, with the *mouth* prefixed, would be written thus,

吐 *se* 嘚 *te* 嚨 *lung;* but these characters, if the *mouth* was taken away, would be read by a Chinese, the *magistrate procured a dragon*.

5th Class. Consists of an inversion of the sense by an inversion of the whole or some part of the character; or it alters the meaning by giving a different name to the same character; or, lastly, the characters which compose it are used in a figurative or metaphorical sense. An European cannot readily comprehend the illusions or allegories that are frequently contained in a single character, though probably they are not more numerous than those which are found in any of the languages of Europe, rendered easy, and indeed not perceived, by early habit. The combined characters of the sun and moon, which, in a physical sense, expressed brightness, brilliancy, splendour, are also, in a moral or metaphorical sense, noble, illustrious, famous. The characters *heart* and *dead* form a third, which signifies *forgetfulness; fickleness* or *levity* is represented by a *girl* and *thought; attention*, by the *heart* and *totality; antiquity*, by *mouth* and the numeral *ten; to flatter*, is compounded of *word* and *to lick; to boast*, of a *mountain* and *to speak*. The *wife of a magistrate* is used metaphorically for *an accomplished lady*, a *wild boar* for *courage*, a *tiger* for *ferocity:* and so of others. It may be observed, however, that these compounds are disregarded by the Chinese in general, just as many words in the European languages are in common use, without any reference to their etymology.

6th Class. These characters are either arbitrary, or formed out of some distant or local allusion, most of which are inexplicable to the Chinese themselves. Thus, a *bamboo* and *heaven* form a compound, which signifies *to laugh; water* and *to go*, compose a character signifying *law; wood* and the *sun* form the word *east;* the character *woman* three times repeated may signify *adultery*, or *communicating with an enemy*. These may or may not be arbitrary combinations. We can explain why the compound of *wine* and *seal* should signify *marriage*, from the circumstance of *wine* being presented by the bridegroom to the bride as the *seal* to the contract; and why that of *girl* and *upright* should signify *concubine*, or inferior wife, because such a one must *stand* in the presence of her lord and master; also why that of *woman* and *sickness* should signify *death*, because when the sovereign was sick, and given over by the physicians, he was left to *die* in the hands of *women;* but by far the greater part are utterly inexplicable.

Such, by the Chinese account, is the philosophy of their language; not very clear, it must be confessed, nor exactly calculated for practical facility; but, at the same time, approximating to a very beautiful system. That system has, to a certain degree, been preserved in the modern classification under the 214 elements. Thus, under the element or key which signifies *heart*, we shall find all the characters arranged expressive of the sentiments, passions, and affections of the mind, as grief, joy, love, hatred, anger, and the like. The element *water* enters into all the compounds which relate to the sea, rivers, lakes, swamps, depth, transparency, and so forth. The key or element *plant* takes in the whole vegetable kingdom. *Yen*, a *word*, enters into the composition of those characters which relate to reading, speaking, studying, debating, consulting, trusting, and the like. The handicraft trades, laborious employments, and a great number of verbs of action, have the element *hand* for their governing character. All this is perfectly intelligible; but, on casting a glance over the elementary characters, it will be seen that fully one half of them are utterly incapable of being formed into any generic arrangement; and one is surprised and puzzled to conjecture by what accident they could possibly have been included among the elementary characters, or even as indices to characters. The fact is, that, of the 214 characters thus employed, not more than 150 can be considered as effective; the rest being very rarely employed in the combination of characters. Of the 40,000 characters, or thereabouts, contained in the standard dictionary of the language, sixty of the elements govern no less than 25,000. The most prolific is the element *grass* or *plants* (No. 140), which presides over 1423 characters; the next *water* (No. 85), which has 1333; then the *hand* (No. 64), which has 1012. After these follow, in succession, the *mouth*, *heart*, and *insect*, each having about 900; then a *word*, a *man*, and *metal*, each exceeding 700; next a *reed* or *bamboo*, a *woman*, *silk*, a *bird*, *flesh*, *mountain*, and so on, each governing from 500 to 600. In the modern classification, therefore, of the characters, though probably intended as a more convenient instrument for reference in the dictionaries, so much of the natural arrangement has been preserved as will serve to convey to the eye at once the general meaning of a character; at least of such characters as are governed or fall under any of the principal elements. They have even gone beyond this. Feeling how much more capable of nice discrimination the eye is than the ear, the written character has been employed to mark distinctions, which, in an alphabetic language, would be impossible. Instead of the modifications of time, place, age, colour, and the like, by which sensible objects are affected, being expressed by so many epithets or additional characters, in the several stages of their existence, or the lights in which they may be viewed, the Chinese employ only one single character for each several modification of which an object or idea may be susceptible, whether in the physical or intellectual world. Thus they have the key or elementary character for *water* simply, another under that key for *salt* water, a third for *fresh* water, a fourth for *muddy* water, a fifth for *clear* water, and so on for *running*, *standing*, *deep*, *shallow*, and every other qualification that water is capable of receiving; and the same of love, anger, jealousy, ambition, &c. all of which are expressed by their respective symbols, combined with the element *heart*.

The colloquial language is not less singular than the symbolical characters, being, like the latter, exclusively their own, and having borrowed nothing from, nor lent anything to, the rest of the world. The 330 monosyllables, each beginning generally with a consonant, and ending with a vowel, or liquid, or the double consonant *ng*, which, as we have observed, complete the catalogue of words in their language, are, by means of four modifications of

sound, or intonation to each syllable, extended to about 1300; beyond which, not one of them is capable of the least degree of inflexion, or change of termination; and the same unchangeable monosyllable acts the part of a noun substantive and adjective, a verb and a participle, according to its collocation in a sentence, or the monosyllables with which it is connected. It is neither affected by number, case, nor gender; mood, tense, nor person; all of which, in speaking, are designated by certain affixes or prefixes to mark the sense. Thus the genitive of *love*, *gai*, is expressed by the particle *tié* set after it, as *gai-tié*, of love; the dative by *eu-gai*, to love; and the ablative by *tung-gai*, by or from love. The plural is expressed sometimes by the repetition of the noun, as *yin*, a man; *yin-yin* men; *to-yin*, many men; *to-to-yin*, all men. Certain particles of number are also employed before nouns, which vary according to the nature of the noun. Thus *man* has *ko*, as *san-ko-yin*, three men; most other animals *tchee*, as *liang-tchee-ma*, two horses; bodies with extended surfaces *tchiang*, as *ye-tchiang-tchoa*, one table. The number of particles so employed amount to about thirty. The final expletive *tsé* is added to nouns, not only to distinguish them from adjectives, but for the sake of euphony; as *pie-tsé*, a pipe; *fang-tsé*, a house; *ya-tsé*, a chair; the particle *tié*, the same which designates the genitive of the substantive, is set after the adjective or pronoun; as *ta*, he, with *tié* after it, becomes a possessive, *ta-tié*, his, &c. The gender of nouns is seldom necessary to be expressed in conversation, unless for the sake of removing ambiguity. When this is the case, *nan* and *neu* distinguish male from female, as *nan-yin*, a man; *neu-yin*, a woman. Adjectives admit of comparison in various ways. Commonly *ye-yang* is used to express the positive, as *ye-yang-hoa*, as good as, or equally good; the preposition *keng* forms the comparative, as *keng-hao*, better; and, with the addition of *toa* following it, the superlative, as *hao-toa-keng*, the best. A repetition of the positive also marks the superlative, as *hao-hao*, very good.

The personal pronouns *go*, *ne*, *ta*, I, thou, he, are made plurals by the addition of *mun*, as *go-mun*, *ne-mun*, *ta-mun*, we, ye, they. *Che-ko*, this, and *no-ko*, that, are the demonstratives.

The only tenses of the verb necessary to be distinguished are the present, past, and future. The past is formed by the particle *leau* set after it, and the future by *yau*, will or determination, or *tchong lai*, time to come. Thus, *go gai*, I love; *gi gai leau*, I have loved, or did love; *go yau gai*, or *go tchang lai gai*, I shall hereafter love. The negatives generally in use are *mo* and *poo*; as *yeu*, to have; *mo yeu*, not to have; *hao*, good; *poo hao*, bad.

Such is the simple and inartificial language spoken by a mass of people equal in number to that of the whole of Europe. Its imperfection must be obvious when it is considered that 40,000 distinct characters are represented by about 1300 monosyllabic sounds; but, as a good composition is intended only to be seen, the particles and expletives necessary in familiar conversation are all omitted. If such writing were read aloud it would scarcely be intelligible, and, at any rate, full of ambiguity. Indeed, it frequently happens, that, in reading a paper, the auditors are assisted by the reader making, with a motion of his hand in the air, or with his fan, the shape of the character, or, at least, the key of it, to remove any ambiguity. This, in conversation, is obviated by the use of certain expletives. For instance, when a man is speaking of his father, which is *foo*, a monosyllable that has seventy or eighty other meanings besides that of father, a Chinese will say *foo-chin*; and, instead of *moo* for mother, *moo-chin*. The syllable *chin*, signifying *kindred*, removes at once all doubt as to the meaning of the speaker; but the *chin*, in writing, is wholly unnecessary, and would be left out, the character signifying *father* being totally different from any other character that may have the name of *foo*. A foreigner, not always aware of this, is liable to many equivoques in speaking the language. Thus a missionary, requesting to be allowed to pass the night at a peasant's house, asked for a *young girl* to sleep with, when he meant only to ask for a *mat*; and another told the emperor he served *three wives*, when he meant to say so many *churches*. (Barrow's *Travels in China*; Morrison's *Dictionary*; Marshman's *Clavis Sinica*; Fourmont's *Meditationes Sinicæ*, &c.)

One of the most remarkable features of Chinese policy is the very general diffusion of education, and the encouragement that from a very early period has been given to the cultivation of letters. The importance of educating the people was acknowledged and acted upon in China even before the time of Confucius, and at a period when no other nation had any established system for general education. Schools and colleges are established in all parts of the empire, and education is very generally diffused among all classes of the people; indeed, almost every man in this vast empire can read and write sufficiently for the ordinary purposes of life. The education of females, though less encouraged, is yet not entirely neglected. The course of instruction to be followed, and the books to be studied, are prescribed by law; and to this in a great measure is to be attributed the fact, that so little progress has resulted from the general diffusion of education. The object of the government is to impart the knowledge already possessed to as large a portion as possible of the people—not to extend the bounds of knowledge itself. The peace of the kingdom has no doubt been much promoted by the general diffusion of knowledge among all classes. Education is inculcated by positive precept, as well as encouraged by open competitions for the highest rewards. One prime motive for every Chinese to educate his sons must be the consciousness that he is liable to punishment for their misdeeds, while he receives credit for their merits. How such a system must operate as a stimulus to education is sufficiently obvious. The great encouragement to the cultivation of letters, however, is, that they are professedly the sole channel of introduction to political advancement in the state, and to the acquirement of office, rank, and honours, of almost every description. The pursuits of literature throw open the highest offices in the state to the lowest of the people; and it would appear that honours and offices are very generally bestowed according to merit. The pressing necessities of government, more particularly of late, have obliged it to have recourse to the selling of offices; but this practice does not seem to be extensively carried on. Exceptions may also occasionally be made regarding particular favourites, or Tartars connected by blood with the imperial family. The prospect of such rewards brings forward a number of competitors for offices, and a taste for letters is almost universally diffused among all ranks and denominations.

The degrees of literary merit are four, viz., *Sew-tsee*, "men of cultivated talent;" *Keu-jin*, "elevated persons;" *Tzin-sze*, "advanced scholars;" and *Han-lin*, "the forest of pencils," or national institute. The examinations for the first title takes place in the country towns; for the second, in the provincial capital; for the third, in the imperial capital; and for the fourth, in the emperor's palace. The examinations are very strict, and only a few out of numerous candidates receive titles. After undergoing certain preliminary examinations by the superintendent of the district, the scholar is recommended as a candidate for the first degree, the examinations for which take place twice every three years. The trial takes place in the county hall, which is divided into compartments just sufficient for the accommodation of each student. They receive themes on which

to write both in prose and verse, and are strictly guarded by soldiers to prevent their receiving any assistance. Those who have passed the first examination may become competitors at the second, which takes place once every three years. The examiners on this occasion are the imperial chancellor and the chief officers of the province; and the aspirants usually number about 10,000, who are confined in cells, and guarded as already mentioned. The number that receive this degree are only about 72 in each province. The third degree is the result of a still more rigorous examination at the capital. Here, also, about 10,000 candidates enter the list, and after being examined in the way described, about 300 of these are dignified with the title of *Tsin-sze*. The fourth degree follows a very close examination of those who have already obtained the third, and takes place in presence of the emperor. The successful candidates on this occasion obtain liberal salaries from the emperor, and are employed to deliberate on all questions regarding politics and literature, to prepare public documents, &c. The three highest candidates are forthwith mounted on horseback, and paraded for three days round the capital, signifying that "thus it shall be done to the man whom the king delighteth to honour." The chief of the three occupies the most enviable post in the nation, and yet a post to which all are eligible, and to which all may aspire.

To succeed at any of these examinations, it is necessary to put forth extraordinary exertions. Each candidate is expected to know by heart the whole of the Four Books and Five Classics, as well as the authorized commentaries upon them, to be familiar with the history of China from the earliest times, and to be well acquainted with the most celebrated authors of antiquity. The chief excellency of their essays consists in introducing as many quotations as possible from ancient authors; but they are deprived of all books and writings, being expected, as their phrase is, "to carry their books in their stomachs." All this can only be attained by great application and perseverance. The first five or six years at school are spent in committing the canonical books to memory; another six years are required to collect phrases for a good style; and an additional number of years spent in incessant toil are needed to insure success. (Medhurst's *China*; Davis's *China*.)

As a further encouragement to literature, the press is left free to all, and any one may print what he pleases, taking his chance for the consequences. That this unrestrained liberty of the press should exist in one of the most arbitrary governments that is known, is a remarkable phenomenon in the history of nations. No previous license is required, no restrictions are imposed, though the publication of books is made amenable to certain regulations established by law. In general, crimes, and their corresponding punishments, are clearly and minutely defined in the *Laws of China*; but the law which regards the press is left, perhaps intentionally, vague and uncertain. According to the *Leu-tee*, "whoever is guilty of editing wicked and corrupt books, with the view of misleading the people, and whoever attempts to excite sedition by letters or handbills, shall suffer death by being beheaded; the principals shall be executed immediately after conviction, but the accessaries shall be reserved for execution at the usual season." And further, "all persons who are convicted of printing, distributing, or singing in the streets, such disorderly and seditious compositions, shall be punishable as accessaries."

These severe laws are by no means a dead letter; numbers have been executed in virtue of them. Three unfortunate authors were punished with death, and their families banished, by that great patron of literature, Kienlung, in three consecutive years, for publishing books that no European government would have deigned to notice; but political discussions are least of all palatable to despotic governments, and are easily brought under the charge of constructive treason, a crime that in China is never pardoned.

The instances, however, that occur of severity of punishment seem to have little effect in diminishing the number of publications, and are not more hostile to the liberty of the press in China than the occasional punishment of a jail for libel is destructive of that liberty in England. A writer in a popular periodical journal says, that thousands of novels and moral tales, amusing stories, laughable comedies, moral precepts from ancient sages, and exhortations from living sovereigns; popular songs, fables, and romances; books of receipts to heal the sick and to pamper the appetite; predictions of the weather, and of good or bad luck; manuals of devotions, of religious rites, and rules of good breeding; almanacs and court calendars,—are the lighter sort of publications which issue daily from the press in Pekin and other great cities of the empire. All ranks in China read, and find it a cheap luxury; the more bulky and expensive works, as those on history, philology, and jurisprudence, are sometimes published by subscription, but are supplied to the libraries of the magistrates by the government. Libraries are seldom formed to any great extent by individuals. The grand collections of history, philosophy, and other standard national works, published by the direction of the sovereign, under the superintendence of the *Han-lin*, are distributed to the princes of the blood, the viceroys of provinces, presidents of departments, and to the learned of the empire, but are rarely met with in the libraries of private individuals. "Books," says Mr Medhurst, "are multiplied at a cheap rate, and to almost an indefinite extent; and the very peasant and pedlar have the common depositories of knowledge within their reach. It would not be hazarding too much to say, that in China there are more books, and more people to read them, than in any other country in the world. Amongst the 360 millions of Chinamen, at least two millions are *literati*." (*China Opened.*) A further idea of the extent of the Chinese literature may be gathered from the fact, as stated by Williams, that the catalogue of all their books in the four libraries, affording a complete and succinct synopsis of the contents of the best books in the language, extends over 112 volumes 8vo, of about 300 pages each, and probably contains the names of upwards of 20,000 works. The books are arranged into four divisions, viz., classical, historical, scholastic or professional writings, and belles-lettres. There is not, however, much that is original in their books, the Chinese generally believing that all that is known, or that is to be known, has already been discovered and communicated by the ancient sages. Many of their works, however, on history, biography, statistics, &c., are very valuable and interesting. Their biographical works are numerous and interesting. They have also a very interesting work entitled *The Complete Antiquarian Researches of Ma Twanlin*, who lived A.D. 1275. It is a very extensive and profound work, containing researches upon every matter relating to government, and extending through a series of dynasties which held the throne for nearly 4000 years. Remusat says, that "this excellent work is a library by itself; and if the Chinese literature possessed no other, the language would be worth learning for the sake of reading this alone."

The most celebrated compositions in the Chinese language are the "Five Classics" and the "Four Books," most of which were compiled by Confucius and his disciples. The Five Classics are the *Yihe-king*, "Book of Diagrams;" the *She-king*, "Collection of Odes;" the *Le-ke*, "Record of Ceremonies;" the *Shoo-king*, containing the history of the three first dynasties; and the *Chun-tsew*, an account of

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the life and times of Confucius. Of the Four Books, the first two,—*Chung-yung*, "The Happy Medium," and *Taheo*, "The Great Doctrine,"—were written by Tsze-sze, the grandson and disciple of Confucius; the third, called the *Lun-yu*, "Book of Discourses," is the production of the different disciples of the sage, who recollected and recorded his words and deeds; while the last of the Four Books was written by Mencius, the disciple of Tsze-sze, and bears the name of its author. The text of these nine books is equal in bulk to that of the New Testament; and it is not hazarding too much to say, that were every copy annihilated to-day, there are a million of people who could restore the whole of it to-morrow. (Medhurst's *China.*)

To acquire a knowledge of the Chinese language is not so difficult a matter as many suppose. No doubt, to understand it thoroughly, to become familiar with its style, and to speak accurately its delicately marked tones, is, as in any other language, a work of great labour and difficulty; but to acquire a partial knowledge of it, so as to be able to speak it intelligibly and read it with considerable ease, is by no means a difficult task. In proof of this, we might allude to the fact, and there are many similar, that Sir John Davis, before he had been two years in Canton, had acquired a sufficient knowledge of the language to enable him, with the occasional assistance of a native, to translate several pieces of poetry, two or three novels, and, what was probably the most difficult of all, a Chinese drama, subsequently published in London. The numerous grammars, dictionaries, and translations that now exist tend materially to diminish the labour of learning the language. Europeans have been deceived as to the vast number of characters in use among the Chinese. Ainsworth's or Johnson's *Dictionary* contains about 45,000 words, and though the great Dictionary of Kaung-hee may contain nearly as many, it includes many obsolete and synonymous characters. It is probable that the total number of characters in the language sanctioned by good usage does not exceed 25,000, and even this latter sum contains many thousands of characters seldom to be met with. "It may be safely said," says Williams, "that a good knowledge of 10,000 characters will enable one to read any work in Chinese, and write intelligibly on any subject." The nine canonical works contain altogether only 4601 different characters. (Williams' *Middle Kingdom.*)

Poetry.

The origin of Chinese poetry is indicated by the component parts of the character employed to express it,—*words* of the *temple*,—short-measured sentences, delivered as instructions to the people: such are those in the ancient writings, and such chiefly are the moral maxims of Confucius. It is so far from being true, as Grozier flippantly asserts, "that a learned man writing good verses would be considered in the same light as a dragoon officer playing well on the fiddle," that there are few men having any pretensions to learning who do not write verses. The several odes and didactic poems of Kien-lung were quite sufficient to make poetry fashionable, if there were no taste for it among the people; but all are fond of poetry. We have before us the translation of an Ode on England and London, written in 1813, by a common Chinese servant, brought over by a gentleman from Canton, in which are many just observations, with accurate and concise descriptions. The climate, he says, is cold, and people live close to fires; and the houses are so lofty that you may pluck the stars. Kaung-hee made the same observation to the Jesuits, and supposed that Europeans lived, like birds, in the air, for want of space to build upon. Our Chinese proceeds to say, that the virtuous read their sacred book, and (*pe lee to Got*) pray to God; that they hate the French, and are always fighting with them; that the little girls have red cheeks, and the ladies are fair as the white gem; that husbands and wives love each other; that the playhouses are shut in the day and open at night; that the players are handsome, and their performance delightful. The nature of the character is well adapted to that expressive kind of poetry which pleases the eye of a Chinese, by selecting such as are most comprehensive, or such as allude to some ancient custom, or such as can be used in a metaphorical sense: for instance, "the rushing of water down a precipice roars like thunder," is expressed by a single character; and that which signifies "happiness," reminds him, by its component parts, of his guardian angel, of the benefits of union and concord, and of plenty, signified by a mouth over a cultivated field. The intercalary moon is expressed by the character *king* placed in that of *gate*, because on such an occasion it was the ancient custom for the king to stand in the door. Thus, also, a *man* and *word* express *fidelity*; *fire* and *water*, *calamity*; *eye* and *water*, *tears*; *heart*, *truth*, and *words*, *sincerity*; *word* and *nail*, a *bargain*; *beauty* and *goodness* are signified by a character composed of a young virgin and an infant; a *flatterer*, of *word* and to *lick*, a kingdom is expressed by a *square* or *space*, within which is a *mouth* and *weapons*, alluding, perhaps, to *arms* and *counsel*, being the best protection of a state. But though the sense of seeing seems to be that which is rather addressed in Chinese poetry than the sense of hearing, yet they have their rules both of rhyme, and measure, and quantity, the last of which is given by the tones or accentuations, which are entirely modern. Mr (now Sir John) Davis has published a very curious work, in which he enters into a critical examination of the rules, and the merits and the defects of Chinese poetry. Among the specimens of ancient poetry from the *Shoo-king*, the following is an address of the emperor *Chun* to his ministers:—

Koo, koong khée tsai
Yuen shyeu khée tsai
Puh koong hee tsai.

When the chief ministers delight in their duty,
The sovereign rises to successful exertion,
A multitude of inferior officers ardently co-operating.

To which the ministers responded in the same strain:—

Yuen shyeu ming tsai
Koó koong lyang tsai
Shyu tsé khang tsai.

When the sovereign is wise,
The ministers are faithful to their trust,
And all things happily succeed.

The *Shee-king*, or Collection of Odes, upwards of three hundred in number, is of a higher strain, one of which, on marriage, has been beautifully versified by Sir William Jones. The lines consist of no definite number of syllables, some containing three, some seven; but the greater part are limited to four. The rhyme is equally irregular, some having none, in others every line terminating with the same word; sometimes six lines rhyme in a stanza of eight, occasionally four, three, and sometimes only the first and last. Four lines in the stanza, and four characters in each line, seem to be the most common measure in ancient poetry; but many odes of the *Shee-king* extend the stanza to eight, ten, or twelve lines. At present, *five* and *seven* characters are the most common number in the line; the former having the stanza of sixteen, the latter generally of eight; the rhyme seems to be entirely arbitrary. There is not much sublimity of mind or depth of thought in these odes; but they abound with many touches of nature, and are exceedingly interesting and curious, as showing how little change time has effected in the manners and sentiments of this singular people.

We give the following from Grozier's collection, as no unfavourable specimen of modern poetry. It may be called the Contented Philosopher.

"My palace is a little chamber, thrice my own length; finery never entered it, and neatness never left it. My bed is a mat, and the coverlid a piece of felt; on these I sit by day, and sleep by night. A lamp is on one side, and on the other a pot of perfume. The singing of birds, the rustling of the breeze, the murmuring of a brook, are the only sounds that I hear. My window will shut, and my door open,—but to wise men only; the wicked shun it. I shave not, like a priest of Fo; I fast not, like the Tao-tsé. Truth dwells in my heart, innocence guides my actions. Without a master, and without a scholar, I waste not my life in dreaming of nothings, and in writing characters, still less in whetting the edge of satire, or in trimming words of praise. I have no views, no projects. Glory has no more charms for me than wealth, and all the pleasures of the world cost me not a single wish. The enjoyment of ease and solitude is my chief concern. Leisure surrounds me, and bustle shuns me. I contemplate the heavens, and am fortified. I look on the earth, and am comforted. I remain in the world without being in it. One day leads on another, and one year is followed by another; the last will conduct me safe to port, and I shall have lived for myself."

The drama.

Dramatic entertainments are in China, as in Europe, closely connected with poetry. The songs and recitative, in the lighter pieces, abound with characters of double meaning and equivocal expression; but are generally so contrived that, while the written characters shall bear one sense, the sound shall convey to the ear another; and these subterfuges are resorted to in order to avoid that punishment which the magistrates would be compelled to inflict for a breach of the law respecting public decorum, in the publication or exhibition of any thing directly and unequivocally obscene; and yet real life is represented on the stage, without any of its polish or embellishments. All acts, however infamous or horrible, are exhibited on the stage,—a murder or an execution. Whether the culprit be condemned to die by the cord, by decollation, by being cut into ten thousand pieces, or by being flayed alive, the spectators must be indulged with a sight of the operation. Nor do they stop here. Those functions of animal life over which decency requires a veil to be thrown, are exhibited in full display; many of them so gross and indelicate, so coarse in the dialogue, and so indecent in the scenic representation, that foreigners who have witnessed them have retired from the theatre in disgust.

It is no excuse that these obscene exhibitions were performed for the amusement of foreigners, whom they are pleased to consider as barbarians. The representation of real life, in its ugliest dress and most hateful deformities, could only be conceived by a people of depraved habits and a vicious taste. Of the court exhibitions we have amusing descriptions in the journals of Lord Macartney, Van Braam, and De Guignes. Lord Macartney describes the theatrical entertainments to consist of great variety, tragical as well as comical; some historical, and others of pure fancy, "partly in recitative, partly in singing, and partly in plain speaking, without any accompaniment of instrumental music, but abounding in battles, murders, and most of the usual incidents of the drama." The grand pantomime followed, the subject of which his lordship conceived to be "The Marriage of the Ocean and the Earth. The latter exhibited her various riches and productions, dragons, and elephants, and tigers, and eagles, and ostriches, oaks and pines, and other trees of different kinds. The ocean was not behind hand, but poured forth on the stage the wealth of his dominions, under the figures of whales and dolphins, porpoises, and leviathans, and other sea monsters, besides ships, rocks, shells, sponges, and corals, all performed by concealed actors, who were quite perfect in their parts, and performed their characters to admiration." These marine and land productions paraded about for a while, when the whale, waddling forward to the front of the stage, took his station opposite to the emperor's box, and spouted out of his mouth into the pit several tons of water. "This ejaculation," says his lordship, "was received with the highest applause; and two or three of the great men at my elbow desired me to take particular notice of it, repeating at the same time, *Hao, kung hao! charming, delightful!*" After this, they were entertained with tumbling, wire-dancing, and posture-making; and the amusements of the morning concluded with various fire-works, which were much admired for their novelty, neatness, and ingenious contrivance.

The Dutch ambassadors were chiefly entertained by the feats of jugglers and posture-makers; after which there was a kind of pantomimic performance, the principal characters of which were men dressed in skins, and going on all fours, intended to represent wild beasts. After them were a parcel of boys habited like mandarins, who were to hunt these animals. "This extraordinary chase, and the music and the rope-dancing, put the emperor into such good humour, that he rewarded the performers very liberally; and the ladies behind some Venetian blinds appeared, from their tittering, to be equally well entertained."

An eclipse happened, which kept the emperor and his mandarins the whole day devoutly praying the gods that the moon might not be eaten up by the great dragon that was hovering about her; and the next day a pantomime was performed, exhibiting the battle of the dragon and the moon; and in which two or three hundred priests, bearing lanterns at the end of long sticks, dancing and capering about, sometimes over the plain, and then over chairs and tables, bore no mean part.

The dramatic representation of the eclipse of the moon is thus described by De Guignes: "A number of Chinese, placed at the distance of six feet from one another, now entered, bearing two long dragons of silk or paper painted blue, with white scales, and stuffed with lighted lamps. These two dragons, after saluting the emperor with due respect, moved up and down with great composure, when the moon suddenly made her appearance, upon which they began to run after her. The moon, however, fearlessly placed herself between them; and the two dragons, after surveying her for some time, and concluding apparently that she was too large a morsel for them to swallow, judged it prudent to retire, which they did with the same ceremony as they entered. The moon, elated with her triumph, then withdrew with prodigious gravity, a little flushed, however, with the chase which she had sustained."

It is not easy to reconcile the admission of these puerile absurdities and gross indelicacies on the stage, where regular dramas of a higher order exist, and comedians are trained up to perform them, unless it be that their thorough contempt for foreigners induces them to think any thing good enough for their entertainment. The dialogue in the regular drama is uttered in a kind of whining recitative, full of querulous cadences, which are drowned generally in a crash of trumpets, cymbals, gongs, and the kettle-drum. The passions, as in the Italian opera, are mostly expressed in song. If a fight ensues, each of the combatants sings a stanza, and then falls to, and during the combat the instruments of music keep up a most tremendous noise.

A statute is in force against females appearing on the stage, as actresses; and yet it is said that Kien-lung's mother was

at one time an actress. The parts in which females appear are performed by eunuchs and boys, the latter of whom are regularly bound apprentices to the trade. Pekin is said to have about a hundred different companies, and each company to consist of fifty persons and upwards, composed of speakers, musicians, tumblers, and jugglers, so as to suit all tastes. They live in passage-boats, in which they are conveyed from place to place. There are no regular theatres, but players are hired by the wealthy at so much by the day. They are said to be ready at any moment to perform any play that may be fixed upon, out of a list seldom short of 100. These are the sorts of plays performed before their countrymen, and not the trash which they exhibit before foreigners at the court and at the sea-port town of Canton. The translation of *An Heir in his Old Age*, by Mr Davis, is calculated to give rather a favourable opinion of the Chinese drama. It consists of five regular acts; it has plot and character; the action is simply one, and never stands still. It is deficient in wit, but not in sentiment, and the several characters are well preserved. It is, in short, a story that may commonly occur in a family, thrown into action instead of being merely told, and the catastrophe is quietly and naturally brought about.

Many of their dramas, however, are full of bustle and business, and abound with incident. They are generally representations of real life, and contain sometimes the whole life and adventures of an individual, some great sovereign, or celebrated general; a history, in fact, thrown into action, not unlike that "Lamentable tragedy, mixed full of pleasant mirth, conteyning the life of Cambyses king of Percia, from the beginning of his kingdom unto his death." The argument of a drama of this kind was found among Mr Wilkinson's papers. An aged matron and her son (the hero of the piece) being reduced to poverty, are driven to the necessity of asking alms for their support. An officer's daughter, finding them of good parentage and education, gives money to the son, and engages the mother to attend on her. The son hires himself to serve in a tea-house kept by an old woman and her daughter. A rakish young officer, liking the daughter, gains the consent of the old woman to take her into his house, but the girl rejects the offer. He then sends his servants to carry her off by force, but the new servant rescues her. The officer lays an accusation against him; he is carried before a magistrate, who orders him a flogging, and to wear the cangue or wooden collar. Not satisfied with this, the young officer sends out his people with cudgels to beat him to death. Unable, on account of the collar, to reach his mouth, they find the young girl giving him food. His hands, however, being at liberty, he lays about him on all sides, and, by a sudden whirl of his wooden ruff, the corner of it strikes the young officer on the head and kills him on the spot. The head man of the street takes him and the young woman into custody, carries them before a magistrate, who releases the young man, but takes the girl of the tea-shop into his own house, from which she is suffered to escape by his wife. The superior magistrate of the district being informed of the death of the young officer, and that the girl of the tea-house was the chief cause of it, sends an order to the inferior magistrate, who had taken her into his house, to deliver her up; but she is nowhere to be found; and, in the greatest dismay, this inferior magistrate orders his servants to go out and seize any woman they meet with and carry her before the superior magistrate. They find, in a temple, the officer's daughter first mentioned, with the old woman, who had fled from home on her father being disgraced, and all his goods and family seized. She is hurried away before the magistrate, and, in the supposition of her being the tea-house girl, sentenced to lose her head. Being carried to the place of execution at midnight, she is recognized by the old matron's son, who was among the spectators, and who, by seizing the officer's sword, attacks the executioner, and rescues the young lady; but they are speedily taken, and both ordered for execution; the truth, however, is discovered, and the magistrate who played off the trick suffers in their stead. This superior magistrate, however, falls in love with the lady, and proposes to take her for his *first* or legitimate wife, and hires the young man for his servant. The lady peremptorily refuses, upon which she is ordered to be beaten by the servants till she lies for dead, and the young man is directed to carry the body and throw it into the river. He lays her on the bank, covers her with his cloak, and goes to buy a coffin, as his last act of gratitude for one who had relieved his mother and himself in their distress. A boat approaching, and finding a woman thus bestowed, carries her off to serve the Tartar queen in her wars against the Chinese; this same people, it seems, having already carried off the old matron and the young girl of the tea-shop. Our hero returning and missing the body, falls in great distress. However, he tells his master he has obeyed his commands, who by this time has learned whose daughter he had thus cruelly treated; and, to prevent further mischief, he engages his new servant (the hero of the piece) to put to death her father, instead of which he reveals the whole to the father, and they concert together and put to death his master. The hero then flies to the wars against the Tartars; and it being the custom (or the Chinese thinking so) for the women to fight, he encounters his own mother, the young lady who relieved her, and the girl of the tea-shop, on which discovery he suffers himself to be taken prisoner by the Tartars, is brought before the queen, who, on hearing the story, sets the three Chinese women at liberty, and commits them to his care. They all return to China; they find the father of the young lady restored to his rank and honours, who bestows his daughter on the hero of the piece; and the other young woman of the tea-shop is provided for by his taking her for a second wife. By the emperor's patent he is created a great mandarin for the service he has performed, receives the suitable habit for himself and his two wives, and the congratulations of all their friends. (Macartney; Staunton; Barrow; De Guignes; *Missionary Communications* in Du Halde; Grozier, *Mém. sur les Chinois*, &c.)

Music.

As connected with the drama, the state of Chinese music may next be considered. Detestable as Europeans must find the very best of this music, such is the force of habit or prejudice, that the Chinese are as fond of their own as a Highlander is of the bagpipe. Their ancient writers ascribe to it all those extraordinary and extravagant effects of softening the manners and promoting civilization, taming wild beasts, moving rocks and stones, and, in short, performing all the wonders which have been related of the strains of Orpheus and the lyre of Amphion. The Shoo-king says, that the emperor *Chun* considered music as one of the most efficient engines of government, and a test for proving the national character. Confucius was so astounded with one of the old airs, that he could neither eat nor drink, and for three months could think of nothing else. In the book of *Odes* it is remarked, that, while the Institutes of the empire continue to be observed, and music to be cultivated, China will remain a mighty and invincible nation. And one of the early emperors has this remark: "would you conquer your enemies without bloodshed, diffuse among them songs set to tender and voluptuous melodies, to soften their minds and enervate their bodies, and then, by sending among them plenty of women, your conquest will be complete."

Dr Burney has well observed, that the more barbarous the age and the music, the more powerful its effects:

For still the less they understand,
The more they admire the slight of hand.

In China the music is still barbarous enough, whatever the people may be who can admire it. It has neither science nor system; but from a strange confused account given by Père Amiot, of the generation and true dimensions of the tones (not one word of which, as he afterwards acknowledges, he could understand), the Abbé Roussier concludes, that, like the music of the Greeks, it appears to be the remaining fragments of a complete system, belonging to a people more ancient than either of them. It will, perhaps, be safer to follow Dr Burney's conclusion, "that, from all the specimens he had seen of Chinese music (and he quotes Dr Lind, who resided some time in China, in support of his opinion), all the melodies of this nation have a very strong analogy to the old Scottish tunes;" that "the Chinese scale is very Scottish;" that "both resemble in their melodies the songs of ancient Greece;" and that, "the music of all three ought to be considered as *natural* music."

The Chinese airs are almost invariably sung in slow movements, generally plaintive, and mostly of a querulous or complaining cast; and they are always accompanied by some stringed instrument in the shape of a guitar. They make use, in singing, of so many shakes, their airs abound with so many half and quarter tones, that they are dull, drawling, and drowsy.

Their gamut consists of five natural tones, which they distinguish by five characters of the language, and two semitones; but they use neither lines nor spaces to note down their music. They however, write down in succession the characters or notes in a column, as they are played, though it does not appear that they pay any attention in marking the time, the key, the mode of expression, or the like, but acquire their airs by dint of labour and imitation. Their gamut for instrumental music is so imperfect, and the keys so inconsistent, wandering from flats to sharps, and the contrary, that they are under the necessity of being steadied and directed by a bell or cymbal. They always play, or endeavour to play, in unison, having no idea of counterpoint and parts in music. The band of Lord Macartney, on this account, afforded them no pleasure, except when it played some simple air, such as "Malbrook," or the national song of "God save the King." Some of their instruments, however, do occasionally rise to the octave in the accompaniment. The wind instruments are in general shrill, harsh, and discordant; the drums, bells, cymbals, and other pulsatory instruments, loud and jarring; and the stringed instruments meagre and jingling. The sweetest instrument is a small organ, made of unequal reeds stuck into the upper surface of a hollow cup of wood, of which there are numbers in this country, but for which Dr Burney tried in vain to adapt a scale. This we believe to be the same *tibia* which that literary coxcomb Isaac Vossius maintained to be superior to all the instruments of modern Europe.

As a favourable specimen of Chinese music, the following national song of *Moo-lee-wha* is here inserted:

This air was played by Lord Amherst's band, and delighted the Chinese more than any other.

It may be added, that the affected gravity of Chinese manners, and their unsocial life, are unfavourable to the cultivation of music, which cannot be expected to arrive even at a state of mediocrity, among a people who rarely assemble together, who take no enjoyment in the amusement of dancing, and whom the loves and the graces have not as yet condescended to visit.

Painting.

In a country where every kind of luxury is discouraged, and some of them constitute a crime, where property is so precarious as rarely to descend to three generations, and where the useful only is affected to be considered as valuable, no great progress can be looked for in the fine arts. For the same reason that their poetry is deficient in invention, imagination, and dignity of sentiment, and their music of harmony, the sister art of painting is wanting in all the requisites that are considered to be necessary to form a good picture. Indeed it could not well be otherwise, as, independently of their contracted ideas, they offend against every principle of perspective, which, with the effects produced by a proper disposition of light and shade, they affect to consider as unnatural. That it is not from want of talent that their drawings and paintings are so extravagantly outré, is sufficiently proved by the facility and accuracy with which the painters of Canton copy any picture put into their hands, whether on paper, glass, or canvass; and, so far from the Abbé Grozier's Parisian idea being true, that their best works are executed in Pekin, the very reverse is the case; all the arts, manufactures, even down to common printing, being worse executed in the capital than in any other city of the empire: and the reason is obvious enough; for the moment that a man acquires a superior reputation, he is summoned to the palace, where, within its spacious precincts, his talents must be exercised for the emperor alone. Here their arts and manufactures remain stationary, while the artists of Canton, being in the habit of copying from better models, are superior to any that the imperial palace can boast. It is all very well for a Chinese to pretend that the ancients greatly excelled the moderns in the art of painting, and to produce examples in their books of one painter having drawn on the palace walls some hawks so very natural that the little birds, afraid to approach, flew screaming away; and of another having painted a door on a wall, the deception of which was so complete, that people endeavoured to go through it: but why should the Jesuits repeat these idle stories as if they were facts? or why should we be told that the Chinese would be good sculptors if the art was not prohibited by the government? which is so far from being true, that in every temple, bridge, and burying-ground, may be seen all manner of grotesque figures of men, women, quadrupeds, and other creatures. that never existed but in the sculptor's imagination; and these we have abundantly in all manner of materials, wood, stone, metals, and baked clay. Individual objects they can paint with great accuracy; and in a composition each individual object is represented as close to the eye. Thus the leaves of trees, however distant, are distinctly represented; and objects in the back-ground are painted of the

same size with those of the same kind in the fore-ground, which they absurdly contend to be proper, because they are so in nature. It may be doubted whether the most skilful European artist can excel a Chinese in painting a bird or a reptile, an insect, a fish, or a flower; so correct is he to nature, that not one plumula of a feather, nor a single scale of a fish, escapes him, and every shade and tint of colour is minutely imitated. It is strange that a man of Pauw's sagacity should suffer his judgment to be so warped as to assign the "singular disposition of their optical organs" as the cause which prevented the Chinese from becoming good painters. As little truth is there in his assertion, that they are unable to copy from good models, without falling into their own style, and converting European eyes, ears, and noses, into those of a Chinese; they are the most servile imitators on earth. A Chinese will imitate the likeness of any object in shape, colour, and proportion. Though when left to himself he has no mind to convey the idea of distance, solidity, expression, and magnitude of objects, by fore-shortening, perspective, and a due distribution of light and shade, yet he will copy them all in a picture with scrupulous accuracy.

Sculpture.

Sculpture has been thought by some to date its improvements, if not its origin, from monumental edifices. No country can boast a greater number or variety of objects of this nature than China; but, like the rest of its edifices, they are totally destitute of the character of solidity and duration. A few monsters, or distorted forms of men and domestic animals, generally moulded in clay, are sometimes placed among the tombs, but they are wholly undeserving of notice. In cutting wood, in forming the root of a plant into the shape of human beings, quadrupeds, or monsters, they succeed better, and communicate to the features or to the action a high degree of expression; the same things occur in metal and in porcelain; but the human figure is always clothed, and a naked statue never seen. Some of the gigantic clay figures in the temples are by no means void of character and expression, and the images cut in stone, which sometimes adorn the avenues to the palaces, the gates of cities, and the parapets of bridges, monstrous as they generally are, show that, by proper encouragement and instruction, they are capable of producing something better; but they seem to be deficient in taste and feeling, and to possess no general ideas of the beauties of nature. Content with the representation of individuality, the imagination is never called into play; they servilely imitate what appears before them, with all its beauties and all its blemishes. They are deficient neither in ingenuity nor in dexterity. They engrave with a tool on copper, on silver, or on wood, as well, generally speaking, as the same kind of work can be executed in any part of Europe; and they are expert enough as lapidaries, in cutting all sorts of precious stones. They use spectacles made of crystal.

Architecture.

It is somewhat remarkable that a government so long and so firmly established, and a population so numerous and civilized, should at no period of its history have constructed a building, public or private, that could deserve the least attention or admiration for its form, solidity, or magnitude, or that could possibly resist the action of two or three centuries; such is the obstinate and inveterate adherence of this people to ancient usage, which has narrowed and confined their ideas in the construction of their dwellings to the primitive tent. Perhaps, however, the want of permanent security to private property may have operated against the construction of solid and expensive edifices, and confined them to the less durable materials of half-burnt bricks, mud, clay, and wood. This is more likely to be the case than the absurd and ridiculous reason assigned by Grozier, that the heat and moisture of the southern provinces, and the rigorous cold of the northern ones, would render buildings of marble and other stone unhealthy and scarcely habitable; and that the same reasons equally operate against a number of stories, as the second and third would not be habitable. If the Abbé Grozier had passed but a single summer's day under the roof of one of the magnificent stone buildings of Calcutta, and another under a Chinese tent, he would not have committed such nonsense to paper. From the want of windows in their houses to the street, and from the small courts behind being barricadoed by high walls, which overtop the roofs, and conceal the dwellings from adjoining courts, it may perhaps be concluded that privacy, and jealousy of their women, have been the causes that prevent the Chinese from building second and third stories to their dwelling-houses. The missionaries, however, have assigned the frequent earthquakes in the northern provinces as the cause of the lowness of the houses and slightness of the materials; as if men would speculate, over a whole empire of unparalleled extent, on a contingency which might never happen, and which, when it had happened, was confined to certain limits. The eruptions of Vesuvius have not prevented the inhabitants of Naples from building palaces, much less the Russians from rebuilding Moscow; though the distance between these two cities is not greater than that of Pekin, where earthquakes are frequent, from that of Canton, where they never happen.

These earthquakes have produced the most disastrous effects in this populous empire. The lives that have been lost are reckoned in Chinese history by hundreds of thousands, especially under the Mongoos dynasty. This might lead to a suspicion of exaggeration, as famines, earthquakes, and inundations, are considered by the Chinese as the scourges inflicted by heaven on the people, to show its dislike to a sovereign whom it disapproves, did not the accounts of more recent earthquakes, given by the missionaries, who were eye-witnesses of their tremendous effects, correspond with those recorded in Chinese history. It is stated by Père Mailla, that, in 1679, in the reign of Kaung-hee, more than 300,000 inhabitants of Pekin were buried under the ruins of the houses thrown down by an earthquake; that at the same time above 30,000 persons perished in the city of Tong-tchoo. The statements, however, of the missionaries, are vague and discordant. Père Couplet says, *Sub decimam horam matutinam, regiam urbem et loca vicina tam horribilis terræ motus concussit, ut innumerá palatia, deorum fana, turres et urbis mœnia corruerint; et sub ruinis sepulta quadraginta hominum millia.* Again, in 1730, in the reign of Yong-tchin, a violent earthquake shook the capital to its foundations, and 100,000 of its inhabitants were crushed to death. The earth opened in various places, black volumes of smoke issued forth, and left behind large pools of water. The city of Pekin is represented as affording a horrible spectacle; its walls, its palaces, the public buildings, two of the Jesuits' churches, and a multitude of dwelling-houses, were wholly or in part thrown down. The palace of the emperor, more solid than any other edifice, was greatly injured; that of Yuen-min-yuen was scarcely reparable. Of the 100,000 inhabitants contained in the adjoining village of Hai-tien, 20,000 are stated to have perished. The imperial family betook themselves to their barges in the canals within the precincts of the palace. The emperor distributed many millions of money to the sufferers, and gave the Jesuits one thousand ounces of silver towards the expense of repairing their churches.

If earthquakes were to throw down the tall and ill-built brick pagodas of seven and nine stories in height, there would be nothing surprising; yet these appear to stand

China. the shocks, and many of them are evidently among the oldest buildings in China. These, and the temples of Fo and Tao-tse, are among the most striking buildings of the country. The want of a national or state religion will best explain the want of those magnificent edifices in China, that almost every other civilized nation has reared to the objects of divine worship. Some of their bridges are light, and sufficiently pretty in their appearance; but they are generally slight and faulty in their construction. They consist of every possible variety of form. Their monuments to the memory of the dead are still more various than their bridges, but they are poor in design and bad in execution. Wooden pillars forming a triple gateway, roofed over, and painted, gilt, and varnished, are among the most striking objects that catch the eye of a stranger. They are monuments erected at the public expense, in streets or by the sides of highways, to commemorate some celebrated warrior, some ancient mandarin, or some antiquated virgin who had withstood temptation, and never swerved from the strict rules of decorum. To such a one will probably be inscribed, in letters of gold, " Honour granted by the emperor—to icy coldness, hard frost." But these *pei-loos* have little permanency. The mandarin to whom the emperor's order is addressed for erecting it, employs a carpenter, contracts for building the edifice as cheaply as he can, and pockets the rest of the money. The emperor's object is answered by publishing the edict in the National Gazette. It is handed down to posterity in the great history of the empire, whilst the monument itself in a few years is consumed by the dry-rot, and is seen no more.

Superior as the temples and palaces of the Hindus and Mahommedans in India and Persia, and indeed throughout Asia, are to those of the Chinese, the dwellings of the latter are infinitely more comfortable in every respect than those of the former. Their stoves for warming the apartments and for cooking, their beds and furniture, bespeak a degree of refinement and comfort unknown to other oriental nations; but the great characteristic difference is, that the Chinese sit on chairs, eat off tables, burn wax candles, and cover the whole body with clothing.

Naval architecture. Their naval architecture wears the stamp of great antiquity, and is exceedingly grotesque. They have, in fact, made little progress in maritime navigation, from the inveterate dislike of the government to all foreign intercourse, and to all innovation. The very same kind of vessels as those described by Marco Polo at the port nearest to Pekin, in the thirteenth century, were found without variation by Lord Macartney, five hundred years afterwards, and accurate to the Italian's description, even to the number of compartments into which the hold of each vessel was divided. They had anchors of wood, and ropes and sails of bamboo. The boats and barges for internal commerce and communication are very varied, generally commodious, especially the passage-boats on the grand canal, and all of them suited to the depth and velocity of the stream, and the width of the locks and flood-gates of the respective canals and rivers which they are intended to navigate. These vessels are so numerous as almost to supersede the necessity of land-carriage; and the most common and convenient mode of travelling in China is in barges, which are generally provided with cabins for sleeping, and a kitchen and utensils for cooking victuals. Their military navy is unworthy of the name. It consists of a flotilla, whose principal occupation is that of conveying soldiers from place to place as they may be wanted, and looking after pirates and smugglers. (Du Halde's *History of China;* Barrow's *Travels in China;* Grozier, De Guignes, &c.)

The state of their military architecture and military science is equally rude and imperfect. There is nothing, in fact, from the celebrated wall on the side of Northern and Western Tartary, to the mouth of the Bocca Tigris near Canton, that merits the name of a fortress. They are all of the same construction, being mounds of earth heaped into the shape of a wall, and cased on each side with bricks, and flanked with square towers at bowshot distance; and with walls of this description all their cities are surrounded. China. Military architecture.

The best defences of China are its great distance from any civilized country; its rugged mountains and sandy deserts on one side, and a stormy sea, whose navigation is but little known, on the other. In its military strength it can place little or no confidence; a fact which has frequently been proved by the successful incursions of the Tartars, who have twice since the Christian era conquered the whole country, and changed the ruling dynasty. Nor is it to be expected that a race like the Chinese, in the most servile condition, and subjected to the greatest humiliations, can make good soldiers. Military and defences.

It has been supposed, from their skill in fire-works, and from the frequent mention of them in ancient books, that the deflagrating power of nitre, sulphur, and other ingredients, was well known to them; but it is pretty evident that they had but an imperfect, if any knowledge of cannon or muskets, before the arrival of European missionaries in the capital. We may form some notion of the mode of fighting of the Tartars and the Chinese about the Christian era, from the memoir of a general officer, presented to the sovereign when about to make war on the Tartars.

" The manner," this general says, " in which the Tartars carry on war is very different from ours. To mount up and descend the steepest mountains with astonishing rapidity; to swim deep and rapid rivers; to brave storms of wind and rain, hunger and thirst; to make forced marches, and overleap all impediments, training their horses to tread in the narrowest paths; expert in the use of the bow and arrow, they are always sure of their aim—such are the Tartars. They attack, retreat, rally, with a promptitude and facility peculiar to themselves. In the gorges of the mountains, and in the ravines and deep defiles, they will always have the advantage over us; but on the plains, where our chariots can perform their evolutions, our cavalry will always beat theirs. Their bows have not the strength of ours, their spears are not so long, and their arms and arrows are inferior in quality to ours. To stand firm, to come to close quarters, to handle the pike, to present a front, to cut their way when surrounded, are the proper manœuvres of our troops, of which the Tartars are ignorant, and against which they can oppose no successful resistance. In such situations, with equal numbers, our forces are as five, when the Tartars are but as three." (*Hist. Gén. de la Chine.*)

The first mention of anything like fire-arms, and that is but an equivocal one, is in the year 1219, when Gengis-khan was penetrating the provinces of China. It is stated that the Chinese, from the turrets of the walls of Tsao-yong, played their machines called *pao*, the present name of guns, by which they killed great numbers at every stroke. Again, when Ogdai-khan laid siege to Lo-yang, the Chinese commandant Kiang-chin invented a kind of *pao*, which hurled large stones to the distance of one hundred paces, with such accuracy as to strike any point that might be desired. But another passage is more to the purpose. The Tartars are said to have breached an angle of the wall, by employing more than a hundred machines, consisting of tubes, each made of thirteen laths of bamboo; that the Chinese repaired these breaches with wood, straw mixed with horse-dung, &c., which the Tartars set on fire with their *ho-pao*, or fire-tubes; and immediately

afterwards we find these *ho-pao* called *Tchen-tien-ley*, or heaven-shaking thunder; and it is further stated that a certain substance put into them, when set on fire, explodes like a thunder-clap, loud enough to be heard at the distance of a hundred *ley*, or thirty miles. This description, and that of the effects produced, leave no doubt of these bamboo staves, hooped together, being the first attempt in China at the use of cannon, to which succeeded probably those of plates of malleable iron, also hooped together, several of which kind have been found in India, and also seen by Bell, lying in heaps, within the walls of a city near the great wall.

In 1453 we find mention made of chariots of war, carrying cannon in their fronts; but it is probable they knew very little of the use of them; for when Chin-tsing, in 1608, made war upon the Tartars on the northern frontier, and was defeated, the Portuguese at Macao, availing themselves of the panic into which the Chinese were thrown, made an offer of assistance with a party of artillery. A Jesuit was dispatched from the capital to hasten the new auxiliaries. The party consisted of two hundred Portuguese, and as many Chinese trained and exercised in the European manner, and they were commanded by two Portuguese captains, Pierre Cordier and Antoine Rodriguez del Capo. They were feasted and treated with distinguished honours on their passage to the capital, where they were well received and generally admired, except in the cut of their jackets, which, according to Chinese notions, were too scanty to be elegant. This admiration, however, soon ceased, and in a few days they were sent back to Macao. It is stated by one of the missionaries, that this was owing to a Portuguese and four Chinese being killed in firing the guns. That the Jesuit Verbiest taught them how to cast cannon there can be no doubt, for the president of the tribunal of rites thanks the missionaries for this signal service; and the matchlocks now in use by the Chinese troops are nothing more than the old Portuguese matchlock.

The Tartars are soldiers by profession, mostly cavalry, and their arms the bow and a broad simitar, which they wear on the left side, with the point forwards, and which they draw by carrying the right hand behind them, in order, they say, that their adversary may not cut the arm when in the act of drawing. They are arranged under eight banners, distinguished by different colours. The Chinese soldiers are for the most part a sort of militia, enrolled for the defence of the extended frontier, guards to the city gates, and the military posts placed at certain distances along the roads, rivers, and canals. All expresses are forwarded from post to post by the soldiers. Vast multitudes are employed to assist the civil magistracy, and act in the cities as police-officers. Their dress and appearance are most unmilitary, better suited for the stage than the field of battle; their paper helmets, wadded gowns, quilted petticoats, and clumsy satin boots, are but ill adapted for the purpose of war. Indeed, unless it be to quell an insurrection, or to pursue bands of robbers, the Chinese military are rarely called away from their pacific employments. There was some anxiety, on the return of Lord Amherst through the country, that the military should put on an imposing appearance. "Through the whole route," says the emperor, "take care that the soldiers have their armour fresh and shining, and their weapons disposed in a commanding style, and that an attitude be maintained at once formidable and dignified."

The people are all enrolled for service, when called upon, from a certain age. A father of a family, having a certain number of children, is exempt from service; an only son, and a son who supports his parents, are both exempt. Great distinctions are shown to those who fall in battle. The body of an officer is burnt, and his ashes, with his armour and a suitable eulogium, sent to his friends; the bow and sabre of a common soldier slain in fight are sent to his family; rewards are distributed, and honourable mention made of the deceased in the Pekin Gazette.

All the military of the empire are under the management of their proper tribunal or board at Pekin, the power of which, however, is jealously checked by a dependence on some of the others,—as the Board of Revenue which supplies the funds, and the Board of Public Works which supplies the *materiel* of the army. The total number of the Tartar troops is estimated to be about 80,000 men; besides which there is the local militia spread through the provinces, which may amount to about 600,000. By far the greater portion of the latter are fixed to their native districts, and are chiefly occupied in cultivating the land, or in following some other private pursuit. From such materials the army of China cannot be otherwise than in a very inefficient state. That overwhelming superiority which the empire possesses over the petty and barbarous states on its frontiers has prevented aggressions on it, but has likewise precluded the practice and experience necessary to make good soldiers.

The Chinese seem to possess no knowledge of the pure, speculative, and abstract science of mathematics. Their knowledge of arithmetic and geometry is bounded by mere practical rules. Their numerical notation is marked down by symbols of the language, as that of the Greeks and the Romans was by letters of the alphabet; and, like them, the Chinese symbols want that value in position which the Arabic numbers possess. The common operations of arithmetic are generally performed by a few balls strung on wires, somewhat resembling the Roman abacus, and sometimes by the joints of the fingers. The measure of quantity is usually determined, by reducing all surfaces and sides to the dimensions of squares or cubes; and with those few practical operations they contrive to manage all the common purposes of life.

Yet the Chinese have been represented by some of the French missionaries as profound astronomers at a time when all Europe was in a state of barbarism; as being able to calculate the recurrence of eclipses; to adjust the irregular motions of the sun and moon; to measure the distances of the planets, and so forth. The ridiculous ceremonies observed by the great officers of state when eclipses happen, furnish, it is true, no proof against the knowledge of their causes. A government established on ancient customs cannot afford to lop off any of its props; and the foretelling of eclipses, the frightening away of the dragon that would devour the sun or moon, the favourable or unfavourable omens of the heavenly appearances, are so many engines for keeping the ignorant in awe. The Imperial Calendar is an admirable coadjutor of the Imperial Gazette. But when we find, from their own annals, and from the report of the earliest travellers, that foreigners have had the superintendence of the astronomical part of this almanac; and that, from the defective knowledge of these foreign astronomers, and the occasional want of them altogether, the national calendar, as declared by one of their emperors, had undergone no less than seventy-two revisions, it may safely be concluded that the Chinese know very little of the matter. M. Fréret says he had in his possession the copy of a celestial chart, constructed in China about the sixth century of the Christian era, on which were inserted 1460 stars in their proper positions, at least sufficiently near to be recognised; but this may have been made mechanically, and perhaps by a foreigner. It is recorded in their annals, that in 718 of the Christian era, an Indian astronomer of the name of *Koo-tan*, having brought from the west a treatise on astronomy, was employed at court

China.

to translate it into the Chinese language; and they also mention that Kublai-khan encouraged learned men to remain in China, and that under his reign an Arab astronomer was employed in rectifying the calendar, and constructing astronomical instruments. Since that time, Armenians, Bucharians, Hindus, Arabs, and Christians, have presided over the board charged with the construction of the National Almanac, in which the native Chinese took no other part than that of assigning the lucky and unlucky days, what was to be done and what abstained from on those days. When Lord Macartney was in Pekin, a Portuguese, who called himself Bishop of Pekin, a person of no great skill in mathematical knowledge, presided over this board. Indeed, the state in which their calendar was found when Adam Schaal, one of the earliest Jesuits, made his way to Pekin, sufficiently proves their ignorance of astronomical calculations, an intercalary month having been introduced into the wrong year. On making them acquainted with this blunder, all the departments of the state, ordinary and extraordinary, were summoned to sit in judgment on the good father's report, which they voted to be erroneous, and that the ancient system should be continued. They kept, however, the learned Jesuit at court, and quietly allowed him to set them right. The emperor Kaung-hee, who seems to have entertained no high opinion of his Chinese subjects, brought the Chinese president of the board of astronomy to trial because he could not calculate the length of shadow which a gnomon would throw, but which was immediately done by Father Verbiest. This intelligent Tartar put himself under the tuition of the Jesuits, who made for him a quadrant, translated into the Chinese language a set of logarithm tables, which were printed, and a copy of which is now in the library of the Royal Society of London; a very beautiful specimen of Chinese typography. Kaung-hee carried these tables and his quadrant suspended from his girdle, and, when in Tartary, is said to have constantly amused himself in taking angles, and measuring the height of mountains.

The Chinese system, if system it can be called, of astronomy, resembles so closely that which remains of the Hindus, that both must have been derived from the same source. The period or cycle of sixty years, by which their chronology is regulated—the period of 10,800 years, observed by the Tao-tse, which is the sum of the first three Hindu ages, with their intermediate periods—the division of the zodiac into twelve signs, and also into twenty-eight constellations, or habitations of the moon, corresponding with the twenty-eight Hindu nacshatras—are so many proofs of a common origin; and both may perhaps have derived the remains of this science from some third nation, more ancient than either; as the little which both nations do possess appears to be the remains rather than the elements of the science.

The system of policy which discouraged all intercourse with strangers, which set no value on foreign commerce and navigation, and which cultivated no language but that of the country, which was unintelligible to other nations, must necessarily have kept the people of China in ignorance of all the rest of the world. China was to them, in fact, the whole world. It appears, however, that at a very remote period they had intercourse with Pegu, Siam, Malacca, Hindustan, and several of the Asiatic islands. Two centuries before the Christian era, they had a knowledge of the upper regions of Tartary; and one of their travellers gives an account of an inland sea, into which the rivers running to the westward were received, which could be no other than the Caspian. The great islands of Borneo, Java, Sumatra, and Ceylon, are names easily recognized in their annals, on which great numbers of Chinese are still found, retaining their original language, manners, and government. Captain Sayer, of his Majesty's ship Leda, on ascending a river of the western coast of Borneo, came unexpectedly on a colony of Chinese in the interior, consisting of not less than 200,000 or 300,000 persons, all united under one chief or captain; and Sir Thomas Raffles says, that near the same place, it has been calculated that the number of Chinese employed in the gold mines alone amounts to 32,000 working men.

Their knowledge, however, of their immediate neighbours was very limited and imperfect. By the aid of practical geometry, they had a tolerable notion of their own country. Père Mailla asserts, that on comparing an ancient chart of China, said to be copied out of the *Shoo-king*, with the actual survey made by his brother Jesuits and himself, and which took them ten years to complete, they found the limits and the positions of the provinces, the courses of the rivers, and the direction of the mountains, pretty nearly to accord; but the proportions of the objects to each other, and to the whole, were not in the least observed. He further observes, that they saw and gazed with astonishment and admiration at the chasms which the emperor Yu caused to be cut through solid mountains, to open new channels for the waters of the Yellow River. Some, however, will be apt to conclude that it was the water itself, and not the emperor Yu, which opened these channels.

Of natural and experimental philosophy, they know only what the Jesuits taught them, and that appears not to be much. Of clock-making, dialling, optics, and electricity, they know nothing; of hydrostatics and hydraulics, very little. They raised water by a machine resembling the Persian wheel, and by a large wheel, with bamboo tubes fixed obliquely on its rim; but they were ignorant even of the principle of the common pump. The use of most of the mechanical powers is known to savages; but the most commodious and effective application of them was not known to the Chinese. In most cases manual strength supplied the place of mechanical power. When Mr Barrow, in delivering the presents to the emperor Kien-lung, failed in making him comprehend the use of the mechanical powers from a complete set of models, the old man observed, that they might serve as playthings for his grandchildren.

State of the liberal professions.

The nature of their own language, their universal ignorance of any other, and their pertinacious resistance to all intercourse with foreigners, may explain the low ebb of the sciences and liberal professions in China. The maxims of the sovereigns and sages of antiquity, the rites and ceremonies and duties required by the civil and religious institutions of the empire, the laws and customs, are the points of knowledge which lead to wealth, power, and distinction in the state. As there is no established religion, so none is paid or preferred by the government for instructing the people. As there is no pleading in criminal or civil suits, so there are none who act as attorneys or advocates; and the practice of physic is attended with too little either of honour or emolument to excite emulation in men of rank and ability in the pursuit of it, and is generally in the hands of the sectarian priests of Fo and Tao-tsé, or of low vulgar quacks. Without the least knowledge of anatomy or surgery, they can know little of the animal economy. The seat of the disease they pretend to discover by the quackery of the pulse, by the eye, the nose, the tongue, the ears, and the voice. When this is ascertained, they prescribe their vomits, purges, febrifuges, &c. extracted from the three kingdoms of nature, of which mercury, antimony, rhubarb, and ginseng, constitute no inconsiderable part. Of ginseng alone they profess to have no less than seventy-seven preparations. Their sur-

gery consists chiefly in acupunctuation and shampooing, and it is practised chiefly by the barbers. There are certain persons whose occupation is to discover whether those who may be found dead have died a natural death or by violence, whether by their own means or that of others; and the verdict of the criminal court is often grounded on the decision of these quacks.

The emperor Kaung-hee soon convinced himself that several of the Jesuits were better skilled in medicine than his own physician. At first, however, he had some scruples, upon being attacked by a fever, of following their advice. Three of the first physicians to the court dissuaded him from taking a medicine of whose qualities they professed themselves ignorant, and advised him to let the disease go on, that they might discover its true character. The emperor, however, at last took the Peruvian bark which the Jesuits had prescribed, and soon recovered; but it is said in the *General History*, that several officers who had similar fevers were first ordered to take the bark, and finding it at least harmless, he then ventured upon it himself. As ignorance is a crime in the eyes of the ignorant, it is more especially so at the court of China, and made capital in those to whom the life of the sovereign is intrusted. The three physicians were, therefore, delivered over to the criminal court, who condemned them to death; but Kaung-hee mitigated the punishment to that of exile, and rewarded the Jesuits with a house in Pekin, and contributed largely towards the building of a church.

Kaung-hee was a man of great humour, and used frequently to joke with the missionaries respecting their religion and the customs of their country. One day he asked Mezzabarba, the pope's legate, if it was the custom in Europe to condemn a man to death without sufficient proof of his guilt; and being answered in the negative,—" One cannot," says the emperor, " attach too great a value to the life of man;" and turning to his body physician, and ordering him to approach, " Here," continues he, " is a much more formidable person than myself. I can only put a man to death on legal proof of guilt; but this fellow can dispatch whomsoever he pleases without the form of trial."

Whoever may be curious to see the quackery of the pulse detailed, without a complete knowledge of which a physician would gain no reputation in China, may find a translation of the doctrine in the collection of Du Halde.

The Chinese are subject to a species of contagious leprosy, which their physicians cannot cure, and which the law ordains to be a legitimate cause of divorce, as the only means to stop its progress. The itch is most prevalent, and cutaneous disorders of various kinds are very common; but they have escaped the plague, more, as Pauw thinks, by constant ventilation, by burning sandal-wood dust, and other odoriferous woods, by the abundant use of musk and various strong scented drugs, than by any attention to cleanliness. Perhaps, also, the universal smoking of tobacco may have contributed to save them from the horrors of the plague. (*Hist. Gén. de la Chine*, par Du Halde.)

Though little progress has been made in any of the liberal arts or abstract sciences, and little as they are likely to advance under a system of government which interdicts all intercourse with foreign nations, the arts which necessity demands, which add to the conveniences and increase the comforts of a civilized state of society, seem to have flourished at a very early period of their history; and many of them have been brought to a degree of perfection which is still unequalled by the most polished nations of Europe. Whatever depends on mere imitation and manual dexterity, can be executed as well and as neatly by a Chinese, as by the most skilful artists of the western world; and some of them in a style of very superior excellence. No people, for example, have carried the art of dyeing, or of extracting dyeing materials from so great a variety of animal, mineral, and vegetable substances, as the Chinese have done; and this merely from a practical knowledge of chemical affinities, without troubling themselves with theories derived from scientific principles. In like manner practice has taught them how to detect the exact proportion of alloy that may be mixed with gold and silver, and how to separate it. We import from China their native cinnabar; but our vermilion, extracted from it, is not to be compared with theirs for brilliancy and deepness of colour, which is supposed to be given to it by long and patient trituration under water. Again, the beautiful blues on their porcelain are more transparent, deep, and vivid, than the same blues applied to our pottery-ware; yet we supply the Chinese with the same cobalt frits from which our own colours are extracted. It has been supposed that the greater or less brilliancy of the colours used for painting porcelain depends more on the nature of the glaze on which they are laid, than on their own intrinsic merits. Here then we have something still to learn from the Chinese. The biscuit of their porcelain, too, is much superior in whiteness, hardness, and transparency, to any which has been made in Europe. The Swansea porcelain comes the nearest to it in these respects, which is supposed to be owing in some degree to a proportion of magnesian earth being mixed with the aluminous and silicious ingredients. In form and decoration, which depend on a taste and feeling which the Chinese are strangers to, we far surpass them.

In the cutting of ivory into fans, baskets, pagodas, nests of nine or more hollow movable balls, one within the other, beautifully carved, the artists of Europe cannot pretend to vie with the Chinese; yet it does not appear that they practise any other means than that of working in water with small saws. As little can Europeans pretend to rival their large horn lanterns, of several feet in diameter, perfectly transparent in every part, without a flaw or opaque spot, and without a seam; yet a small portable stove or furnace, an iron boiler, and a pair of common pincers, are all the tools that are required for the manufacture of those extraordinary machines. In silver fillagree they are at least equal to the Hindus, and their lacquered cabinets and other articles are excelled only in Japan. They are not less expert in cutting tortoise-shell and mother of pearl, and all kinds of gems and stones. They have a method of ornamenting their cabinet wares, tea-chests, and other articles, with spangles laid on with the black varnish in the shape of plants, birds, insects, &c., exhibiting varied iridescent colours, appearing like metallic scales that have undergone the process of heat; but they are nothing more than the thin lamina of a particular species of shell (*Helix*), which they have a method of separating by boiling, as they pretend, for the space of half a moon. In all the metals they work with neatness; and if they make not a lock or a hinge that an English artist would look at, it is only because a Chinese would not pay the price of a good one. Their white copper is a metal, or a mixture of metals, unknown in Europe; and though we think that we have ascertained the component parts of the famous gong to be copper, tin, and bismuth, we are yet unable to make a Chinese gong. In works of the loom, and especially in the manufacture of silk and satin cloths, we cannot pretend to cope with them; and their silken twisted cords, tassels, and all kinds of embroidery, in general the labour of females, are extremely beautiful. In the variety of gums, spices, and perfumes, they excel the rest of the world. Our artists can attest the excellence of their ink, and their paper and printing may challenge those of Europe. Many other branches of the mechani-

cal arts might be enumerated, in which the Chinese may consider themselves as second to none; but those already mentioned are sufficient to exemplify their skill in this respect. There are no manufactories carried on by machinery, or upon a great scale. Generally speaking, each individual in the country spins, weaves, and dyes his own web. It would appear, however, from some regulations laid down in the *Leu-lee*, that of porcelain, silks, satins, and certain other articles, government is its own manufacturer. The manufactories of porcelain and the coarser kinds of pottery, for the sake of the coal, are mostly in Kiang-see; and the village of Kin-te-chin, it is said, contains nearly a million of people, all of them engaged in the potteries.

Not the least remarkable circumstance connected with this remarkable country is the immense population that it contains. It was usual to doubt the accuracy of the accounts commonly given by the Chinese on this subject, but as the country has become more known, the nearer do these statements seem to be to the truth. "I think," says Sir John Bowring, "our greater knowledge of the country increases the evidence in favour of the approximate correctness of the official document, and that we may with tolerable safety estimate the present population of the Chinese empire as between 350,000,000 and 400,000,000 of human beings." The following is the population of China according to the last official census—that of 1812:—

Provinces.	Area in square Miles.	Average population to sq. mile.	Total population.
Chihli	58,949	475	27,990,871
Shantung	65,104	444	28,958,764
Shonsi	53,268	850	14,004,210
Honan	65,404	420	23,037,171
Kiangsu	44,500	850	38,843,501
Ngonhwui	48,461	705	34,168,059
Kiongsi	72,176	320	33,046,999
Chekiang	39,150	671	26,256,784
Fokien	53,480	276	14,777,410
Hupeh	70,450	389	27,370,098
Hunan	74,320	251	18,652,507
Shensi	67,400	153	10,207,256
Konsuh	86,608	175	15,193,125
Sz'chuen	166,800	128	21,435,678
Kwontung	79,456	241	19,174,030
Kwongsi	78,250	93	7,313,895
Kweichan	64,554	82	5,288,219
Yunnan	107,969	51	5,561,320
Shingking	...	...	2,167,286
Total	1,297,999	6,574	362,447,183

The following is a statement of some of the most trustworthy censuses of China, taken at different periods:—

Authorities.	Date of Census.	Population.
Chinese Repository	1711	28,605,716
Grozier, De Guignes	1736	125,046,245
,, ,,	1743	157,343,975
Chinese Repository	1753	103,050,060
Yih-tung-chi, a Chinese work	1760	143,125,225
De Guignes	1760	203,916,477
,,	1761	205,293,053
Allerstein, Grozier, De Guignes	1762	198,214,553
Chinese Repository, vol. i.	1790	155,249,897
Dr Morrison	1792	307,467,400
Lord Macartney	1792	333,000,000
Chinese Repository, vol. i., p. 359	1812	362,467,183

The four censuses which deserve the most credit, so far as the sources from which they are obtained are concerned, are those of 1711, 1753, 1792, and 1812. They show the following rates of increase:—

From 1711 to 1753 the population increased 74,222,602, which was an annual advance of 1,764,824 inhabitants, or a little more than six per cent. per annum for 42 years. This high rate of increase, however, it must be remembered, arises in some measure from the more thorough subjugation of the S. and W. at the later date when the Manchoos could safely enrol large districts, which in 1711 they would not have been allowed to enter for such a purpose. From 1753 to 1792 the increase was 104,636,882, or an annual advance of 2,682,997 inhabitants, or about two and a half per cent. per annum for thirty-nine years. During this period the country enjoyed almost uninterrupted peace under the sway of Kien-lung, and the unsettled regions of the S. and W. rapidly filled up.

From 1792 to 1812 the increase was 54,126,679, or an annual advance of 2,706,333,—not quite one per cent. per annum for twenty years. At the same rate the present population would amount to over four hundred and fifty millions; but from the great numbers that have left the country since the last census, as well as from the internal disturbances that have recently taken place, it is probable that they do not nearly amount to that sum. They have overflowed the bounds of their possessions on all sides, especially in Manchooria, Mongolia, Ili, and towards Thibet, while the emigration towards the Indian Archipelago and other places has also been very large.

The constant flow of emigration from China, contrasted with the complete absence of immigration into China, is striking evidence of the redundancy of the population. In the kingdom of Siam it is estimated that there are at least a million and a half of Chinese, of which 200,000 are in the capital (Bangkok). In Java there are 136,000 of them. Cochin-China teems with Chinese; and they abound in all the islands of the Indian Archipelago. Multitudes go to Australia, the Philippines, the Sandwich Islands, California, and the western coast of Central and Southern America. The emigration to the British West Indies has been considerable; to the Havannah greater still. The annual arrivals in Singapore are estimated at an average of 10,000, and about 2000 are said annually to return to China. Besides this enormous maritime emigration, a considerable inland efflux of Chinese takes place towards Manchooria and Thibet; and it may be added, that the large and fertile islands of Formosa and Hainan have been to a great extent won from the aborigines by successive inroads of Chinese settlers. Yet this perpetual outflowing of people seems in no respect to diminish the number of those who are left behind. Few Chinamen leave their country without a fixed purpose to return to worship in the ancestral hall, to bring sacrifices to the tombs of their fathers; but it may be doubted if one in ten revisits his native land. The loss of life from disease, from shipwreck, and other casualties, amounts to a frightful per-centage on those who emigrate.

The prevalence of infanticide in China is also adduced by some as a proof of the extreme populousness of the empire. That this revolting system is carried on to such an extent as to have any considerable effect in diminishing the numbers of the people, or that it is viewed with indifference by government, as tending to keep down the population, we are inclined to doubt; though it is very probable that much of it is the result of poverty. This practice is not taught or enjoined by any religious system in China, nor do they expect to reap any spiritual advantage from it; and females being the objects of it, it is likely that the parents wish to save themselves the trouble and expense of bringing up one who is likely to cost more than she will ever bring on being sold out in marriage. Boys, on the contrary, are likely to repay by their labour the care and expense bestowed on them, and contribute to the building up of the family name and fortunes.

The statements of Dr Morrison were taken by him from Chinese works. That of Lord Macartney, who was ambassador to China from England, rests on Chinese authority. The census of 1812, as given above, was considered by

Drs Morrison and Bridgman, who must be ranked among the highest authorities, as "the most accurate that has yet been given of the population."

The fact is, that the censuses, as that of 1812 and others, taken by the Chinese government, were not intended for the public eye; they were taken, moreover, under circumstances which would greatly tend to render them too small rather than too large, for the people of China have ever endeavoured, as the people now do and have done in all Spanish countries, to cause as small a number to be registered as possible, hoping thereby to escape the contribution that would be levied on them by the government. Dr Morrison says,—"We know from several authorities that the people are in the habit of diminishing rather than increasing their numbers in their reports to government;" and one reason for doing so is, that the local authorities may pocket the difference in the taxes assessed for collection in their districts. (Williams's *Middle Kingdom.*)

There can be little doubt that the present redundancy of the population renders dependence for support on the produce of the country very precarious, and frequently induces much suffering from an inadequate supply of food. Though extraordinary harvests may have enabled the Chinese to export rice to foreign countries, yet of late the importations from foreign countries have been very large; and notwithstanding this, famine has committed dreadful ravages, the provisions of the imperial granaries having been wholly inadequate to provide for the public wants. The evil consequences resulting from an over-abundant population are experienced in one or another part of the kingdom almost every year,—drought, inundations, locusts, mildews, or other natural causes, producing a deficiency in the crops, give rise to frequent insurrections and disturbances. The anxiety of the government to provide stores of food for the necessities of the people in times of scarcity, shows rather the fear of the disastrous results usually following a short crop, such as the gathering of clamorous crowds of starving poor, and the consequent increase of banditti and disorganization of society, than any peculiar care of the rulers for their subjects.

It has been supposed that nearly a tenth of the population live by the fisheries, thus affording evidence not only that the land is cultivated to the greatest possible extent, but that it is insufficient to supply the necessities of the overflowing population; for the pursuit of agriculture is in high esteem among the Chinese, the husbandman standing next in rank to the literary man in the social hierarchy. The immense number of persons that live continually in boats,—that are born, marry, rear families, and die on the water,—shows to what an extent the land is crowded, and how inadequate it is to maintain the cumberers of the soil. In the city of Canton alone it is estimated that 300,000 persons dwell upon the surface of the river, the boats extending for several miles, sometimes twenty or thirty deep; while the wants of the people are supplied by ambulatory salesmen, who wend their way by every accessible passage. Some of these boats are finely decorated, and used for every purpose of license and festivity,—for theatres, concerts, feasts, gambling, &c.; others are employed in conveying goods and passengers, and are in a state of constant activity; and others are moored, and their owners engaged as servants or labourers on shore. Indeed, their pursuits are probably nearly as various as those of the land population. But besides these, many of the Chinese dwell on artificial islands which float upon the lakes. These are formed by the binding together of rafters on which they raise houses and gardens. There they have everything needful for the supply of their daily wants—their poultry and vegetables for use, their flowers and scrolls for ornament, and their household gods for protection and worship.

While so many elements of vitality are in a state of activity for the reproduction and sustenance of the human race, there is probably no part of the world in which the harvests of mortality are more sweeping and destructive than in China. Multitudes perish absolutely from want of the means of subsistence; inundations destroy towns and villages, with their inhabitants; and typhoons or hurricanes, which visit the coast occasionally, cause immense loss of life. The late civil wars in China must have led to the loss of millions of lives. The sentiment of dishonour attached to the extinction of a race by the want of descendants is general among the Chinese, arising from the reverential services which descendants pay to their ancestors. The Chinese moralists set it down as a law, that if a wife give no children to her husband, she is bound by every tie of duty to encourage and to patronize a concubine through whom his name may be preserved, and provision made that when he leaves the world honours will be paid to his manes. Generally the wife willingly coincides with the husband in introducing into the household any number of concubines he may be able to maintain; and the child of a concubine is bound to pay higher respect to the first wife than to its own mother. The domestic affections of the Chinese are strong; and on the whole the social arrangements must be considered friendly to an augmentation of the human race. Parents are generally very fond and proud of their children, and the children are obedient to their parents.

The marriage of their children is one of the great concerns of families. Scarcely is a child born in the higher ranks of life ere the question of its future espousal becomes a frequent topic of discussion. There is a large body of professional match-makers, whose business it is to put all the preliminary arrangements in train, to settle questions of dowry, to accommodate differences, and report on the *pros* and *cons* of suggested alliances. There being no hereditary honours in China, except those which reckon upwards from the distinguished son to the father, grandfather, and the whole line of ancestry, which may be ennobled by the literary or martial genius of a descendant, the distinctions of caste are unknown, and a successful student, even of the lowest origin, would be deemed a fit match for the most opulent and distinguished female in the community. The severe law which prohibits marriages within certain degrees of affinity tends to make marriages more prolific, and to produce a healthier race of children. So strong is the objection to the marriage of blood relations, that a man and a woman of the same *sing* or family-name cannot lawfully wed. The proportion of unmarried to married people is exceedingly small. To promote marriages seems everybody's affair. Matches and betrothings naturally enough occupy the attention of the young, but not less that of the middle-aged and the old. A marriage is the great event in the life of a man or woman, and in China is associated with more of preliminary negotiations, ceremonials at different steps of the negotiations, written correspondence, visitings, protocols, and conventions, than in any other part of the world. (Sir John Bowring; Williams's *Middle Kingdom.*)

Classes of society.

The constituent parts of the population of China were anciently considered to consist of four classes: the *tsé*, or learned, who governed and instructed the rest; the *nung*, or agriculturists, who provided food and materials for clothing the rest; the *kung*, artizan or manufacturer, who clothed, and built, and furnished houses for the rest; and the *shang*, who distributed and exchanged the productions of the other two among all the classes of society. But nothing like a division into *castes* ever appeared in China. On the contrary, every encouragement is held out for the children of the three inferior classes to aspire to the first.

The numbers of the *tsé*, or officers and literary men, consisting of the members of the several boards, governors of provinces and cities, judges, treasurers, collectors, commissaries, inspectors, and the like, with an enormous list of subaltern officers and literati, cannot, according to Grozier, be estimated at less than 494,000.

The great mass of the people, however, are employed in productive labour; perhaps, on a rough estimate, full two thirds in agriculture and the fisheries; the remaining third, after deducting the military, the civil officers, the students, and candidates for office, amounting, perhaps, on a rough guess, to about ten millions, are manufacturers, tradesmen, shopkeepers, and the multitudes that are employed in the numerous vessels and barges on the rivers and canals, to carry on the internal commerce of the kingdom. Agriculture is the productive labour that has always received the highest encouragement from the government; and occasionally the emperor himself has turned out into the field with great pomp and solemnity, to hold the plough, as an example to the peasantry. Perhaps, however, as Pauw observes, if they would remove all the trammels from agriculture, it would have a better effect than the continuance of this ancient ceremony. These trammels are, however, fewer and lighter than in most countries. The amount of taxes paid to the state is very small; and the people have neither priesthood nor poor to maintain, each family being compelled by law and custom to take care of its poor relations, and the sovereign taking care of the spiritual concerns of his subjects. The monarch may be considered as the universal and exclusive proprietor of the soil. There is no such thing as freeholds; but undisturbed possession is kept, as long as the holder complies with the conditions on which the land was granted. As there are no public funds, and capital vested in trade is not very secure, nor the profession highly esteemed, the purchase of land is the most eligible mode of rendering capital productive. Still there are very few great landed proprietors. Two reasons may be assigned for this; first, the rate of legal interest being as high as three per cent. for a month, it would be ruinous to borrow money on mortgage; and, secondly, it appears by the penal code, that the proprietorship of the landholder is of a very qualified nature, and subject to a degree of interference and control on the part of government, not known under any of the European governments. It can only be disposed of by will, under certain restrictions; the inheritors must share it under certain proportions. If a proprietor should neglect to register his land in the public records, and to acknowledge himself as responsible for the payment of the taxes, such land would become forfeited. If land capable of cultivation be suffered to lie waste, through the inability of the proprietor to till it, another may obtain permission to cultivate it; and the mortgagee becomes responsible for the payment of the taxes, until the land be redeemed by the proprietor. All these restrictions operate against large landed proprietorships.

Much has been said in praise of Chinese agriculture—much more, in fact, than it deserves. In Europe it would be despised. There are no great farms in China; few families cultivate more than is necessary for their own use, and for payment of the imperial taxes; and without teams of any kind—without any knowledge or practice of a succession of crops—without any grazing farms, for feeding cattle or for the dairy, of which they are totally ignorant—making no use of milk, butter, or cheese—they can have little manure, nor can the land be kept in good condition. In fact, the old fallowing system is followed, and in many parts the spade and the hoe are the great implements of cultivation, their miserable plough scarcely deserving the name. The command of water is the principal substitute for manure. Every substance, however, that can be converted into manure, is most carefully collected; and numbers of old people and children of both sexes find employment in scraping together, with wooden rakes, into their little baskets, whatever may have fallen in the streets or roads, where these

> Lean pensioners upon the traveller's tract
> Pick up their nauseous dole.

Leaves, roots, or stems of plants, mud from the sides of canals, and every sort of offal that presents itself, of which human hair, shaven from the scalps of a hundred millions weekly, forms no inconsiderable ingredient, are carefully scraped together. Large earthen vessels are sunk in the ground, to which, it is said, their cattle are taught to retire; and on the outskirts of many towns and villages are small buildings, invitingly placed for the accommodation of passengers who may have occasion to use them. All these resources, however, are very limited, and the utmost supply thus afforded can only serve for horticultural purposes.

The whole of the land in China under cultivation may be said to be employed exclusively for the subsistence and clothing of man. The staff of life is rice; and it is the chief article of produce in the middle and southern provinces. This grain requires little or no manure; age after age the same piece of ground yields its annual crop, and some of them two crops a year. In the culture of rice, water answers every purpose; and nature has supplied this extensive country most abundantly with that valuable element. It is here that Chinese agricultural skill is most displayed; the contrivances for raising it out of rivers where the banks are high, by means of wheels, long levers, swinging buckets, and the like; or of leading it down from mountain springs, and along terraces levelled on the sides of hills, or in little channels across the plains, are all admirable; but when, from long drought, the rivers run low in their channels, and the springs fail, a scarcity of the crop is the inevitable consequence, and the effects of famine are most dreadful; for though the government has not been wanting in storing up a year's supply of grain in the public magazines (the produce of the taxes being mostly paid in kind), yet, before the beneficent intentions of the sovereign can be carried into effect, there are so many previous memorials and references necessary, and so many forms of office to pass through, that the mischief has worked its effects before the remedy is applied; and though in this vast empire the scarcity of grain may be local and partial, they have no relief to look to from without, and the system of external commerce is too slow in its operations to throw in a timely supply where it may be most wanted. In the northern provinces, where water is less abundant and less to be depended upon, wheat, barley, buck-wheat, and a great variety of millets, supply the place of rice. Everywhere are met with leguminous plants of different kinds, pumpkins, melons, sweet potatoes, and whole fields of a luxuriant vegetable called *pei-tsai*, the white herb, apparently a species of brassica, which is salted for winter consumption. In Kiang-nan and Tche-kiang, vast tracts of land are planted with the white mulberry tree, as food for the silk worms. They appear like a young orchard of cherry trees, being kept low by constant pruning, to make them throw out young shoots and fresh supplies of leaves. In all the middle provinces are large fields of cotton, which article supplies the usual clothing of the great mass of the population; in addition to which, immense quantities are imported annually from Bombay. That peculiar species of a yellowish tinge, which we call Nankin, is not worn by the Chinese, at least in its natural colour; blue, brown, and black, are the prevailing colours. Patches of indigo are generally found in the vicinity of the cotton plantations.

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The tea plant, which forms so important an article for the common beverage of the country, and also for exportation, is largely cultivated only in particular provinces, and in certain situations, but is also to be found in gardens and small inclosures in every part of the empire; and has very much of the habit and appearance of the broad-leafed myrtle. It was till recently generally believed that the different kinds of tea were collected from different species of plants. It has now, however, been satisfactorily ascertained that the difference between black and green tea is entirely owing to the mode of preparation. Both sorts undergo the process of *roasting* in their iron pans; the black in a higher degree of heat than the green, which is sufficient to give a different character to the extractive matter from the two sorts; and the nervous quality usually ascribed to green tea may be owing to the little alteration which the juices of the leaf undergo from the small degree of heat that is used in the process. To procure the fine flavour, the Chinese usually press the green teas into the chests and cannisters while hot. They have a practice also of giving a finer bloom to dull-green teas, by sprinkling a little indigo, mixed with powder of gypsum, while stirring the leaf about in the pan. The different sorts of black and green are not merely from soil, situation, and age of the leaf; but, after winnowing the tea, they are taken up in succession as the leaves fall: those nearest the machine, being the heaviest, form the gunpowder tea; the light dust the worst, being chiefly used by the lower classes. That which is brought down to Canton undergoes there a second roasting, winnowing, packing, &c.; and many hundred women are employed for these purposes, the rate of pay being about fifty of their small copper coins, or fourpence per day. The Chinese say that the best tea is that which is gathered in the morning while the dew is on. The gathering in the hyson countries, Kiang-nan and Fokien, commences about the middle of April, and continues till about the middle of May. The collecting, the rolling, the twisting, and roasting, give employment to a multitude of people. From the berry of the *tcha-wha*, or flower of tea (*Camelia sesanqua*), a fine edible oil is extracted. The almond and the *Palma Christi* also afford them an oil for culinary purposes. The white wax is the produce of a tree, or rather of a small insect which frequents the tree; and the *Croton sebiferum* yields an excellent vegetable tallow; both of these articles serving them to make candles. In the southern provinces sugar is a common article of cultivation, but it is rather a luxury than an article of common consumption. It is used mostly in a coarse granulated form; but for exportation, and for the upper classes, it is reduced to its crystallized state. Tobacco is universally cultivated, and in universal use by all ages and both sexes. Fruits of every kind abound, but are mostly bad, except the orange and the *lee-tchee*, both of which are probably indigenous. The art of grafting is well known; but they do not appear to have taken advantage of this knowledge to the improvement of their fruits. They have also an art, which enables them to take off bearing branches of fruit, particularly of the orange and peach, and transfer them, in a growing state, to pots, for their artificial rocks, and grottoes, and summer-houses. It is simply by removing a ring of the bark, plastering round it a ball of earth, and suspending a vessel of water to drop upon it, until it has thrown out roots into the earth. It would require too much space to describe the various vegetable productions used for food and for clothing, for medicine and for the arts. The climate and the soil are well adapted for producing almost all that the rest of the world affords, except, perhaps, those parts which lie within a few degrees of the equator; and the Chinese have obtained their full share even of them.

They are exceedingly sparing in the use of animal food. Those important articles of milk, butter, and cheese, are wholly unknown to them. The broad-tailed sheep are kept in the hilly parts of the country, and brought down to the plains; but the two animals most esteemed, because they contribute most to their own subsistence, and are kept at the cheapest rate, are the hog and the duck. Whole swarms of the latter are bred in large barges, surrounded with projecting stages, covered with coops, for the reception of these birds, which are taught, by the sound of a whistle, to jump into the rivers and canals in search of food, and by another call to return to their lodgings. They are usually hatched by placing their eggs, as the ancient Egyptians were wont to do, in small ovens, or sand-baths, in order that the same female may continue to lay eggs throughout the year, which would not be the case if she had a young brood to attend. The ducks, when killed, are usually split open, salted, and dried in the sun, in which state they afford an excellent relish to rice or other vegetables.

The fisheries are free to all; there are no restrictions on any of the great lakes, the rivers, or canals. The subject is not once mentioned in the *Leu-lee;* but the heavy duties on salt render the use of salt fish in China almost unknown. Besides the net, the line, and the spear, the Chinese have several ingenious methods of catching fish. In the middle parts of the empire, the fishing cormorant, the *Pelicanus piscator*, is almost universally in use; in other parts, they catch them by torch-light; and a very common practice is, to place a board painted white along the edge of the boat, which, reflecting the moon's rays into the water, induces the fish to spring towards it, supposing it to be a moving sheet of water, when they fall into the boat.

When animal food fails them, the Chinese make no scruple in eating lizards, toads, grubs, cats, rats, mice, and many other nauseous creatures. The naked Egyptian dog is commonly exposed for sale in the market. But rice, the hog, and the duck, may be considered as the staple articles of human subsistence for the great mass of the population. Those who can afford it indulge in every species of luxury, and more especially in gelatinous soups, which, while they pamper the appetite, are supposed to excite the passions, and to increase their corpulency, which, in their ideas, confers a degree of respectability and dignity to which a small meagre figure can never arrive

Commerce.

No country in the world is better adapted, from situation, climate, and products, for extensive commerce, than China; yet no civilized country has profited less by these advantages. The happy distribution of its numerous rivers, aided by artificial canals, affords an almost uninterrupted water communication from the northern to the southern, and from the western to the eastern extremities of this grand empire; and in this respect a facility is given for the interchange of the products of one province with those of another, such as is unequalled in any other country in the world. But the commerce that exists is principally that of barter; no system of credit is established between the merchants of distant provinces; no bills of exchange; no circulating medium of any kind, as a common measure of value, excepting a small copper coin, of the value of the thousandth part of 6s. 8d., or about one-third of a farthing. It is impossible to form an idea of the immense number of barges of every variety of form and size that swarm on all the rivers and canals of China. The Chinese themselves are probably not far amiss in stating that the number of imperial barges employed in the Grand Canal and its lateral branches, for the purpose of collecting and distributing among the public granaries the rice and grain paid in kind as taxes, amounts to 10,000, or, as they express it, where they mean to be correct, to 9999. A

China.

vast number of vessels are also employed in conveying the copper currency from place to place, wherever it may be wanted; others in collecting the silks, cottons, and various articles of taxes, paid in kind, and depositing them in the public magazines; and the salt barges alone are probably not less numerous than those which carry grain. It was calculated that the depôt of salt accumulated at Tien-sing for the use of the capital and the northern provinces, was sufficient for a year's consumption for thirty millions of people. This was all brought up, in the course of the summer, from the sea-coast of Tche-kiang and Fokien, in sea-going vessels. Cakes of coal-dust and turf for fuel, and cakes made up of various ingredients for garden manure, employ a multitude of barges; and when to these are added the various kinds of vessels employed in general commerce, in the conveyance of passengers and baggage, in breeding ducks, and in the fisheries of the interior, we may be sure that the number of persons who constantly reside upon the water amounts to many millions. It may be doubted if these are included in any census.

The Chinese government act upon the principle of systematically discouraging all foreign commerce. Satisfied, or affecting to be satisfied, with the prodigal bounty of nature, jealous of strangers, and governed by a gradation of arbitrary despots, the Chinese long considered it as a favour bestowed on foreigners to open any of their ports for the interchange of commodities. The extent, fertility, and variety of their soil and climate, happily situated between the extremes of heat and cold, partaking of the advantages of both, without experiencing the inconveniences of either, have left this great empire, as a nation, almost entirely independent of foreign supplies through the medium of commerce.

The foreign trade at present carried on with China is chiefly in the hands of the English and Americans. The great articles of export are tea and silk, with the former of which China supplies the whole world. The annual consumption of tea in England is estimated at about sixty millions of pounds; in the United States, twenty millions; in Holland, two millions; in Russia, five millions; in Germany, three millions; in Australia, four millions; in France and Spain, three millions. The amount consumed in China itself has been estimated at 700 millions of pounds. The contraband trade in opium is estimated to amount to upwards of 40,000 chests annually.

The Chinese appear to have no regular established system of credit among themselves, and the only circulating medium in the shape of coin is a small piece of base metal (copper, tin, or lead mixed), of the value of the one thousandth part of six shillings and eightpence, of little more intrinsic value, in fact, than a cowrie shell, which the Chinese, as well as the Hindus, would seem once to have used; as the same character in their language which signifies a *shell* signifies also money and wealth, and it enters into the composition of characters which represent *buying*, *selling*, *paying*, &c. Silver in small ingots is used in commerce, but they have no determinate value, the price fluctuating with the demand, as in other articles of commerce. The high rate of interest operates as a discouragement to mercantile speculations, and the rigour of corporal punishment is added with the view, as it would appear, of deterring the most hardy speculator. The law says, "whoever shall lend either money or goods, shall only receive three parts in the hundred per month," and that "how much soever may be suffered to accumulate, the capital shall remain the same." It is lent from month to month, and if the lender should complain of the interest not being punctually paid, the borrower is subject to the punishment of ten stripes of the bamboo the first month, twenty the second, and so on. The legal rate of interest, however, is seldom paid, and in large transactions among business men it is from 12 to 15 per cent. per annum. The borrower makes a special agreement with the lender for a rate of interest varying between these two sums.

General appearance of the country.

When a European first sets his foot in China, he will find the appearance of the country, the buildings, and the people, so totally different from any thing he had before seen, that he might fancy himself to be transported into a new world. In the long line of internal navigation between the capital and Canton, of 1200 miles, with but one short interruption, he will observe every variety of surface, but disposed in a very remarkable manner in great masses. For many days he will see nothing but one uniform extended plain, without the smallest variety; again, for as many days, he will be hemmed in between precipitous mountains of the same naked character, and as unvaried in their appearance as the plains; and, lastly, ten or twelve days sail among lakes, swamps, and morasses, will complete the catalogue of monotonous uniformity. But whether he crosses the dry plains of Petcheli and Shantung, abounding with cotton and all the varieties of grain and pulse,—the more varied surface of Kiang-nan, fertile in silk, in yellow cotton, in fruits, in the staple commodity of grain, and in every thing that constitutes the luxuries, the comforts, and the necessities of the people,—the dreary swamps, morasses, and extensive lakes of the northern part of Kiang-see, where men subsist by fishing,—or its naked and picturesque mountains to the southward, famous for its porcelain manufactories;—or whether he descend to the fertile plains of Quang-tung, on which almost all the vegetable products of the East may be said to be concentrated,—the grand characteristic feature is still the same, namely, a redundant population. Everywhere he meets with large masses of people, but mostly of one sex; thousands of men in a single group, without a single woman mixing among them—men whose long gowns and petticoats give them the appearance of the softer sex; whilst these are sparingly seen at a distance in the background, peeping over the mud-walls, or partially hid behind trees or bushes; and their short jackets and trowsers would make them pass for men among strangers, if their braided hair, stuck full of flowers, and their little cramped and bandaged feet, did not betray their sex. He will be pleased with the unequivocal marks of good humour which prevail in every crowd, uninterrupted and unconcerned by the bawling of some unhappy victim suffering under the lash of magisterial correction; and he will be amused at the awkward exertions of the softer sex to hobble out of sight when taken by surprise; but his slumbers will be interrupted on the nights of the full moon by the nocturnal orgies of squibs and crackers, gongs and trumpets, and other accompaniments of boisterous mirth.

A constant succession of large villages, towns, and cities, with high walls, lofty gates, and more lofty pagodas,—large navigable rivers, communicating by artificial canals, both crowded with barges for passengers and barks for burden, as different from each other, in every river and every canal, as they are all different from any thing of the kind in the rest of the world,—will present to the traveller an animated picture of activity, industry, and commerce. He will behold, in the lakes and morasses, every little islet crowned with villages and mud hovels. He will observe birds (the *leu-tse*, or cormorant) catching fish; and men in the water, with jars on their head, fishing for birds. He will see shoals of ducks issuing from floating habitations, obedient to the sound of a whistle; carts on the land, driven by the wind; and barges on the water, moving by wheels, like those which are now used in Europe for propelling the steam-boats. Among other strange objects, he will observe, at every ten or twelve

miles, small military guard-houses, with a few soldiers fantastically dressed in paper helmets and quilted petticoats, making use of the fan, if the weather be warm, and falling on their knees if an officer of rank should pass them. He will observe that the meanest hut, with walls of clay, and a roof of thatch, is built on the same plan, and of the same shape, with the palace of the viceroy, constructed of blue bricks, and its tiled roof supported on pillars. The use of glass, formerly unknown, is gradually extending throughout the empire, though in the meantime it is only to be found in the houses of the great. Glass windows are superceding the oiled paper, silk gauze, pearl shell, and horn, formerly in use.

Nothing, perhaps, will more forcibly arrest the attention of the traveller than the general nakedness of the country as to trees and hedge-rows, the latter of which have no existence, and the former exist only in clumps near the dwellings of the public officers, or the temples of Fo, or Tao-tse. No green meadows will meet his eye; no cattle enliven the scene; the only herbage is on the narrow ridges which divide the plots of grain or the brown fallow, as in the common fields of England. The terraced hills he will probably observe to be terminated with a clump of trees, or a pagoda, the only objects in the distance that catch the eye. But the bridges on the canals, of every variety of shape, circular, elliptical, horse-shoe, Gothic, slight and unstable as they are, are objects that, by their novelty and variety, must attract notice; and the monumental architecture, which adorns the cemeteries under every form, from the lowly tent-shaped dwelling to the loftiest column—the elevated terraces, supported by semicircular walls—and the round hillocks, which, in their graduated size, point out that of the father, the mother, and the children, according to seniority—are among the most interesting objects that China affords.

If he should happen to enter within the gates of one of their populous cities, as Canton, Pekin, Nankin, Sau-tcheou-foo, or Hong-tcheou-foo, he may fancy himself, from the low houses with curved overhanging roofs, uninterrupted by a single chimney, the pillars, poles, flags, and streamers, to have got into the midst of a large encampment. The glitter arising from the gilding, the varnishing, and the painting, in vivid colours, that adorn the fronts of the shops, and, in particular, the gaily painted lanterns of horn, muslin, silk, and paper; the busy multitude all in motion, and all of one sex; the painted and gilded inscriptions, that, in announcing the articles dealt in, assure the passengers that "they don't cheat here;" the confused noise of tinkers, cobblers, and blacksmiths, in their little portable workshops; the buying, selling, bartering, and bawling, of different wares; the processions of men carrying home their new-married wives, with a long train of presents, and squalling and noisy music, or carrying to the grave some deceased relation, with most lamentable howlings; the mirth and bursts of laughter occasioned by jugglers, conjurors, mountebanks, quack-doctors, musicians, and comedians—in the midst of all which is constantly heard a strange twanging noise from the barbers' tweezers, like the jarring sound of a cracked Jew's harp; the magistrates and officers, attended by their lictors, and a numerous retinue bearing flags, umbrellas, painted lanterns, and other strange insignia of their rank and office;—all these present to the eyes and ears of a stranger a novel and interesting spectacle. The noise and bustle of this busy multitude commence with day-light, and cease only with the setting of the sun; after which scarcely a whisper is heard, and the streets are entirely deserted.

Towards the central parts of China, near to the places where the two great rivers, the Whang-ho and the Yang-tse-kiang, intersect the grand canal, a scene, magnificent beyond description, will arrest the attention of the traveller. Here he will find himself in the midst of bustle and business. The multitudes of ships of war, of commerce, of convenience, and of pleasure, some gliding down the stream towards the sea, others working against it by sails, oars, or wheels, and others lying at anchor; the banks on either side, as well as those of the canals, covered with towns as far as the eye can reach; the continuance along the canals of cities, towns, and villages, almost without interruption; the vast number of light stone bridges, of one, two, and three arches; the temples occurring in frequent succession, with their double and triple tiers of roofs; the Pei-los, or triple gateways, in commemoration of some honest man or chaste virgin; the face of the surrounding country, beautifully diversified with hill and dale, and every part of it in the highest state of cultivation; the apparently happy condition of the numerous inhabitants, indicated by their cheerful looks and substantial clothing, chiefly in silk;—such are the scenes which presented themselves to our countrymen who composed the embassy of the Earl of Macartney, and were afterwards repeated to those who accompanied Lord Amherst.

He would probably be mistaken, however, in inferring the general happy state of the people, or beautiful appearance of the country, from what might occur along this great line of communication between the northern and southern extremities of the empire. The Dutch embassy setting out in winter, when the canals were frozen, proceeded by a different route, and the inconveniences they suffered, as described by Van Braam, are such as can scarcely be credited to have occurred in any nation removed but a few degrees from the savage state. The face of the country was dreary, without a visible trace of cultivation, or a hovel of any kind, for the space of eight or ten miles together. In many parts the surface was covered with water, and the mud hovels completely melted down. Very few cities, towns, or villages, occurred in their route, and those were almost universally in a ruinous condition. Near to the capital they passed a city exhibiting only a mass of ruins. It was not before they had crossed the Yellow River that the prints of wheel carriages marked out the road. The people everywhere appeared indigent and oppressed, equally destitute of the feelings of humanity and hospitality. The Dutch were carried in small bamboo chairs, each having four bearers, so weak and tottering that they could seldom go through the day's journey; and it frequently happened that they halted in the middle of a cold night, in an open uninhabited part of the country, exposed to all the inclemency of the weather, without a hovel of any kind to afford them shelter; and when they reached the end of the day's journey, the lodgings appropriated for their reception were so miserable, admitting on all sides the wind, rain, or snow, that they generally preferred taking a little rest in their bamboo chairs. They observed on the road old men and young women travelling in wheelbarrows, sometimes in litters or chairs carried by a couple of asses, one being fixed between the poles before and one behind. The rivers were without bridges, and crossed, when not fordable, by rafts of bamboo. All this is corroborated in the *Voyage à Peking*, by M. de Guignes; and hence it may be concluded that China, like other countries, has its fertile and its desolate districts, and that much information is yet required to form a competent notion of the real state and condition of this mighty empire. (Staunton's *Authentic Account;* Lord Macartney's *Journal;* Barrow's *Travels; Voyage à Peking;* Van Braam's *Journal; MS. Journal.*)

One thing at least is quite certain, that a traveller in the best and most frequented parts would look in vain for

China. Ornamental gardens.

the least trace of these enchanting gardens, of which Sir William Chambers and his friend Lepqua, the painter of Canton, aided by another brother of the brush, Frère Attiret, Jesuit and painter to the emperor of China, have put together so fanciful a description. Sir William saw, what Europeans generally see in Canton, the shops in China-street, the quay, on which the foreign factories are situated, and perhaps a small mean garden, at the head of the first reach of the river, to which strangers are permitted, as a great favour, to go and buy parcels of lettuce and turnip seeds, neatly packed up, and sold as rare and curious flowers; and the French Jesuit's taste and accuracy may be estimated from his own statement, that "the face of the country from Canton to Pekin is very indifferent; and though six or seven hundred leagues (it is four hundred) nothing occurs worthy of attention." He tells us, it is true, that he was shut up in a kind of close cage, which they laboured to persuade him was a litter, and that he arrived in Pekin without having seen any thing at all on the journey.

With the exception of the imperial gardens of Gehol and Yuen-min-yuen, there is not, perhaps, in all China a piece of ornamental ground of the extent of three acres; and a traveller may pass the whole distance in the open air, which Frère Attiret did in his cage, without seeing a single one of any extent. If he should chance to get a peep within the inclosing walls of those lodges set apart for the residence of the emperor when he travels, or of the habitation of some magistrate or wealthy merchant, he will probably find a square court of a rood or two of ground behind the women's apartments, concealed completely from public view, in which two or three little fish-ponds have their margins fantastically broken by shapeless masses of rock, or cut so as to resemble rugged mountains in miniature; among which, planted in concealed earthen vessels, are dwarfish trees, proportioned in size to the pigmy mountains, and bearing all the marks of venerable age; causing new roots to strike in old branches, twisting and bending them into particular forms and directions, wounding the stem, and smearing it with sugar, to attract the ant and other insects. Among these rocks are narrow paths almost impassable, with holes and crevices here and there to peep through, just to catch a glimpse of some piece of stagnant water, on the shore of which is a wooden temple, a bridge, a pavilion,—or perhaps to view a remarkable piece of rock. Within the water, if large enough, an island with its pagoda will probably be placed; or, as occupying less space, the imitation of a passage-boat stuck upon piles, and fitted up with appropriate apartments, kitchen, &c. In the recesses of the rocks are seats or small summer-houses, opposite to which are parterres of various flowers growing in sunken pots, which can thus be replaced by others in bloom, according to the season of the year; and where there is space, the peach, the orange, the lee-tchee, and other fruit trees, are introduced. From the boundary wall a roof is generally projected, supported on wooden pillars, which forms a covered gallery to walk in; gravel walks are out of the question, and would be wholly inconsistent with the feelings and usage of a nation, the women of which, for whose recreation these gardens are chiefly designed, cannot walk, and whose male population of the upper ranks are too indolent to walk. In short, where secrecy is so desirable, where enjoyments are stolen, and walking is considered as drudgery, seats and concealed recesses are best suited to the comfort and convenience of the people. If a Chinese acts on any principle, it is that of producing the greatest possible variety in the least possible space. He is indebted to nature for many of the most beautiful shrubs and flowers which she has bestowed on man for the gratification of the sense of sight or smell. Various species of camelia, pœonia, chrysanthemum, asters, roses, and a numerous list of the choicest flowers, gratify the eye; while the *Pergularia odoratissima*, the *Olea fragrans*, the *Petrosporum Chinense*, and the Arabian jessamine, spread their fragrance around. The sacred Nelumbium breaks the surface of the water with its peltate leaves and showy flowers, and the elegant bamboo and the water cyprus (*Cupressus pendula*), like the weeping willow, give concealment to their seats of retirement, whether for ease or sensuality.

China. General view of customs and character.

Throughout this extensive empire, embracing so great a variety of climate, the physical and moral characters of the people remain as fixed and unchangeable as the laws and customs, from which, in fact, they receive their colour. Such is the force of ancient usage, and the dread of innovation, that a Chinese never stops to inquire what he ought to do on any pressing emergency, but what Yao and Chun did in a similar case four thousand years ago. Time, in fact, may be said to stand still in China. Here not only the system of morals, of social intercourse, of jurisprudence, of government, is the same now as it was three thousand years ago, but the cut of their robes, their houses and furniture, are precisely the same; so that if custom has exercised its dominion over this singular people, they have at least been freed from the tyranny of fashion. Here a young lady may safely wear the head-dress of her great-grandmother, without the imputation of being singular or old fashioned. One of the missionaries observes, *Parcourez l'empire de la Chine, tout vous semblera fondée dans le même creuset, et façonné par le même moule.* No fault can be found with the metal or the mould in which it is cast. The general stature of the Chinese is about that which in Europe we call the middle size; few tall men are to be found among them, and fewer dwarfs or deformed persons; but they are distinguished by many physical peculiarities, as the narrow, elongated, half-closed eye, the linear and highly arched eye-brow; the broad root of the nose; the projection of the upper jaw a little beyond the lower; the thin straggling beard, and the body generally free from hair; a high conical head and triangular face: and these are the peculiar characteristics which obtained for them, in the *Systema Naturæ* of Linnæus, a place among the varieties of the species distinguished by the name of *homines monstrosi.*

Every individual, without exception, plaits his strong black hair into a long tail, something like the lash of a whip, extending below the waist, sometimes to the calf of the leg. This tail grows from the crown of the head, the rest of the scalp being closely shaven. The hair of the beard is pulled out till nearly the age of forty, when its growth is encouraged, and, being an indication of age, is considered as a mark of respect. The great mass of the people is decently and substantially clothed; the upper and middle classes in rich silks, satins, and fine cottons, the lower orders generally in cottons; but they are not cleanly in their persons, having, apparently, a particular aversion to cold water, which they never use in its pure state as a beverage, and always warm it for washing the hands and face, even in the middle of the dog-days; yet they use ice in the northern provinces for cooling their fruits.

The countenance of a Chinese man has something in it peculiarly pleasing and good humoured, which is just the reverse of that of the women, at least of those in the common rank of life, the only women who are seen in public. A Chinese is never out of humour except when disturbed at his meal; necessity only, not even his own self-interest, will prevail on him to leave his rice unfinished.

The common people seldom sit down to table, or, in fine weather, take their meals within doors; but each with

his bowl in his hand, squatting himself down on his haunches round the boiler, eats his frugal repast of rice or other vegetables, seasoned with a little pork or fish; or salted duck, with oil, fat, or a little soy, washing it down with weak tea, or warm rice beer, or *seau-tcheou*, a villanous ardent spirit. Rice is the staff of life in China, of which they eat largely, but in drinking they are extremely moderate. They are not nice in their choice of food,—dogs, cats, rats, and almost every animal, being eagerly sought after by the poorer class. In such a mass of population, many families must necessarily struggle with all the ills of extreme poverty; fewer, however, it would appear, in proportion to the population, than in most other countries; the small imposts on agricultural produce, the easy terms on which land is procured, the small divisions into which it is partitioned out, the multitude of large rivers, lakes, and canals abounding with fish, the freedom of the fisheries, and the extremely moderate rate at which the agricultural and labouring poor are taxed, are so many spurs to industry; and when a man through age or infirmity becomes incapable of labour, his relations are compelled to contribute to his support; a refusal would be an offence against parental affection, which is not in China a mere moral maxim, but carries with it the force of a positive law; poor-houses are consequently scarcely known, and beggars exist only in the persons of the priests of Fo and Tao-tse and other impostors, in the shape of astrologers and fortune-tellers. Old age is here highly respected, and the imperial family takes every occasion to set the example. On Yung-chin's marriage with a Tartar princess, she distributed a piece of cotton cloth and two measures of rice to every woman throughout the empire whose age exceeded 70 years. In the province of Shang-tung alone, whose population may at that time have amounted to 20,000,000, the list consisted of 98,222 above seventy, 40,893 above eighty, and 3453 above ninety.

In all ranks of life, but more especially among the magistrates and officers of government, vivacity and activity are less esteemed than sedateness and deliberation; gravity is considered as the test of wisdom, and silence of discretion. A magistrate should never attempt to joke, and should forbear to talk; he should resemble great bells, which seldom strike, and full vessels, which give little sound. He should never show his anger, as this would put the person who had offended him on his guard. A Chinese of education is a complete machine; he must act and speak, and walk abroad, dress, receive and return visits, according to rule, founded on ancient usage; the observance of which is a most important part of his duty. If two persons meet, they know from the button on the bonnet their respective ranks; and that alone determines what each has to do and to say. If two officers of equal rank pass each other, they fold their hands and salute each other till out of sight; if of different ranks, the chair or carriage of the inferior must stop, while that of the superior passes; and where the difference is very great, the inferior must alight. It is not, as in Europe, that one person may pass another with indifference, may take off his hat or keep it on, may give or refuse his hand, according to the humour in which he may happen to be; if one of the people should fail to pay the respect that is due to their superiors, a few strokes of the bamboo will bring him back to a sense of his duty. Where there is so much ceremony, there must be much hypocrisy and little cordiality.

When one officer pays a visit to another, a sheet of red paper, folded in a particular manner, bearing the name and quality of the visitor, is dispatched before him, that the person visited may know where to receive him, at the gate, in the first court, or in the inner apartment. The card is accompanied by a list of presents meant to be offered. If part be received, a letter of thanks, and a list of those returned, are sent back, with this observation in two characters, " They are pearls, I dare not touch them;" in allusion to the prohibition of pearls being worn by any except the imperial family, or those who have special leave. The visits of an inferior must always be made before the first meal, that the fumes of meat or wine may not offend the person visited. If he means to decline the visit, the bearer of the card is desired to say to his master, that he will not give him the trouble to alight from his chair; but if he does not return the visit in person, he sends his card within three days, and there the visiting acquaintance ends. Where a visitor is received, a prodigious deal of bowing and ceremony takes place. When once seated, to lounge on the chair, to lean back, to sit cross-legged, or to throw about the arms, or to look round, would be a gross breach of good manners. A cup of tea, sipped simultaneously, according to rule, finishes the formal visit.

These restraints of ceremony, imposed more or less on all conditions of men, are incompatible with frankness and sincerity, and beget that want of confidence between colleagues in office which is particularly observable in this jealous government, by the constant plotting against and undermining each other. The habitual gravity which a magistrate must put on in public stamps an air of importance on matters of the most trifling nature; though it is said they sometimes relax in private, where they indulge in all manner of excesses; and the stiff formality which strongly characterizes this people is said to give way, on such occasions, to conviviality; not, however, unless they are well acquainted with their guests. At such feasts women never appear, but are usually left to be amused by a set of players. To convince the guests how anxious the entertainer is to see them, the invitation is repeated three several times; the first on the preceding evening, the second on the morning of the day, and the third when dinner is ready for serving up, which is the latter of the two meals, and generally from four to six o'clock, according to the season of the year. The guests do not sit down at one table, but generally in pairs, at small square tables, every one of which is served precisely with the same kind of dishes, which are very numerous. Besides the ordinary quadrupeds, birds, and fishes, used as food, several gelatinous articles, as bears' paws, the hoofs of various animals, stags' sinews, sharks' fins, birds' nests, biche-de-mer, fucus or sea-weed, enrich their soups. With these and other substances, mixed with spices, and soys, and various herbs, they have an endless preparation of dishes, served up in small porcelain bowls, eaten with porcelain spoons, and two little ivory or ebony sticks, with which they take the pieces of meat or dry rice, and throw them into the mouth. Pastry and sweetmeats are served up at intervals; tea follows the dinner, after which comes the dessert. Those who, from illness or accident, send an excuse, have their portion of the dinner sent to their homes. Each guest, the next morning, sends a billet of thanks for the good fare he enjoyed the preceding evening.

Though there are tea-houses and cook-shops, to which tradesmen, artizans, and the peasantry, with the inferior officers of state and clerks of the departments, occasionally resort, to refresh themselves and to read the Pekin Gazette, there are no promiscuous assemblies or fixed meetings, as fairs for the lower classes, or routes, balls, or music parties for the higher ranks. Dancing is utterly unknown. The clumsy boots of one sex, and the crippled feet of the other, would be ill adapted for the amusement of dancing, even were the sexes permitted to mix together; but " tripping on the light fantastic toe" would not become that gravity which is so essential in the exterior

of Chinese good breeding. In the former Tartar dynasty, some Lamas from Thibet brought with them to court a set of dancing girls, whose lascivious movements gave great offence to the grave and virtuous Chinese, whose general conduct towards the women is nearly as bad as that which prevails among savage tribes. One may discover in their proverbs the feeling toward the sex. "A family," it is said, "in which there are five women, has nothing to fear from robbers; its poverty will protect it." Again, "When the hen crows in the morning, domestic affairs are not going on as they should be;" and, "What the women have lost in their feet, they have added to their tongues."

It is remarkable enough, that the accurate Marco Polo is wholly silent on the subject of the crippled feet of the Chinese women, which there can be no doubt were as common in his time as they are now. Of the origin of this unnatural custom the Chinese relate twenty different accounts, all equally absurd. Europeans suppose it to have originated in the jealousy of the men, determined, says Pauw, in his severe manner, to keep them "si étroit qu'on ne peut comparer l'exactitude avec laquelle on les gouverne." Whatever may have been the cause, the continuance may more easily be explained: as long as the men will marry none but such as have crippled feet, crippled feet must for ever remain in fashion among Chinese ladies. It is kept up by the pride of superiority and the dread of degradation, like the custom of widows burning themselves in India.

The little value set upon females leads but too frequently to that unnatural crime, female infanticide and exposure. There can be no question as to its existence; the extent of it, however, may have been exaggerated. In the Pekin Gazette of 1815 is a representation from a humane magistrate of Kiang-nan to the tribunal of justice in the capital, praying that the horrible practice of selling and putting away wives and drowning female infants may be prohibited: on which the emperor Kia-king sagaciously observes, that "the existence of male and female is essential to the continuance of the human species;" that "husband and wife form one of the five relationships in which human beings stand to each other;" that "divorce is not allowable except for one of the seven causes;" and concludes, "if it be true that it is a common practice among poor families to drown their female infants, and the husband and wife separate for every trifle, these are indeed wicked practices, which should be put a stop to by admonitory and prohibitory edicts." The magistrates of a district of Fokien sent a case to court on another occasion, to know how they should act. It was this: A man had made a vow that, if his wife recovered from a fit of sickness, he would make a sacrifice of his son, who was three years of age. The wife recovered, and he performed his vow. The supreme court decreed that, having violated the laws of nature, he had incurred the penalty of death; but, on a mistaken notion that, by the unnatural sacrifice, he had saved the life of his mother, the emperor mitigated the punishment to a hundred blows of the bamboo, and perpetual banishment.

This is but a miserable picture of the state of society in China. It is rendered still worse by the common practice of all oriental nations, which admits of a man taking as many wives as he can maintain. In China a second or inferior wife is taken without any ceremony, and generally purchased. The children by her are considered as the children of the first wife, and strictly legitimate; but the mother is without consideration in the eye of law, and may be disposed of in the same way as she was procured.

The athletic exercises of wrestling, boxing, fencing, the active amusements, such as cricket, golf, bowls, tennis, are wholly unknown; and the sports of the field, as hunting, shooting, angling, as pursuits of pleasure, cannot be conceived by them. The Tartars, however, are fond of hunting, of the pleasures of which the Chinese had so little idea, that Kien-lung, in his *Eloge de Moukden*, seems to think it necessary to acquaint them with the benefits arising from this diversion. Having described the pleasures and the dangers of the chase, "Thus," says he, "ends this delightful and highly useful exercise, which is at once propitious to heaven, to the earth, and to the army; to heaven by the offerings it affords in its honour; to the earth, which it relieves from the cruel and pernicious guests that prey upon it; and to the army, by accustoming them to the dangers and fatigues of war."

To appear with the head uncovered, and without boots, would be an act of rudeness not to be tolerated. To receive a present with one hand would be equally rude and disrespectful. To mention the word *death* would be an insufferable rudeness. When a person dies he is said to be gone to his ancestors. Many other peculiarities might be mentioned in which they differ from the rest of the world, and many in which they resemble the Turks in a very marked manner; but this is the less surprising, as the Turks are from the same Scythian stock.

Suicide is no crime with the Chinese. It is a favour to a condemned criminal to allow him to be his own executioner. Women and officers of the government are most addicted to the practice of suicide; the former perhaps from a sense of degradation, or in the gloom of solitude; the latter possibly to escape torture or disgrace when suspected of criminal conduct.

There are two favourable traits in the Chinese character which should not be overlooked,—the respect and veneration of children for their parents, and the almost universal sobriety that prevails in all ranks and conditions of men. A curious story is told by Le Gentil, which he had from Père Laureati, respecting the emperor Kaung-hee, who one day determined to experience the unknown pleasure of getting drunk. He chose his favourite minister as his bottle companion, who contrived to keep sober while his master was unable to stand. The minister apprized the chief eunuch of the emperor's situation, and hinted that, if they did not contrive to cure him of the practice, none of their lives would be safe for a moment. "You must therefore," he continues, "load me with chains, and throw me into a dungeon." Kaung-hee on waking inquired for his companion; the eunuch said that he was in confinement by his orders, for having incurred his displeasure. The emperor doubted his senses; but having ordered the minister to be brought before him, he was so shocked and provoked that he never afterwards ventured to repeat the experiment.

Like other nations, therefore, the Chinese character has its bright as well as its dark side; and if we find the latter to be the most prominent, it should be remembered that it is drawn chiefly by foreigners, and principally by those who have only visited the outports, and whose communication with the interior has been at such rare intervals, that little value is to be attached to their testimony. Here by all accounts they are so much given to knavery and cheating, that it is held to be no crime in the seller to cheat where the buyer is stupid enough to be cheated. Pauw observes that the shopkeepers would never have thought of writing upon their signs, "here nobody will be cheated," if they had not predetermined to cheat all the world; yet our own shopkeepers are not backward in announcing their "genuine" articles. It is to be feared, however, that the boasted morality of the Chinese is built on no principle of feeling or propriety of action between man and man; and that where public decorum is not offended there is no breach of moral duty. Great crimes

China.

are not common, but little vices pervade all ranks of society. A Chinese is cold, cunning, and distrustful; always ready to take advantage of those he has to deal with; extremely covetous and deceitful; quarrelsome, vindictive, but timid and dastardly. A Chinese in office is a strange compound of insolence and meanness. All ranks and conditions have a total disregard for truth; from the emperor downwards the most palpable falsehoods are proclaimed with unblushing effrontery, to answer a political, an interested, or an exculpatory purpose. The emperor asserted, and several great officers of state repeated the assertion to Lord Amherst, that they *saw* Lord Macartney go through the whole of their odious ceremony, and that he performed it to admiration.

These are among the dark shades of the Chinese character; opposed to which may be set his sober and industrious habits, submissive disposition, a mild and affable manner, an exactness and punctuality in all which he undertakes to perform; and if he has not been taught a general philanthropy, or if sentiments of love for the whole species have not been instilled into his mind, he has at least the merit of believing in the God of his fathers, in obeying the commands of his superior, and in honouring his father and mother. Under a better government the Chinese could not fail to become a better people; as it is, some favourable traits may be found, both in the habits of the people and the principles of the government. "Some very considerable and positive moral and political advantages," as Sir George Staunton observes, "are attributable to the system of early and universal marriage; to the sacred regard that is habitually paid to the ties of kindred; to the sobriety, industry, and even intelligence of the lower classes; to the almost total absence of feudal rights and privileges; to the equable distribution of landed property; to the natural incapacity and indisposition of the government and people to an indulgence in ambitious projects and foreign conquests; and, lastly, to a system of penal laws, if not the most just and equitable, at least the most comprehensive, uniform, and suited to the genius of the people for whom it is designed, perhaps of any that ever existed. (J. B—W.)

War with England.

After the discovery of the route to India by the Cape of Good Hope, the Portuguese, Spaniards, Dutch, and English, soon found their way to the coasts of China, and endeavoured to establish commercial relations with that important country. They were allowed for some time to carry on trade at Canton, Amoy, Ningpo, and other places; but, after the accession of the Manchu dynasty, in the middle of the seventeenth century, their privileges were gradually abridged, and at last they were confined to the port of Canton, which alone remained open to European trade. The intercourse of the English with China began considerably later than that of the other maritime nations of Europe. It became, however, far more important in its consequences, and their trade far greater in amount than that of all the other foreign nations together. The first English vessel reached Canton in 1637, and for nearly two centuries the trade was monopolized by the East India Company, and was managed at Canton by a select committee of their supercargoes. In 1833, an act of the British parliament was passed, depriving the company not only of their exclusive right of trading with China, but even of the right of trading with it at all, and authorizing the appointment of superintendents of the trade that should thereafter be carried on by British subjects in China. In terms of that act, the company's monopoly ceased in April 1834, and the select committee announced to the authorities at Canton that their ships would no longer come to China, and that a king's officer would be sent out to superintend the British trade. The only chief, however, that the Chinese expected, was a commercial headman, qualified to communicate with their officers by petition, and through the established medium of the hong-merchants. The new mode of conducting the trade of British vessels was regarded as a trifling matter, affecting only the "outside foreigners." As long as they should be humbly obedient to orders, and duly feel and acknowledge the emperor's kindness, the Chinese cared very little whom they might have for their chief, or what powers he should possess over his countrymen. The first chief commissioner or superintendent appointed by the crown was William John Lord Napier, a captain in the royal navy, who arrived at Macao 15th July 1834, and, in terms of his instructions, announced his arrival by letter to the viceroy. But every effort he made to obtain the recognition of his authority, and to establish a direct official connection with the Chinese rulers at Canton, completely failed; and, worn out with his exertions and disappointment, he died at Macao on the 11th of October following. During 1835 and 1836 matters went on very peaceably under the superintendence of the second and third commissioners, Mr Davis, and Sir G. Robinson; but Mr Davis having returned to England, and Sir G. Robinson having been superseded, Captain Elliot, R.N., became chief commissioner, and renewed the attempt to establish an official connection with the Chinese, but failed as completely as Lord Napier.

The opening of the trade in 1834 gave an immediate stimulus to all kinds of smuggling, and especially in the article of opium, the importation of which into China was prohibited by the imperial government. During the subsequent four years the supply of that drug became immensely increased, and the smuggling trade was extended beyond Canton, along the coasts of the northern provinces. The imperial government becoming seriously alarmed for the possible consequences, not so much for its demoralizing effects as for the continual drain of specie which it occasioned, determined to enforce with the utmost rigour the laws against it. In March 1839 a high imperial commissioner arrived at Canton, and issued an edict requiring that every chest of opium on the river should be delivered up, in order to be destroyed; and that bonds should be given by traders that their ships should never again bring any opium, on pain of forfeiture of the article, and death to the importer. Commissioner Lin having taken strong measures to carry his edict into effect, Captain Elliot proceeded to Canton, and issued a circular letter to his countrymen, requiring them to surrender into his hands all the opium then actually on the coast of China, and holding himself responsible for all consequences. On the 21st of May, the whole of the opium, to the amount of 20,283 chests, was given up to the Chinese government, and immediately destroyed. Even this sacrifice failed to produce the desired effect of leading to peaceful relations with China; for, on the 26th November, Lin issued an edict ordering the cessation of all trade with British ships after the sixth of December; and in January 1840, this was followed by an imperial edict, directing all trade with England to cease for ever.

To put an end to such an unsatisfactory state of things, the British government determined at last to send into the Chinese seas such an armament as should be sufficient to compel the imperial government to acknowledge the principles of international law (which the Chinese had probably never heard of). The first part of the armament reached the Canton river in June 1840, and established a rigorous blockade; but, without attempting further operations there, proceeded northwards, and on 5th July took possession of the large island of Chusan, in the Eastern sea. Captain Elliot proceeded still further north, and, at the mouth of the Peiho river, in the Yellow sea, had a conference with the imperial minister Ke-shen, which resulted in a truce. Ke-shen was appointed imperial commissioner to proceed to Canton for the purpose of investigating the grounds of complaint, and the British plenipotentiaries returned to meet him there.

On 20th January 1841, Captain Elliot issued a circular announcing that a treaty had been agreed to by Ke-shen, stipulating that the island of Hong-kong, situate at the mouth of the bay or gulf of Canton, should be ceded to England, instead of Chusan, which was to be restored to China; that the Chinese government should pay 6,000,000 of dollars as compensation to the English traders; that the trade should be resumed within ten days; and that there should be direct official communication between the two governments on equal terms. On the 26th of that month formal possession was taken of Hong-kong by the British authorities; but on 11th February an imperial edict arrived from Pekin, disapproving of the treaty, rejecting all the terms agreed to by Ke-shen, and degrading and superseding him. Hostilities were immediately resumed: on the 26th February the Bogue forts were taken by the British ships of war, with the loss to the Chinese of 459 guns, and their admiral Kwan, who was killed in the action. After various interruptions and temporary truces, the British forces at last advanced towards Canton; and having got possession of the heights behind the city, which now lay at their mercy, the authorities agreed to pay six millions of dollars for its ransom, and for a cessation of hostilities in that quarter. Five millions having been immediately paid, and security given for the remainder, the British troops were withdrawn, and the trade resumed.

On the 10th of August Sir Henry Pottinger arrived at Macao Roads as the sole commissioner and plenipotentiary of the British government; and on the 12th he sent a communication to the governor of Canton, assuring him that the existing truce would be observed as long as the Chinese should not arm their forts, or impede the regular trade, which had been re-established, or molest the merchants residing in the factories. The trade was carried on at Canton after this without any serious interruption during the remainder of the war.

The expedition proceeded northwards on the 21st; the military forces, numbering about 3500 men, under the command of Major-General Sir Hugh Gough, and the fleet, consisting of two 74-gun ships, seven other ships of war, and a number of transports and other vessels, under the command of Admiral Sir William Parker. Amoy was taken on the 27th, with 500 guns, and large quantities of arms and public stores. Ting-hai, the capital of Chusan, was taken, after a spirited defence, on 1st October, and possession taken again of the whole island. The fleet then proceeded to Chin-hai, which was taken, after a brave defence, on the 10th. On the 13th Ningpo was taken without resistance, and headquarters were established there for the winter. These successes threw the eastern parts of Chekiang open to the invaders, and so alarmed the court of Pekin that on 15th November they issued an edict urging the extermination of the English, and ordering vigorous preparations to be made for the defence of the country. In May 1842, Ningpo was evacuated, and the forces moved up to and took the city of Chapoo. On 13th June the fleet entered the great river Yang-tse. Woosung was taken on the 16th, Shang-hai on the 19th, and on the 18th of July the communication with the great canal was cut off, and all its openings into the river closed. On the 21st the city of Chin-keang was taken, after a gallant defence, and a frightful destruction of life on the part of the inhabitants. On the 9th of August the troops began to disembark at Nankin, and everything was ready for the assault of that city, when, on 12th August, Ke-ying arrived, as imperial commissioner, with full powers to treat of peace. A genuine statement of facts having been sent to the emperor, and the demands of the invaders made known, authority was given to the commissioner to conclude a treaty in accordance with them. On the 29th a treaty of peace was signed before Nankin, on board of the Cornwallis, by Sir Henry Pottinger on the part of Great Britain, and by Ke-ying, Elepoo, and Niu-kien, on the part of the Emperor of China. The most important provisions of the treaty were,—lasting peace and friendship between the two empires; China to pay twenty-one millions of dollars during that and the three succeeding years; the ports of Canton, Amoy, Fuhchau, Ningpo, and Shang-hai, to be thrown open to foreign trade; consular officers to be appointed by foreign powers to reside at these places; regular and just tariffs of import and export and inland transit dues to be established and published; the island of Hong-kong to be ceded in perpetuity to Her Britannic Majesty, her heirs, and successors; and correspondence to be conducted on terms of perfect equality between the officers of both governments. To this important treaty the emperor signified his assent on the 8th of September, and on the 31st of December it was ratified by the British government. In June 1843 the ratifications were exchanged at Hong-kong, which was then taken possession of by proclamation, and the functionaries of government appointed.

The announcement of the treaty of Nankin excited considerable sensation in Europe and America, chiefly in the commercial circles; and agents were sent to China from the governments of Belgium, Holland, Prussia, Spain, and Portugal, and most of them had interviews with Ke-ying at Canton before he returned to court. France and the United States of America sent ambassadors extraordinary to the court of Pekin, but neither of them went farther than Canton. Ke-ying having been re-appointed commissioner for the purpose, a treaty was signed between China and the United States, embodying all the important stipulations of the treaties and commercial regulations agreed to with England, and providing further for the erection of hospitals, chapels, and cemeteries at the five ports, for permission to ships of war to visit any part of the coasts of China; and for the extension of these privileges to all nations. The ratifications of this treaty were exchanged on 31st December 1845. The French ambassador having also arrived at Canton, and entered into negotiation with Ke-ying, a treaty was concluded between them at Whampoa on the basis of that of the United States.

Since then trade has been uninterruptedly carried on at the five ports, but principally at Canton and Shang-hai. The principal articles of export from China are tea and raw silk; and of these the following quantities have been exported during the ten years ending at 1st July 1853:—

		Lb. Tea.	Bales Raw Silk.
Year 1843–4	in 97 vessels	50,613,600	
.. 1844–5	... 105 ...	53,570,200	10,727
... 1845–6	... 117 ...	57,584,600	18,600
... 1846–7	... 106 ...	53,365,000	19,000
... 1847–8	... 92 ...	47,694,300	21,377
... 1848–9	... 86 ...	47,242,700	17,228
... 1849–50	... 98 ...	53,961,800	16,134
... 1851–2	... 115 ...	64,020,100	22,143
... 1852–3	... 113 ...	72,906,100	23,040

Great rebellion

Under the Ta-tsing or Manchu dynasty, who acquired possession of the empire in 1644, the Chinese appear to have rather declined than advanced in civilization, and the government has long been in a state of great and increasing weakness. The people ceased to respect laws that were openly contemned by public functionaries; piracy and smuggling became acknowledged trades; even robbery was winked at, the mandarins being quieted with a share of the plunder. Ever since the Manchu conquest a large national party has existed, who have been always anxious to restore a native dynasty. These patriots, being closely watched, formed themselves into secret societies. One of these, called the *Pe-lien-kiao*, or Worshippers of the Flower of the White Water-Lily, is said to have been organized like the Society of Jesus, from one of whose members, indeed, the

China.

plan is said to have been obtained. This society soon extended its branches into all the provinces, and its members were supposed to amount to several millions. In 1794 they made a vigorous effort to overthrow the Manchus, and the movement was not entirely suppressed till 1802. Occasional revolts have subsequently occurred; but the society conducted their operations so cautiously that all the efforts of the imperial ministers failed to discover their leaders. Through the influence of these societies, and as the natural consequence of misgovernment among a sober-minded practical people, a general dissatisfaction with their rulers and disgust towards the superstitions of their country were widely diffused, and only required occasion and opportunity for an outbreak.

The sixth emperor of the Ta-tsing dynasty, who had reigned for 29 years under the title of *Taou-kwang*, or the lustre (or brightness or splendour) of reason, died in February 1850, and was succeeded on the throne by his son Yih-choo, who assumed *Hien-fung*, or General Plenty, as the title of his reign. Taou-kwang had latterly become somewhat liberal in his views, and had shown considerable desire to ameliorate the social condition of his people, by favouring the introduction of the useful arts of Europe among them; but, on the accession of Hien-fung, a young, rash, sensual, and narrow-minded prince, his father's ministers were degraded, and mandarins of the old school, inimical to change, came again into power. Reactionary measures were adopted against all innovations, and against all foreign, and especially English influence; but their proceedings served only to awaken in the minds of the people a stern purpose of reform, which immediately showed itself in loud complaints against their rulers. In the following August (1850) a rebellion broke out in the south-western province of Quang-si, where it found a favourable element among the hardy and turbulent mountaineers who dwell on its northern frontier in a state of almost complete independence. Great uncertainty, however, still hangs over the manner of its origin and its immediate cause; and there is no evidence of its having been commenced or conducted at first on any preconcerted or well organized plan. Having overrun a large portion of Quang-si and Quang-tung, and established themselves there, the rebels, for the first time, announced to their fellow countrymen the purposes of their movement, which, they said, were simply to expel or extirpate the Tartars, and to transfer the administration of the public business and revenues into the hands of Chinese officers—not a hint being yet given of the restoration of a prince of the dynasty of Ming to the throne of his ancestors. That was announced for the first time about March 1851, and the name or title of *Tien-teh* (celestial virtue), which the pretender assumed, resounded throughout the empire. During a whole year the measures taken by the imperial government to quell the insurrection had utterly failed; the rebels had made a prosperous beginning, and beaten in detail the armies that had been sent against them; and then came the startling intelligence that the pretender to the empire was in their camp.

The insurrection gathered strength as it proceeded from province to province. Spreading from Quang-si it swept over Hou-quang, and reached the Yang-tse, where the insurgents divided; one body of them proceeding to the attack of the great cities of Han-yang and Wan-choo, while another advanced upon and took Nankin. This was soon followed by the fall of Chin-keang-foo, at the junction of the grand canal with the Yang-tse-kiang; and the possession of that important place rendered the insurgents masters not only of the navigation of the river, but also of the communications between the southern provinces and Pekin. Thence they spread along the sea-coast to the south, and northwards to the Yellow river; and according to the latest intelligence they have advanced to the neighbourhood of Pekin itself. The same spirit seems to actuate them everywhere; they rise only against the hated domination of the Tartars; while relentlessly sacking and destroying every building belonging to the government, and mercilessly slaughtering the Tartars that fall into their hands, they generally respect, and even protect, the persons and property of private individuals not belonging to the proscribed race.

The movement claims for itself the sanction, and even the commission, of Heaven, and has identified itself with the propagation of a new religion. Besides aiming at the overthrow and expulsion of the Tartars, the leaders of the insurrection have announced that they are divinely ordered to exterminate the false priests of Buddha and Taow, to destroy their idols, and to proclaim a loftier creed and a purer code of morals. They have not only announced the revival of the ancient religion of China, in the worship of the true spiritual God, *Shang-ti*, but have connected with it the doctrine of Jesus Christ, as the Saviour of the world. Great mystery has enveloped the real author of this religious scheme, and it was for some time believed that the three names or titles of Hung-sieu-tseuen, Tien-teh, and Tae-ping-wang, by which he was spoken of, represented three individuals. It now appears, however, that these names belong to one person only, the first being his proper name, and the other two, which mean celestial virtue, and the prince of peace, being his assumed titles. This personage is a native of Quang-si, and as it seems of obscure origin; but at the time of his examination for a literary degree at Canton, about 1835, he is said to have got from Leang-afa, a Chinese Christian, a certain tract called "Good words to Admonish the Age," the contents of which seem to have made a strong impression on his mind. Travelling from place to place, he composed books of poetry, and urged his countrymen to receive the new truth. About 1844 he is said to have visited Canton, and to have been for some months an inmate in the house of the missionary Roberts, where he had an opportunity of becoming acquainted with the history and doctrines of the Bible. His writings show that he has had copies of the Pentateuch at least and of the New Testament in his possession, and that he is well acquainted with their contents; but, notwithstanding his knowledge of Christian doctrine, it is said that his writings show very little evidence of these doctrines having taken hold upon his heart; and an eminent Chinese Christian goes the length of saying that there is nothing of Christ in his books. While, however, he manifests such a want of apprehension of the internal and spiritual working of the Christian faith, he exhibits no mean knowledge of the scope and design of Christianity; but that is so intermixed with error and false teaching, and there is said to be such evident tokens of design in his folly, and such a consummate plan in his errors, as to force the conviction on unbiassed minds that the whole of his teaching is a deep-laid plan to acquire power over the minds of his followers, and make them the fitter instruments of his purposes.

The leading object and purpose of his religious teaching seems indeed to be to impress upon the minds of his followers a strong conviction that he is aided and guided by the Almighty and all-knowing God; to inspire them with the certain hope of victory, and to animate their courage by the assurance of endless bliss to all who die in fighting for his cause, and of certain death and eternal destruction to all cowards and traitors. His assurances have been believed, and he has in consequence acquired unbounded control over the huge and heterogeneous masses that have been gathered to his standard. By all accounts they have implicit faith in his divine mission, and have no doubt of his success, and no fear of death. He has likewise announced that he is by divine appointment "monarch of all beneath the sky;" that, as the true lord of China, he is the lord of the whole world; that he is the brother of Jesus, and the

second son of God; and that all the people of the whole world must follow and obey him.

He seems, however, to be something better than a mere political adventurer, or ordinary impostor; he appears to be rather somewhat of a fanatic, a person possessed of a great and dominant idea; and, like some other celebrated persons of the same stamp, it may be that the strength of his own imaginings has led him at last to the sincere belief that he is acting under divine inspirations, which sanctify the use of falsehood and fraud and violence to secure success. It is pretended that an angel was sent by God to carry Sieu-tseuen to heaven, where he was instructed in heavenly things by God himself, furnished by Him with odes and compositions, as also with a seal and sword, and then commissioned, along with Jesus, his elder brother, and with the help of angels, to come down to earth and do battle with the devil and his imps; and that God still continues to favour him with revelations. His book also of celestial decrees contains an account of several appearances of Jesus, to attest the divine commission of Sieu-tseuen; he disclaims, however, certain titles of honour usually given by the Chinese to the emperor, on the ground that they belong only to God. He has published several books or pamphlets containing his doctrines and views, evidently drawn from or founded upon the Bible, and even expressed in scriptural language; and the latest accounts we have of his proceedings inform us of the publication of pure versions of the historical books of both the Old and New Testaments. In these publications he firmly asserts the being of one God, the creator of man, of spirits, and of all things; and hence the determination of his followers to abolish idolatry. He grounds this faith on the Old Testament, as well as on the most ancient books and customs of China. He proclaims the excellence and authority of the ten commandments, and adopts them as his moral law. He has also declared Jesus Christ to be the universal Saviour; has composed forms of prayer for the use of penitent sinners; has declared the existence of an evil spirit, whose power in temptation is to be constantly and perseveringly resisted. Many monstrous and grievous errors are, however, mixed up with these Christian doctrines. It appears that his followers make sacrifices or offerings of slaughtered animals, rice, and fruit, to God; and they still retain the national custom of polygamy, and reckless disregard for the sanctity of human life.

This great movement has been ascribed by some to the operations of the secret societies; while others trace it to the influence of the Christian missionaries that have been labouring for centuries among the Chinese. Christianity is no new thing in China. In the seventh and following centuries it was introduced and widely diffused by Nestorian missionaries, who are even said to have prepared that translation of the Scriptures into the Chinese language which has been made use of by Sieu-tseuen. Before the fifteenth century the Christianity so introduced had almost completely died out. In the sixteenth the Jesuits commenced their missionary labours in China; and the Romanists have been ever since perseveringly endeavouring to convert the natives; but hitherto, it appears, with very indifferent success, even though they have numbered their proselytes by hundreds of thousands.

They have introduced rites and ceremonies, and new objects of worship, in abundance; they have even martyrs and confessors to boast of, but they have never introduced a version of the Scriptures. Latterly, Protestant missionaries have been engaged in the work of Christianizing China; but neither of these rival parties seems entitled to claim the honour of originating the great movement that is now in progress. There is an absence of everything that would indicate Roman influence, and the Romanists themselves avow that they find no Catholic element in it. The adoption also of the word *Shang-ti* as the name of God, in opposition to *Tien-chu*, the word that was sanctioned by Pope Clement XI. in 1715, and the title of "worshippers of Jesus" given to the insurgents, are virtually a protest against Romanism, which has acquired, in popular language, the name of *Tien-chu-kiao*, or "the worship of the Lord of heaven." The whole spirit of the movement is alien to the genius of the Romish Church, and is characterized rather by reckless impetuosity than by tame subserviency, or the blind subjection of thought and action to the dictates of their leaders. The movement, however, neither seems to indicate very intimate connection with the doctrines preached by the Protestant missionaries, nor to be owing in any degree to their personal influence or exertions, as the published books of the insurgents are said to be absolutely free from any trace of the party spirit or symbolism and conventional language of any of the rival sectaries of Protestant Christendom.

CHINA-Ink, a pigment made of lamp-black and gelatine, or isinglass, well incorporated by levigation on a stone slab. It is usually perfumed slightly with musk or with camphor. The finest kind is said to be prepared in the East from the soot obtained by burning camphor. When prepared in the ordinary way, the addition of a minute quantity of alkali is an improvement, as it serves to saponify any oily matter, and thereby renders the pigment more readily miscible in water.

CHINA-Root, the root of a species of Smilax, once used in medicine, but now discarded from our pharmacopœias, being superseded by sarsaparilla. It comes from the West Indies as well as from China; but that from the latter is much superior to the other.

China-*Ware*. See Porcelain.

CHINCHILLA, a city of Spain, province of Murcia, picturesquely situated on an abrupt hill ten miles S.E. of Albacete. Pop. 7565. It is surrounded by old walls, defended by a citadel, and has manufactures of earthenware and coarse linen and woollen cloths.

Chinchilla, a small animal of the order *Rodentia*, from which a valuable fur is obtained. See index to Mammalia.

CHINGLEPUT, the chief town and fortress of a district of the same name, on the N.E. bank of the Palar river, 36 miles S.S.W. from Madras. In 1751 Chingleput was taken by the French, and retaken in 1752 by Clive. During the wars of the British with Hyder Ali, it was one of the few strongholds which withstood his power, and afforded a secure refuge to the natives. In 1780, after the defeat of Colonel Baillie, the army of Sir Hector Munro sought protection under its walls. It is now the residence of the British civil establishment, namely, the judge, collector, &c. The town is noted for its manufacture of pottery. Long. 80. 2.; Lat. 12. 41.

The district of Chingleput is bounded N. by Nellore; E. by the bay of Bengal; S. by South Arcot; and W. by North Arcot. Within its limits is situated the city of Madras. Area about 3000 square miles. Pop. 583,462. It was obtained from the nabob of Arcot in 1763; and the cession was confirmed by the emperor of Delhi in 1765.

CHIN-HAE, a district town of China, province of Chekiang, at the mouth of the Yung-kiang river, 12 miles N.E. of Ningpo, N. Lat. 25. 58., E. Long. 121. 35. It lies at the foot of a hill on a tongue of land, and is partly protected from the sea on the N. by a dike about 3 miles long, composed entirely of large blocks of hewn granite. The walls are 20 feet high and 3 miles in circumference, but suburbs extend along the shore for the convenience of the shipping. The defences consist of two batteries on the river side, and a well built citadel on a precipitous cliff, 250 feet high at the extremity of the tongue of land on which the town

is built. In the neighbourhood an engagement took place between the English and Chinese in October 1841.

CHIN-KIANG-FU, a maritime city of China, province of Kiang-su, at the junction of the Grand Canal with the Yang-tse-kiang, 48 miles E.N.E. of Nankin. This city was taken by the British after a desperate resistance on 21st July 1842.

CHINON, a town of France, capital of a cognominal arrondissement, department of Indre-et-Loire, pleasantly situated on the right bank of the Vienne, 28 miles S.W. of Tours. Pop. (1851) 6675. It has a tribunal of primary instance, a communal college, and some trade in grain, dried fruits, wine, brandy, &c. Here Henry II. of England died in 1189; and the ruins of the castle where Charles VII. of France resided after the occupation of Paris by the English, and where Joan of Arc presented herself to him, are still seen. Rabelais was born at a hamlet in the vicinity in 1483.

CHINSURA, a town situated in the western bank of the Bhagarutty or Hooghly river, 24 miles above Calcutta, and formerly the principal Dutch settlement in Bengal. It was among the cessions on the continent of India made by the king of the Netherlands in 1824 in exchange for the British possessions in the island of Sumatra. The Dutch erected a factory here in 1656, on a clear and healthy spot of ground, much preferable to that on which Calcutta is situated, and soon attracted a considerable number of natives to settle in the vicinity. About thirty-five years after this they fell under the displeasure of one of the native potentates, who sequestrated their property and prohibited their traffic. In 1686 all their factories were re-established, and their trade long continued to flourish. In 1759 a British force under Colonel Forde was attacked by the garrison of Chinsura on its march to Chandernagore. The action was short but decisive; for in less than half an hour the Dutch were entirely routed. In 1795, when Holland became a province of France, the British offered to retain Chinsura for the stadtholder; but the governor having declined to surrender, the settlement was reduced by a detachment from the military stations at Barrackpore, and was occupied by a British garrison during the whole war. At the general peace of 1814 it was restored to the Dutch. The town, which extends for half a mile along the banks of the river, is built neatly, and with great solidity, of brick and mortar. The houses are plastered with fine lime, and have flat roofs and green Venetian windows. Long. 88. 23. E., Lat. 22. 52. N.

CHIO, or CHIOS. See SCIO.

CHIOGGIA, a seaport-town of Northern Italy, government of Venice, and 15 miles S. of that city, situated on a cognominal island at the southern extremity of the lagoon of Venice. It consists of a long wide street extending the whole length of the island, with smaller streets branching off at right angles; and is connected with the mainland by a low stone bridge of 43 arches. It is the seat of a bishop, and has a theological seminary, several schools and charitable institutions, shipbuilding yards, and important salt-works. Pop. 25,000, principally engaged in the coasting trade, in fishing, and in piloting vessels into the harbour of Venice.

CHIONE, in *Grecian Mythology*, daughter of Dædalion, was beloved by Apollo and Mercury, by whom she became the mother of twins, Philammon and Autolycus. The first, being the son of Apollo, excelled as a musician; while Autolycus became no less famous for those robberies of which his father Mercury was supposed to be the patron. Chione was killed by Diana because she had the arrogance to compare her beauty with that of the goddess. Chione is also called Philonis. (Ov. *Met.* xi. 300; Hygin. Fab. 200.) There was also another Chione, daughter of Boreas and Orithyia. By Neptune she became the mother of Eumolpus, whom she threw into the sea; but Neptune saved the child.

CHIPPENHAM, a parliamentary and municipal borough and market-town of England, hundred of the same name, in Wiltshire, 30 miles N.N.W. of Salisbury, and 94 miles from London by the Great Western railway. It stands in a valley on the left bank of the Avon, which is here crossed by a handsome stone bridge of 22 arches. Chippenham is governed by a mayor, 4 aldermen, and 12 councillors, and returns 2 members to parliament. Pop. (1851) of parliamentary borough, 6283; of municipal borough, 1707. The town consists chiefly of one well-built street more than half a mile in length, and has a spacious Gothic church, town-hall, market-house, savings-bank, literary institution, free school, a silk factory, corn-mills, tanneries, and manufactures of woollens. Market-day Friday.

CHIPPEWAY INDIANS. See AMERICA, vol. ii., p. 680.

CHIPPING, CHIP, CHEAP, in the names of places, signify a market; from the Saxon *ceapan* or *cypan*, to buy or sell. Hence Chipping-Norton, Chippenham, Cheapside. The word *chapman* also is from the same root.

CHIPPING-NORTON, a municipal borough and market-town of England, hundred of Chadlington, county and 18 miles N.W. of Oxford. It is governed by a mayor, 4 aldermen, and 12 councillors; and returned 2 members to parliament in the 30th of Edward I., and the 32d and 33d of Edward III. It has a town-hall, 2 churches, 3 chapels, a free grammar-school, almshouses, and several charities. The parish church is a fine large Gothic edifice. Market-day Wednesday. Pop. (1851) 2932.

CHIPPING-SODBURY, a market-town, hundred of Grumbald's Ash, Gloucestershire, 27 miles S.S.W. from Gloucester, and near the Yate station of the Bristol and Gloucester railway. It contains one parish and various dissenting churches, with several schools and charitable institutions. The population is chiefly agricultural, the principal articles of trade being malt and cheese, for the sale of which there are monthly markets, and two annual fairs. Near the town are several quarries and coal-pits; and about two miles from it there are Roman remains. Pop. of parish (1851) 1195.

CHIQUITOS, a province of Bolivia, department of Santa Cruz. It is thinly inhabited, on account of the swamps which occupy a large portion of the interior, and render it both sterile and unhealthy. See BOLIVIA.

CHIROGRAPH (χείρ the hand, γράφω to write), an ancient kind of deed which, requiring a counterpart, was engrossed twice on the same piece of parchment counterwise, with a space between in which was written CHIROGRAPH, through which the parchment was cut, and one part given to each party. It answered to what is now called a *charter-party*. Chirographs were first used in England in the time of Henry III.

CHIROMANCY, a species of divination drawn from the lines of the hand, by which fortune-tellers pretend that the dispositions, &c., may be discovered.

CHIRON, a famous personage of antiquity, styled by Plutarch, in his dialogue on music, *the wise Centaur*. Sir Isaac Newton places his birth in the first age after Deucalion's deluge, commonly called the Golden Age; and adds, that he formed a scheme of the constellations for the use of the Argonauts when he was eighty-eight years of age, fixing with accuracy the solstitial and equinoctial points.[1] Chiron may, therefore, be said to have flourished in the earliest ages of Greece, as he preceded the Argonautic

[1] Sir Isaac Newton has founded his emendation of the ancient chronology on a calculation of the regular precession of the equinoxes from this period to the present, as well as on an estimate of the medium length of human generations. Tytler's *Elements of History*.

expedition and the Trojan war. He is generally called the son of Saturn and Philyra; and he is said to have been born in Thessaly among the Centaurs, the first Greeks who acquired the art of breaking and riding horses; from which circumstance the poets, painters, and sculptors have represented them as a compound of man and horse; and perhaps it was imagined by the Greeks, as well as the aboriginal Americans when they first saw cavalry, that the horse and the rider constituted but one animal.

Chiron was represented by the ancients as one of the first inventors of medicine, botany, and chirurgery; which last word some etymologists have derived from his name.* He inhabited a grotto or cave at the foot of Mount Pelion, which, from his wisdom and great knowledge of all kinds, became the most celebrated and frequented school throughout Greece. Almost all the heroes of his time were fond of receiving his instructions; and Xenophon, who enumerates them, names the following illustrious personages among his disciples: Cephalus, Æsculapius, Melanion, Nestor, Amphiaraus, Peleus, Telamon, Meleager, Theseus, Hippolytus, Palamedes, Ulysses, Mnestheus, Diomedes, Castor and Pollux, Machaon and Podalirius, Antilochus, Achilles, and Æneas. From this catalogue it appears that Chiron frequently instructed both fathers and sons; and Xenophon has recorded a short eulogium on each, which may be read in his works. The Greek historian, however, has omitted naming several of his scholars, such as Bacchus, Phœnix, Cocytus, Arystæus, Jason and his son Medeus, Ajax, and Protesilaus. It is pretended that the Grecian Bacchus was the favourite scholar of the Centaur; and that he taught this master the revels, orgies, bacchanalia, and other ceremonies of his worship. According to Plutarch, it was likewise at the school of Chiron that Hercules studied music, medicine, and justice; although Diodorus Siculus affirms that Linus was his instructor in this art. But of all the heroes who were desciples of the Centaur, none reflected so much honour upon him as Achilles, whose renown he in some measure shared, and to whose education he in a particular manner attended, being his grandfather by the mother's side. Apollodorus tells us, that music occupied a considerable part of the time which he devoted to the instruction of his young pupil, and that he viewed it as an incitement to virtuous actions, and a bridle to the impetuosity of his temper. One of the best remains of antique painting now extant is a picture on this subject, dug out of the ruins of Herculaneum, in which Chiron is represented in the act of teaching the young Achilles to play on the lyre. The death of this philosophical musician was occasioned, at an extreme old age, by an accidental wound in the knee with a poisoned arrow, aimed by his scholar Hercules at another person. After his death he was placed by Musæus among the constellations, from respect for his virtues, and in gratitude for the great services which he had rendered the people of Greece. Sir Isaac Newton says, in proof of the constellations being formed by Chiron and Musæus for the use and honour of the Argonauts, that nothing later than the expedition was delineated on the sphere; and according to the same author, Chiron lived till after the Argonautic expedition, in which he had two grandsons. The ancients have not failed to attribute to him several writings, among which, according to Suidas, are *precepts*, ὑποθῆκαι, in verse, composed for the use of Achilles; and a medicinal treatise on the diseases incident to horses and other quadrupeds; and the lexicographer even pretends that it is from this work that the Centaur derived his name. Fabricius gives a list of the works attributed to Chiron, and discusses the claims which have been set up for others to the same writings; at the same time giving him a distinguished place in his catalogue of ancient physicians.

CHIRONOMY, the science which treats of the rules of gesticulation, which is one part of pantomime. Among the ancients this formed part of a liberal education; and it received the approbation both of Socrates and Plato.

CHISEL (French *ciseau*), an instrument used in sculpture, masonry, joinery, carpentry, &c., for paring, hewing, or gouging.

CHISLEV, the name of the third month of the civil, and the ninth of the ecclesiastical year of the Jews, commencing with the new moon of our December.

CHISWICK, a village on the north bank of the Thames, Middlesex, 4½ miles from Hyde Park Corner, contains numerous fine villas, the principal of which is Chiswick House, the residence of the Duke of Devonshire. The parish church is ancient, and in the churchyard is the tomb of Hogarth. In the neighbourhood are the gardens of the Horticultural Society, and extensive market-gardens for the supply of the metropolis. Chiswick is a station of the loop line of the South-Western railway. Pop. of parish (1851) 6303.

CHITORE, or CHETORE, in Hindustan, a town with a fortress, and formerly the capital of the Rajpoot state of Odeypoor. It is situated on the top of a high and rugged mountain, and is considered a place of great strength. In 1303 it was taken by the Mohammedan emperor of Delhi, by whom, however, it was subsequently granted to the nephew of its former ruler, subject to the payment of tribute, and on condition of furnishing an armed feudal force of 5000 horse, and 10,000 foot. In 1533 it surrendered to Bahadur Shah, king of Guzerat, from whom it was shortly after wrested by Humayon, emperor of Delhi, who reinstated the Rajpoot prince. In 1567 it was taken by the armies of the emperor Acbar. The place was garrisoned by 8000 disciplined Rajpoots, who made an obstinate defence; and when driven to despair, sacrificed their women and children, and were trampled to death by the war elephants introduced into the place by the emperor. The fort appears to have been subsequently recovered by the chief of Odeypoor, and to have been recaptured by the Moguls in 1680 during the reign of Aurungzebe, when 63 Hindu temples were destroyed. On the dismemberment of the empire of Delhi, Chitore reverted to the Rajpoots. For a short period it was held by a rebel named Bheem Singh; but the insurgent chief being dispossessed by Scindia, the fortress in 1790 was restored to its lawful possessor the Rana of Odeypoor, under whose dominion it still remains. Distant from Neemuch N.W. 30 miles; from Agra S.W. 270. Lat. 24. 52., Long. 74. 41.

CHITTAGONG, a British district under the presidency of Bengal, bounded on the N. by the Hill state of Tipperah, on the E. by the Youmadoung mountains separating it from Burmah, on the S. by Arracan, and on the W. by the bay of Bengal. Its area, irrespective of the mountainous tract inhabited only by wild tribes, has been returned at 2717 square miles, supporting a population estimated at a million. Aurungzebe, emperor of Delhi, wrested this province from the rajah of Arracan towards the close of the seventeenth century, and annexed it to the imperial dominions. It formed one of the earlier acquisitions of the East India Company, having been ceded to them by the nawaub of Bengal in 1760. Its cession was insolently demanded by the king of Ava in 1824, previous to the breaking out of the first Burmese war, under the pretext that previous to its conquest by Aurungzebe it formed a dependency of Arracan, then a portion of the Burmese dominions. The district extends from Lat. 20. 45. to 23. 25.; and from Long. 91. 32. to 93.

CHITTLEDROOG, a town and celebrated fortress of Hindustan, and capital of a district belonging to the rajah of Mysore. The fort is situated on a rock which is surrounded by walls, and is considered as impregnable. Around it are low, rocky, bare hills. It was besieged without effect by Hyder Ali in 1776; but three years later the fortress

fell into the possession of that prince, who had bribed the Mohammedan part of the garrison. The fort was used by Tippoo Sultan as a state prison, in which, among many other captives, native and British, General Matthews was incarcerated in 1783 after the capitulation of Bednore. Distant from Seringapatam N. 128 miles. Lat. 14. 14.; Long. 76. 27.

CHITTOR, a town and fortress of Hindustan, situated among mountains, on the western frontier of the Carnatic, 80 miles W. from Madras. It was in 1721 the residence of the military commander of the district, Tahir Khan, and was well fortified. It was selected by the nawaub Anwarradden Khan as a place of refuge in times of danger. It was occupied by his younger son, with several females of the family, when it was assaulted and taken in 1780 by Hyder Ali. It was afterwards retaken by Sir Eyre Coote. In 1801 it was made over to the British; and the polygars, who were extremely turbulent and refractory, were reduced by a military force sent against them in 1804. Long. 79. 10. E.; Lat. 13. 12. N.

CHIUSA, or LA CHIUSA, a town on the Pesio, province of Coni, kingdom of Sardinia. It has a population of about 5600, chiefly engaged in the manufacture of silk and glass.

CHIVALRY.

THE primitive sense of this well-known word, derived from the French *chevalier*, signifies merely cavalry, or a body of soldiers serving on horseback, and has been used in that general acceptation by the best of our poets, ancient and modern, from Milton to Thomas Campbell.

But the present article respects the peculiar meaning given to the word in modern Europe, as applied to the order of knighthood, established in almost all her kingdoms during the middle ages, and the laws, rules, and customs, by which it was governed. These laws and customs have long been antiquated, but their effects may still be traced in European manners; and, excepting only the change which flowed from the introduction of the Christian religion, we know no cause which has produced such general and permanent difference betwixt the ancients and moderns as that which has arisen out of the institution of chivalry. In attempting to treat this curious and important subject, rather as philosophers than as antiquaries, we cannot, however, avoid going at some length into the history and origin of the institution.

Origin of the institution.

From the time that cavalry became used in war, the horseman who furnished and supported a charger rose, in all countries, into a person of superior importance to the mere foot soldier. The apparent difficulty of the art of training and managing in the field of battle an animal so spirited and active, gave the ἱππόδαμος, or *domitor equi*, in rude ages, a character of superior gallantry, while the necessary expense attending this mode of service attested his superior wealth. In various military nations, therefore, we find that horsemen were distinguished as an order in the state; and we need only appeal to the *equites* of ancient Rome as a body interposed betwixt the senate and the people; or to the laws of the conquerors of New Spain, which assigned a double portion of spoil to the soldier who fought on horseback, in support of a proposition in itself very obvious. But in the middle ages the distinction ascribed to soldiers serving on horseback assumed a very peculiar and imposing character. They were not merely respected on account of their wealth or military skill, but were bound together by an union of a very peculiar character, which monarchs were ambitious to share with the poorest of their subjects, and governed by laws directed to enhance into enthusiasm the military spirit, and the sense of personal honour associated with it. The aspirants to this dignity were not permitted to assume the sacred character of knighthood until after a long and severe probation, during which they practised, as acolytes, the virtues necessary to the order of chivalry. Knighthood was the goal to which the ambition of every noble youth turned; and to support its honours, which, in theory at least, could only be conferred on the gallant, the modest, and the virtuous, it was necessary he should spend a certain time in a subordinate situation, attendant upon some knight of eminence, observing the conduct of his master, as what in future must be the model of his own, and practising the virtues of humility, modesty, and temperance, until called upon to display those of a higher order.

The general practice of assigning some precise period when youths should be admitted into the society of the manhood of their tribe, and considered as entitled to use the privileges of that more mature class, is common to many primitive nations. The custom also of marking the transition from the one state to the other by some peculiar formality and personal ceremonial, seems so very natural, that it is quite unnecessary to multiply instances, or crowd our pages with the barbarous names of the nations by whom it has been adopted. In the general and abstract definition of chivalry, whether as comprising a body of men whose military service was on horseback, and who were invested with peculiar honours and privileges, or with reference to the mode and period in which these distinctions and privileges were conferred, there is nothing either original or exclusively proper to our Gothic ancestors. It was in the singular tenets of chivalry,—in the exalted, enthusiastic, and almost sanctimonious ideas connected with its duties,—in the singular balance which its institutions offered against the evils of the rude ages in which it arose,—that we are to seek those peculiarities which render it so worthy of attention.

The original institution of chivalry has often been traced to the custom of the German tribes recorded by Tacitus. "All business," says the historian, "whether public or private, is transacted by the citizens under arms; but it is not the custom that any one shall assume the military dress or weapons without the approbation of the state. For this purpose, one of the chief leaders, or the father or nearest relation of the youthful candidate, introduces him into the assembly, and confers on him publicly a buckler and javelin. These arms form the dress proper to manhood, and are the first honour conferred on youth. Before he receives them the young man is but a member of his own family, but after this ceremony he becomes a part of the state itself." (Taciti *Germania*.) The records of the northern nations, though we cannot rely upon their authenticity with the same unlimited confidence, because we conceive most of the legends relating to them have been written at a much later period than the times in which the scene is laid, may be referred to in confirmation of the Roman historians. The Scandinavian legends and *Sagas* are full of the deeds of those warriors whom they termed heroes or champions, and who appear to have been formed into an order somewhat resembling that of chivalry, and certainly followed the principal and most characteristic employment of its profession,—wandering from court to court and from shore to shore, bound on

high adventure, and seeking with equal readiness their fortunes in love and in war. It would not be difficult to deduce from this very early period some of those peculiar habits and customs, which, brought by the Gothic conquerors into the provinces of the divided empire of Rome, subsisted and became ingrafted upon the institutions of chivalry. Tacitus, for example, informs us, that among the Germans, and especially among the Catti, every youthful champion permitted his beard and hair to grow, and did not shave them until he had performed some signal feat of arms. In the like manner, as the general reader may have learned from that irrefragable authority, Don Quixote de la Mancha, a knight who received his order was obliged to wear white armour, and a shield without a device, until, by some daring and distinguished achievement, he had acquired title to an honourable badge of distinction. If this correspondence of customs shall be thought too far fetched and too general, the next, which we also derive from Tacitus, is too close to be disputed. The German warriors who piqued themselves upon this bravery, used, at the commencement of a war, to assume an iron ring, after the fashion of a shackle, upon their arm, which they did not remove until they had slain an enemy. The reader may be pleased to peruse the following instance of a similar custom from the French romance of *Jehan de Saintré*, written in the year 1459, and supposed to be founded, in a great measure, upon real incidents.[1] The hero, with nine companions at arms, four of whom were knights, and five squires, vowed to carry a helmet of a particular shape, that of the knights having a visor of gold, and that of the squires a visor of silver. Thus armed, they were to travel from court to court for the space of three years, defying the like number of knights and squires, wherever they came, to support the beauty of their mistresses with sword and lance. The emblems of their enterprise were chained to their left shoulders, nor could they be delivered of them until their vow was honourably accomplished. Their release took place at the court of the emperor of Germany, after a solemn tournament, and was celebrated with much triumph. In like manner, in the same romance, a Polish knight, called the Seigneur de Loiselench, is described as appearing at the court of Paris wearing a light gold chain attached to his wrist and ankle in token of a vow; which emblem of bondage he had sworn to wear for five years, until he should find some knight or squire without reproach, by encountering with whom he might be *delivered* (such was the phrase) of his vow and enterprise. Lord Herbert of Cherbury mentions, in his memoirs, that when he was made knight of the bath, a tassel of silken cordage was attached to the mantle of the order, which doubtless had originally the same signification as the shackle worn by the German champion. The rule was, however, so far relaxed, that the knot was unloosed so soon as a lady of rank gaged her word that the new knight of the bath would do honour to the order; and Lord Herbert, whose punctilious temper set great store by the niceties of chivalrous ceremony, fails not to record, with becoming gratitude, the name of the honourable dame who became his security on this important occasion.

Other instances might be pointed out, in which the ancient customs of the Gothic tribes may be traced in the history of chivalry; but the above are enough to prove that the seeds of that singular institution existed in the German forests, though they did not come to maturity until the destruction of the Roman empire, and the establishment of the modern states of Europe upon its ruins.

Having thus given a general view of the origin of chivalry, we will, I. Briefly notice the causes from which it drew its peculiar characters, and the circumstances in which it differs so widely from the martial character as it existed, either among the ancient Greeks and Romans, or in other countries and nations. II. We will attempt a general abstract of its institutions. III. The rise and progress of chivalry, its effects upon the political state of Europe, and its decay and extinction, will close the article.

I. Agreeably to this general division, the general nature and spirit of the institution of chivalry falls first under our consideration.

Peculiar nature and spirit of this institution.

In every age and country valour is held in esteem, and the more rude the period and the place, the greater respect is paid to boldness of enterprise and success in battle; but it was peculiar to the institution of chivalry to blend military valour with the strongest passions which actuate the human mind—the feelings of devotion and those of love. The Greeks and Romans fought for liberty or for conquest, and the knights of the middle ages for God and for their ladies. Loyalty to their sovereigns was a duty also incumbent upon these warriors; but although a powerful motive, and by which they often appear to have been strongly actuated, it entered less warmly into the composition of the chivalrous principle than the two preceding causes. Of patriotism, considered as a distinct predilection to the interests of one kingdom, we find comparatively few traces in the institutions of knighthood But the love of personal freedom, and the obligation to maintain and defend it in the persons of others as in their own, was a duty particularly incumbent on those who attained the honour of chivalry. Generosity, gallantry, and an unblemished reputation, were no less necessary ingredients in the character of a perfect knight. He was not called upon simply to practise these virtues when opportunity offered, but to be sedulous and unwearied in searching for the means of exercising them, and to push them without hesitation to the brink of extravagance, or even beyond it. Founded on principles so pure, the order of chivalry could not, in the abstract at least, but occasion a pleasing, though a romantic development of the energies of human nature; but as, in actual practice, every institution becomes deteriorated and degraded, we have too much occasion to remark, that the devotion of the knights often degenerated into superstition,—their love into licentiousness,—their spirit of loyalty or of freedom into tyranny and turmoil,—their generosity and gallantry into hairbrained madness and absurdity.

We have mentioned devotion as a principal feature in the character of chivalry. At what remote period the forms of chivalry were first blended with those of the Christian religion, would be a long and difficult inquiry. The religion which breathes nothing but love to our neighbour and forgiveness of injuries, was not, in its primitive purity, easily transferable into the warlike and military institutions of the Goths, the Franks, and the Saxons. At its first infusion, it appeared to soften the character of the people among whom it was introduced so much, as to ren-

[1] We may here observe, once for all, that we have no hesitation in quoting the romances of chivalry as good evidence of the laws and customs of knighthood. The authors, like the painters of the period, invented nothing, but, copying the manners of the age in which they lived, transferred them without doubt or scruple to the period and personages of whom they treated. But the romance of *Jehan de Saintré* is still more authentic evidence, as it is supposed to contain no small measure of fact, though disguised and distorted. Probably the achievement of the Polish knights may have been a real incident.

der them less warlike than their heathen neighbours. Thus the pagan Danes ravaged England when inhabited by the Christian Saxons,—the heathen Normans conquered Neustria from the Franks,—the converted Goths were subdued by the sword of the heathen Huns,—the Visigoths of Spain fell before the Saracens. But the tide soon turned. As the necessity of military talent and courage became evident, the Christian religion was used by its ministers (justly and wisely, so far as respected self-defence) as an additional spur to the temper of the valiant. Those books of the Old Testament which Ulphilas declined to translate, because they afforded too much fuel for the military zeal of the ancient Goths, were now commented upon to animate the sinking courage of their descendants. Victory and glory on earth, and a happy immortality after death, were promised to those champions who should distinguish themselves in battle against the infidels. And who shall blame the preachers who held such language, when it is remembered that the Saracens had at one time nearly possessed themselves of Aquitaine, and that, but for the successful valour of Charles Martel, Pepin, and Charlemagne, the crescent might have dispossessed the cross of the fairest portion of Europe. The fervent sentiments of devotion which direct men's eyes toward heaven, were then justly invoked, to unite with those which are most valuable on earth—the love of our country and its liberties.

But the Romish clergy, who have in all ages possessed the wisdom of serpents, if they sometimes have fallen short of the simplicity of doves, saw the advantage of converting this temporary zeal, which animated the warriors of their creed against the invading infidels, into a permanent union of principles, which should blend the ceremonies of religious worship with the military establishment of the ancient Goths and Germans. The admission of the noble youth to the practice of arms was no longer a mere military ceremony, where the sword or javelin was delivered to him in presence of the prince or elders of his tribe; it became a religious rite, sanctified by the forms of the church, which he was in future to defend. The novice had to watch his arms in a church or chapel, or at least on hallowed ground, the night before he had received the honour of knighthood. He was made to assume a white dress, in imitation of the Neophytes of the church. Fast and confession were added to vigils, and the purification of the bath was imposed on the military acolyte, in imitation of the initiatory rite of Christianity; and he was attended by godfathers, who became security for his performing his military vows, as sponsors had formerly appeared for him at baptism. In all points of ceremonial, the investiture of chivalry was brought to resemble, as nearly as possible, the administration of the sacraments of the church. The ceremony itself was performed, where circumstances would admit, in a church or cathedral; and the weapons with which the young warrior was invested were previously blessed by the priest. The oath of chivalry bound the knight to defend the rights of the holy church, to respect religious persons and institutions, and to obey the precepts of the gospel. Nay more, so intimate was the union betwixt chivalry and religion supposed to be, that the several gradations of the former were seriously considered as parallel to those of the church, and the knight was supposed to resemble the bishop in rank, duties, and privileges. At what period this complete infusion of religious ceremonial into an order purely military first commenced, and when it became complete and perfect, would be a curious but a difficult subject of investigation. Down to the reign of Charlemagne, and somewhat lower, the investiture was of a nature purely civil; but long before the time of the crusades, it had assumed the religious character we have described.

The effect which this union of religious and military zeal was like to produce in every other case save that of defensive war, could not but be unfavourable to the purity of the former. The knight, whose profession was war, being solemnly enlisted in the service of the gospel of peace, regarded infidels and heretics of every description as the enemies whom, as God's own soldier, he was called upon to attack and slay wherever he could meet with them, without demanding or waiting for any other cause of quarrel than the difference of religious faith. The duties of morality were indeed formally imposed on him by the oath of his order, as well as that of defending the church and extirpating heresy and misbelief. But in all ages it has been usual for men to compound with their consciences for breaches of the moral code of religion, by a double proportion of zeal for its abstract doctrines. In the middle ages, this course might be pursued on system; for the church allowed an exploit done on the infidels as a merit which might obliterate the guilt of the most atrocious crimes.

The genius alike of the age and of the order tended to render the zeal of the professors of chivalry fierce, burning, and intolerant. If an infidel, says a great authority, impugn the doctrines of the Christian faith before a churchman, he should reply to him by argument; but a knight should render no other reason to the infidel than six inches of his falchion thrust into his accursed bowels. Even courtesy, and the respect due to ladies of high degree, gave way when they chanced to be infidels. The renowned Sir Bevis of Hamptoun, being invited by the fair Princess Josiane to come to her bower, replies to the paymims who brought the message,

> I will ne gou one foot on ground
> For to speke with an heathen hound;
> Unchristen houndes, I rede ye flee,
> Or I your hearte's bloode will see.

This intemperate zeal for religion the knights were expected to maintain at every risk, however imminent. Like the early Christians, they were prohibited from acquiescing, even by silence, in the rites of idolatry, although death should be the consequence of their interrupting them. In the fine romance of *Huon of Bourdeaux*, that champion is represented as having failed in duty to God and his faith, because he had professed himself a Saracen, for the temporary purpose of obtaining entrance into the palace of the Amial Gaudifer. "And when Sir Huon passed the third gate, he remembered him of the lie he had spoken to obtain entrance into the first. Alas! said the knight, what but destruction can betide one who has so foully falsified and denied his faith towards him who has done so much for me!" His mode of repentance was truly chivalrous. When he came to the gate of the last interior inclosure of the castle, he said to the warder, "Pagan, accursed be thou of God, open the gate." When he entered the hall where the Pagan monarch was seated in full state, he struck off, without ceremony, the head of the Pagan lord who sat next in rank to him, exclaiming at the same time, with a loud voice, "God, thou hast given me grace well to commence my emprize; may our Redeemer grant me to bring it to an honourable conclusion." Many such passages might be quoted, to show the nature of the zeal which was supposed to actuate a Christian knight; but it is needless to ransack works of fiction for this purpose. The real history of the crusades, founded on the spirit of chivalry, and on the restless and intolerant zeal which was blended by the churchmen with this military establishment, are an authentic and fatal proof of the same facts. The hairbrained and adventurous character of these enterprises, not less than the promised pardons, indulgences,

and remissions of the church, rendered them dear to the warriors of the middle ages; the idea of re-establishing the Christian religion in the Holy Land, and wresting the tomb of Christ from the infidels, made kings, princes, and nobles, blind to its hazards; and they rushed, army after army, to Palestine, in the true spirit of chivalry, whose faithful professors felt themselves the rather called upon to undertake an adventure, from the peculiar dangers which surrounded it, and the numbers who had fallen in previous attempts.

It was after the conquest of the Holy Land that the union between temporal and spiritual chivalry (for such was the term sometimes given to monastic institutions) became perfect, by the institution of the two celebrated military orders of monks, the knights templars and knights of St John of Jerusalem, who, renouncing (at least in terms) the pomp, power, and pleasures of the world, and taking upon themselves the monastic vows of celibacy, purity, and obedience, did not cease to remain soldiers, and directed their whole energy against the Saracens. The history of these orders will be found in its proper place in this work; but their existence is here noticed, as illustrating our general proposition concerning the union of devotion and chivalry. A few general remarks will close this part of the subject.

The obvious danger of teaching a military body to consider themselves as missionaries of religion, and bound to spread its doctrines, is, that they are sure to employ in its service their swords and lances. The end is held to sanctify the means, and the slaughter of thousands of infidels is regarded as an indifferent, or rather as a meritorious action, providing it may occasion the conversion of the remnant, or the peopling of their land with professors of a purer faith. The wars of Charlemagne in Saxony, the massacres of the Albigenses in the south of France, the long-continued wars of Palestine, all served to illustrate the dangers resulting from the doctrine which inculcated religion, not as a check upon the horrors and crimes of war, but as itself its most proper and legitimate cause. The evil may be said to have survived the decay of chivalry, to have extended itself to the new world, and to have occasioned those horrors with which it was devastated for ages after its first discovery. The Spanish conquerors of South America were not, indeed, knights-errant; but the nature of their enterprises, as well as the mode in which they were conducted, partook deeply of the spirit of chivalry. In no country of Europe had this spirit sunk so deeply and spread so wide as in Spain. The extravagant positions respecting the point of honour, and the romantic summons which chivalry proclaimed to deeds of danger and glory, suited the ardent and somewhat oriental character of the Spaniards, a people more remarkable for force of imagination and depth of feeling than for wit and understanding. Chivalry, in Spain, was embittered by a double proportion of intolerant bigotry, owing to their constant and inveterate wars with the Moorish invaders. The strain of sentiment, therefore, which chivalry inspired, continued for a long time to mark the manners of Spain, after the decay of its positive institutions, as the beams of the sun tinge the horizon after the setting of his orb. The warriors whom she sent to the new world sought and found marvels which resembled those of romance; they achieved deeds of valour against such odds of numbers as are only recorded in the annals of knight-errantry; and, alas! they followed their prototypes in that indifference for human life, which is the usual companion of intolerant zeal. Avarice, indeed, brought her more sordid shades to complete the gloomy picture; and avarice was unknown to the institutions of chivalry. The intolerant zeal, however, which overthrew the altars of the Indians by violence, instead of assailing their errors by reason, and which imputed to them as crimes their ignorance of a religion which had never been preached to them, and their rejection of speculative doctrines of faith, propounded by persons whose practice was so ill calculated to recommend them,—all these may be traced to the spirit of chivalry, and the military devotion of its professors.

The religion of the knights, like that of the times, was debased by superstition. Each champion had his favourite saint, to whom he addressed himself upon special occasions of danger, and to whom, after the influence of his lady's eyes, he was wont to ascribe the honour of his conquests. St Michael, the leader of banded Seraphim, and the personal antagonist of Satan,—St George, St James, and St Martin, all of whom popular faith had invested with the honours of chivalry,—were frequently selected as the appropriate champions of the militant adventurers yet on earth. The knights used their names adjected to their own as their insignia, watchword, or signal for battle. Edward III. fighting valiantly in a night-skirmish before the gates of Calais, was heard to accompany each blow he struck with the invocation of his tutelar saints, Ha! Saint Edward! ha! Saint George! But the Virgin Mary, to whom their superstition ascribed the qualities of youth, beauty, and sweetness, which they prized in their terrestrial mistresses, was an especial object of the devotion of the followers of chivalry, as of all other good Catholics. Tournaments were undertaken, and feats of arms performed, in her honour, as in that of an earthly mistress; and the veneration with which she was regarded seems occasionally to have partaken of the character of romantic affection. She was often held to return this love by singular marks of her favour and protection. During an expedition of the Christians to the coast of Africa, Froissart informs us that a large black dog was frequently seen in their camp, which barked furiously whenever the infidels approached it by night, and rendered such service to the Christian adventurers by its vigilance, that with one consent they named it "the dog of our lady."

But although, as is incidental to human institutions, the mixture of devotion in the military character of the knight degenerated into brutal intolerance and superstition in its practical effects, nothing could be more beautiful and praiseworthy than the theory on which it was grounded. That the soldier drawing the sword in defence of his country and its liberties, or of the oppressed innocence of damsels, widows, and orphans, or in support of religious rights, for which those to whom they belonged were disqualified by their profession to combat in person,—that he should blend with all the feelings which these offices inspired, a deep sense of devotion, exalting him above the advantage and even the fame which he himself might derive from victory, and giving dignity to defeat itself, as a lesson of divine chastisement and humiliation,—that the knight on whose valour his countrymen were to rely in danger, should set them an example in observing the duties and precepts of religion,—are circumstances so well qualified to soften, to dignify, and to grace the profession of arms, that we cannot but regret their tendency to degenerate into a ferocious propensity to bigotry, persecution, and intolerance. Such, however, is the tendency of all human institutions, which, however fairly framed in theory, are in practice corrupted by our evil passions, until the results which flow from them become the very reverse of what was to have been expected and desired.

The next ingredient in the spirit of chivalry, second in force only to the religious zeal of its professors, and frequently predominating over it, was a devotion to the female sex, and particularly to her whom each knight selected as the chief object of his affection, of a nature so ex-

travagant and unbounded as to approach to a sort of idolatry.

The original source of this sentiment is to be found, like that of chivalry itself, in the customs and habits of the northern tribes, who possessed, even in their rudest state, so many honourable and manly distinctions over all the other nations in the same stage of society. The chaste and temperate habits of these youth, and the opinion that it was dishonourable to hold sexual intercourse until the twentieth year was attained, was in the highest degree favourable, not only to the morals and health of the ancient Germans, but must have contributed greatly to place the females in that dignified and respectable rank which they held in society. Nothing tends so much to blunt the feelings, to harden the heart, and to destroy the imagination, as the worship of the Vaga Venus in early youth. Wherever women have been considered as the early, willing, and accommodating slaves of the voluptuousness of the other sex, their character has become degraded, and they have sunk into domestic drudges and bondswomen among the poor,—the slaves of a haram among the more wealthy. On the other hand, the men, easily and early sated with indulgences, which soon lose their poignancy when the senses only are interested, become first indifferent, then harsh and brutal, to the unfortunate slaves of their pleasures. The sated lover,—and perhaps it is the most brutal part of humanity,—is soon converted into the capricious tyrant, like the successful seducer of the modern poet.

> Hard! with their fears and terrors to behold
> The cause of all, the faithless lover cold,
> Impatient grown at every wish denied,
> And barely civil, soothed and gratified.
>
> Crabbe's *Borough*, p. 213.

Habitual indulgence seeks change of objects to relieve satiety. Hence polygamy, and all its brutalizing consequences, which were happily unknown to our Gothic ancestors. The virtuous and manly restraints imposed on their youth were highly calculated to exalt the character of both sexes, and especially to raise the females in their own eyes and those of their lovers. They were led to regard themselves, not as the passive slaves of pleasure, but as the objects of a prolonged and respectful affection, which could only be finally gratified when their lovers had attained the age of mature reason, and were capable to govern and to defend the family which should arise around them. With the young man imagination and sentiment combined to heighten his ideas of a pleasure which nature instructed him to seek, and which the wise laws of his country prevented him from prematurely aspiring to share. To a youth so situated, the maiden on whom he placed his affections became an object of awe as well as of affection; the passion which he indulged for her was of a nature as timid and pure as engrossing and powerful; the minds of the parties became united before the joining of their hands, and a moral union preceded the mere intercourse of the sexes.

The marriages formed under these happy auspices were in general happy and affectionate. Adultery was unfrequent, and punished with the utmost rigour. Nor could she who had undergone the penalty of such a crime find a second husband, however distinguished by beauty, birth, or wealth. (Taciti *Germania.*) The awe and devotion with which the lover had regarded his destined bride during the years in which the German youth were enjoined celibacy, became regard and affection in the husband towards the sharer of his labours and the mistress of his household. The matron maintained that rank in society which love had assigned to the maiden. No one, then, says the Roman historian, dared to ridicule the sacred union of marriage, or to term an infringement of its laws a compliance with the manners of the age. The German wife, once married, seldom endeavoured to form a second union, but continued, in honoured widowhood, to direct and manage the family of her deceased husband. This habitual subjection of sensuality to sentiment, these plain, simple, virtuous, and temperate manners of the German females, placed the females in that high rank of society which the sex occupies when its conduct is estimable, and from which it as certainly declines in ages or climates prone to luxurious indulgence. The superintendence of the domestic affairs was assigned to the German women, a duty in which the men seldom interfered, unless when rendered by age or wounds incapable of warfare. They were capable of exercising the supreme authority in their tribe, and of holding the honours of the priesthood. But the influence of the women in a German tribe, as well as their duties in war, will be best understood from the words of Tacitus. "It is the principal incitement to the courage of the Germans, that in battle their separate troops or columns are not arranged promiscuously as chance directs, but consist each of a united family or clan with its relatives. Their dearest pledges are placed in the vicinity, whence may be heard the cries of their females, the wailings of their infants, whom each accounts the most sacred witnesses and the dearest eulogists of his valour. The wounded repair to their mothers and spouses, who hesitate not to number their wounds, and to suck the blood that flows from them. The females carry refreshment to those engaged in the contest, and encourage them by their exhortations. It is related that armies, when disordered and about to give way, have renewed the contest at the instance of the women, moved by the earnestness of their entreaties, their exposed bosoms, and the danger of approaching captivity; a doom which they dread more on account of their females than even on their own, insomuch that these German states are most effectually bound to obedience, among the number of whose hostages there are a number of noble damsels as well as men. They deem, indeed, that there resides in the female sex something sacred and capable of presaging the future; nor do they scorn their advice or neglect their responses. In the time of Vespasian we have seen Velleda long hold the rank of a deity in most of the German states; and, in former times, they venerated Aurinia and other females; not, however, from mere flattery, nor yet in the character of actual goddesses." The tales and *Sagas* of the north, in which females often act the most distinguished part, might also be quoted as proofs of the rank which they held in society. We find them separating the most desperate frays by their presence, their commands, or their mantles, which they threw over the levelled weapons of the combatants. Nor were their rights less extensive than their authority. In the *Eyrbiggia Saga* we are informed that Thordisa, the mother of the celebrated Pontiff Snorro, and wife of Biarko of Stelgafels, received a blow from her husband. The provocation was strong; for the matron had, in her husband's house and at his table, attempted to stab his guest Eyalf Graie, on account of his having slain one of her relations. Yet so little did this provocation justify the offence, that, in the presence of the comitia, or public assembly of the tribe, Thordisa invoked witnesses to bear testimony that she divorced her husband on account of his having raised his hand against her person. And such were the rights of a northern *mater-familias*, that the divorce and a division of goods immediately took place between the husband and wife, although the violence of which Thordisa complained was occasioned by her own attempt to murder a guest.

We have traced the ideas of the Gothic tribes on this

important point the more at length, because they show that the character of veneration, sanctity, and inviolability attached to the female character, together with the important part assigned to them in society, were brought with them from their native forests, and had existence long before the chivalrous institutions in which they made so remarkable a feature. They easily became amalgamated in a system so well fitted to adopt whatever was romantic and enthusiastic in manners or sentiment. Amid the various duties of knighthood, that of protecting the female sex, respecting their persons, and redressing their wrongs, becoming the champion of their cause, and the chastiser of those by whom they were injured, was presented as one of the principal objects of the institution. Their oath bound the new-made knights to defend the cause of all women without exception; and the most pressing way of conjuring them to grant a boon was to implore it in the name of God and the ladies. The cause of a distressed lady was, in many instances, preferable to that even of the country to which the knight belonged. Thus, the Captal de Buche, though an English subject, did not hesitate to unite his troops with those of the Compte de Foix, to relieve the ladies in a town where they were besieged and threatened with violence by the insurgent peasantry. The looks, the words, the sign of a lady, were accounted to make knights at time of need to perform double their usual deeds of strength and valour. At tournaments and in combats the voices of the ladies were heard, like those of the German females in former battles, calling on the knights to remember their fame, and exert themselves to the uttermost. "Think, gentle knights," was their cry, "upon the wool of your breasts, the nerve of your arms, the love you cherish in your hearts, and do valiantly, for ladies behold you." The corresponding shouts of the combatants were, "Love of ladies! Death of warriors! On, valiant knights, for you fight under fair eyes."

Where the honour or love of a lady was at stake, the fairest prize was held out to the victorious knight, and champions from every quarter were sure to hasten to combat in a cause so popular. Chaucer, when he describes the assembly of the knights who came with Arcita and Palemon to fight for the love of the fair Emilie, describes the manners of his age in the following lines:

> For every knight that loved chivalry,
> And would his thankes have a passant name,
> Hath pray'd that he might ben of that game,
> And well was him that thereto chusen was;
> For if there fell to-morrow such a case,
> Ye knowen well that every lusty knight
> That loveth par amour, and hath his might,
> Were it in Engellonde, or elleswhere,
> They wold hir thankes willen to be there.
> To fight for a lady! Ah! Benedicite,
> It were a lusty sight for to see.

It is needless to multiply quotations on a subject so trite and well known. The defence of the female sex in general, the regard due to their honour, the subservience paid to their commands, the reverend awe and courtesy which, in their presence, forbear all unseemly words and actions, were so blended with the institution of chivalry, as to form its very essence.

But it was not enough that the "very perfect, gentle knight," should reverence the fair sex in general. It was essential to his character that he should select, as his proper choice, "a lady and a love," to be the polar star of his thoughts, the mistress of his affections, and the directress of his actions. In her service, he was to observe the duties of loyalty, faith, secrecy, and reverence. Without such an empress of his heart, a knight, in the phrase of the times, was a ship without a rudder, a horse without a bridle, a sword without a hilt; a being, in short, devoid of that ruling guidance and intelligence, which ought to inspire his bravery and direct his actions.

The Dame des Belles Cousines, having cast her eyes upon the little Jean de Saintré, then a page of honour at court, demanded of him the name of his mistress and his love, on whom his affections were fixed. The poor boy, thus pressed, replied, that the first object of his love was the lady his mother, and the next his sister Jacqueline. "Jouvencel," replied the inquisitive lady, who had her own reasons for not being contented with this simple answer, "we do not now talk of the affection due to your mother and sister; I desire to know the name of the lady whom you love *par amours*."—"In faith, madam," said the poor page, to whom the mysteries of chivalry, as well as of love, were yet unknown, "I love no one *par amours*."—"Ah, false gentleman, and traitor to the laws of chivalry," returned the lady, "dare you say that you love no lady? well may we perceive your falsehood and craven spirit by such an avowal. Whence were derived the great valour and the high achievements of Lancelot of Gawain, of Tristrem, of Giron the Courteous, and of other heroes of the Round Table,—whence those of Panthus, and of so many other valiant knights and squires of this realm, whose names I could enumerate had I time,—whence the exaltation of many whom I myself have known to arise to high dignity and renown, except from their animating desire to maintain themselves in the grace and favour of their ladies, without which mainspring to exertion and valour they must have remained unknown and insignificant. And do you, coward page, now dare to aver that you have no lady, and desire to have none? Hence, false heart that thou art." To avoid these bitter reproaches, the simple page named as his lady and love *par amours* Matheline de Coucy, a child of ten years old. The answer of the Dame des Belles Cousines, after she had indulged in the mirth which his answer prompted, instructed him how to place his affections more advantageously; and as the former part of the quotation may show the reader how essential it was to the profession of chivalry, that every one of its professors should elect a lady of his affections, that which follows explains the principles on which his choice should be regulated. "Matheline," said the lady, "is indeed a pretty girl, and of high rank, and better lineage than appertains to you. But what good, what profit, what honour, what advantage, what comfort, what aid, what council for advancing you in the ranks of chivalry, can you derive from such a choice? Sir, you ought to choose a lady of high and noble blood, who has the talent and means to counsel and aid you at your need; and her you ought to serve so truly, and love so loyally, that she must be compelled to acknowledge the true and honourable affection which you bear to her. For believe there is no lady, however cruel and haughty, but through length of faithful service will be brought to acknowledge and reward loyal affection with some portion of pity, compassion, or mercy. In this manner you will attain the praise of a worthy knight; and till you follow such a course, I would not give an apple for you or your achievements." The lady then proceeds to lecture the acolyte of chivalry at considerable length on the seven mortal sins, and the way in which the true amorous knight may eschew commission of them. Still, however, the saving grace inculcated in her sermon was fidelity and secrecy in the service of the mistress whom he should love *par amours*. She proves, by the aid of quotations from the Scripture, the fathers of the church, and the ancient philosophers, that the true and faithful lover can never fall into the crimes of Pride, Anger, Envy, Sloth, or Gluttony. From each of these his true faith is held to warrant and defend him. Nay, so pure was the nature of the flame which she recommended, that she maintained it

to be inconsistent even with the seventh sin of Chambering and Wantonness, to which it might seem too nearly allied. The least dishonest thought or action was, according to her doctrine, sufficient to forfeit the chivalrous lover the favour of his lady.' It seems, however, that the greater part of her charge concerning incontinence is levelled against such as haunted the receptacles of open vice; and that she reserved an exception (of which, in the course of the history, she made liberal use) in favour of the intercourse which, in all love, honour, and secrecy, might take place when the favoured and faithful knight had obtained, by long service, the boon of amorous mercy from the lady whom he loved *par amours*. The last encouragement which the Dame des Belles Cousines held out to Saintré, in order to excite his ambition, and induce him to fix his passion upon a lady of elevated birth, rank, and sentiment, is also worthy of being quoted, since it shows that it was the prerogative of chivalry to abrogate the distinctions of rank, and elevate the hopes of the knight, whose sole patrimony was his arms and valour, to the high-born and princely dame, before whom he carved as a sewer.

"How is it possible for me," replied poor Saintré, after having heard out the unmercifully long lecture of the Dame des Belles Cousines, "to find a lady, such as you describe, who will accept of my service, and requite the affection of such a one as I am?"—"And why should you not find her?" answered the lady preceptress. "Are you not gently born? Are you not a fair and proper youth? Have you not eyes to look on her—ears to hear her—a tongue to plead your cause to her—hands to serve her—feet to move at her bidding—body and heart to accomplish loyally her commands? And, having all these, can you doubt to adventure yourself in the service of any lady whatsoever?"

In these extracts are painted the actual manners of the age of chivalry. The necessity of the perfect knight having a mistress, whom he loved *par amours*, the duty of dedicating his time to obey her commands, however capricious, and his strength to execute extravagant feats of valour, which might redound to her praise,—for all that was done for her sake, and under her auspices, was counted her merit, as the victories of their generals were ascribed to the Roman emperors,—was not a whit less necessary to complete the character of a good knight than the Dame des Belles Cousines represented it.

It was the especial pride of each distinguished champion, to maintain against all others the superior worth, beauty, and accomplishments of his lady; to bear her picture from court to court, and support with lance and sword her superiority to all other dames, abroad or at home. To break a spear for the love of their ladies, was a challenge courteously given, and gently accepted, among all true followers of chivalry; and history and romance are alike filled with the tilts and tournaments which took place upon this argument, which was ever ready and ever acceptable. Indeed, whatever the subject of the tournament had been, the lists were never closed until a solemn course had been made in honour of the ladies.

There were knights yet more adventurous, who sought to distinguish themselves by singular and uncommon feats of arms in honour of their mistresses, and such was usually the cause of the whimsical and extravagant vows of arms which we have subsequently to notice. To combat against extravagant odds, to fight amid the press of armed knights without some essential part of their armour, to do some deed of audacious valour in face of friend and foe, were the services by which the knights strove to recommend themselves, or which their mistresses (very justly so called) imposed on them as proofs of their affection.

On such occasions the favoured knight, as he wore the colours and badge of the lady of his affections, usually exerted his ingenuity in inventing some device or cognisance which might express their affection, either openly, as boasting of it in the eye of the world, or in such mysterious mode of education as should only be understood by the beloved person, if circumstances did not permit an avowal of his passion. Among the earliest instances of the use of the English language at the court of the Norman monarchs, is the distich painted in the shield of Edward III. under the figure of a white swan, being the device which that warlike monarch wore at a tourney at Windsor.

Ha! ha! the white swan,
By God his soul, I am thy man.

The choice of these devices was a very serious matter; and the usurpation of such as any knight had previously used and adopted was often the foundation of a regular quarrel, of which many instances occur in Froissart and other writers.

The ladies, bound as they were in honour to requite the passion of their knights, were wont on such occasions to dignify them by the present of a scarf, ribbon, or glove, which was to be worn in the press of battle and tournament. These marks of favour they displayed on their helmets, and they were accounted the best incentives to deeds of valour. The custom appears to have prevailed in France to a late period, though polluted with the grossness so often mixed with the affected refinement and gallantry of that nation. In the attack made by the Duke of Buckingham upon the Isle of Rhé, favours were found on the persons of many of the French soldiers who fell at the skirmish on the landing; but for the manner in which they were disposed we are compelled to refer to Howel and Wilson.

Sometimes the ladies, in conferring these tokens of their favour, clogged them with the most extravagant and severe conditions. But the lover had this advantage in such cases, that if he ventured to encounter the hazard imposed, and chanced to survive it, he had, according to the fashion of the age, the right of exacting from the lady favours corresponding in importance. The annals of chivalry abound with stories of cruel and cold fair ones who subjected their lovers to extremes of danger, in hopes that they might get rid of their addresses, but were, upon their unexpected success, caught in their own snare, and, as ladies who would not have their name made the theme of reproach by every minstrel, compelled to recompense the deeds which their champion had achieved in their name. There are instances in which the lover used his right of reprisals with some rigour, as in the well-known *fabliau* of the three knights and the shift, in which a lady proposes to her three lovers successively the task of entering unarmed into the melée of a tournament, arrayed only in one of her shifts. The perilous proposal is declined by two of the knights, and accepted by the third, who thrusts himself, in the unprotected state required, into all the hazards of the tournament, sustains many wounds, and carries off the prize of the day. On the next day the husband of the lady (for she was married) was to give a superb banquet to the knights and nobles who had attended the tourney. The wounded victor sends the shift back to its owner, with his request that she would wear it over her rich dress on this solemn occasion, soiled and torn as it was, and stained all over with the blood of its late wearer. The lady did not hesitate to comply, declaring that she regarded this shift, stained with the blood of her "fair friend, as more precious than if it were of the most costly materials." Jaques de Basin, the minstrel,

who relates this curious tale, is at a loss to say whether the palm of true love should be given to the knight or to the lady on this remarkable occasion. The husband, he assures us, had the good sense to seem to perceive nothing uncommon in the singular vestment with which his lady was attired, and the rest of the good company highly admired her courageous requital of the knight's gallantry.

Sometimes the patience of the lover was worn out by the cold-hearted vanity which thrust him on such perilous enterprises. At the court of one of the German emperors, while some ladies and gallants of the court were looking into a den where two lions were confined, one of them purposely let her glove fall within the palisade which inclosed the animals, and commanded her lover, as a true knight, to fetch it out to her. He did not hesitate to obey; jumped over the inclosure; threw his mantle towards the animals as they sprung at him; snatched up the glove, and regained the outside of the palisade. But when in safety, he proclaimed aloud, that what he had achieved was done for the sake of his own reputation, and not for that of a false lady, who could for her sport and cold-blooded vanity face a brave man on a duel so desperate; and, with the applause of all that were present, he renounced her love for ever.

This, however, was an uncommon circumstance. In general, the lady was supposed to have her lover's character as much at heart as her own, and to mean, by pushing him upon enterprises of hazard, only to give him an opportunity of meriting her good graces, which she could not with honour confer upon one undistinguished by deeds of chivalry. An affecting instance is given by Godscroft.

At the time when the Scotch were struggling to recover from the usurpation of Edward I., the castle of Douglas was repeatedly garrisoned by the English, and these garrisons were as frequently surprised and cut to pieces by the good Lord James of Douglas, who, lying in the mountainous wilds of Cairntable, and favoured by the intelligence which he maintained among his vassals, took opportunity of the slightest relaxation of vigilance to surprise the fortress. At length a fair dame of England announced to the numerous suitors who sought her hand, that she would confer it on the man who should keep the perilous castle of Douglas (so it was called) for a year and a day. The knight who undertook this dangerous task at her request discharged his duty like a careful soldier for several months, and the lady relenting at the prospect of his continued absence, sent a letter to recal him, declaring she held his probation as accomplished. In the meantime, however, he had received a defiance from Douglas, threatening him, that, let him use his utmost vigilance, he would recover from him his father's castle before Palm-Sunday. The English knight deemed that he could not in honour leave the castle till this day was past; and on the very eve of Palm-Sunday was surprised and slain with the lady's letter in his pocket, the perusal whereof greatly grieved the good Lord James of Douglas.

We are left much to our own conjectures on the appearance and manners of these haughty beauties, who were wooed with sword and lance, whose favours were bought at the expense of such dear and desperate perils, and who were worshipped, like heathen deities, with human sacrifices. The character of the ladies of the ages of chivalry was probably determined by that of the men, to whom it sometimes approached. Most of these heroines were educated to understand the treatment of wounds, not only of the heart, but of the sword; and, in romance at least, the quality of leech-craft (practised by the Lady Bountifuls of the last generation) was essential to the character of an accomplished princess. They sometimes trespassed on the province of their lovers, and actually took up arms. The Countess de Montfort in Bretagne is celebrated by Froissart for the gallantry with which she defended her castle when besieged by the English; and the old prior of Lochleven in Scotland is equally diffuse in the praise of Black Agnes, countess of March, who, in the reign of Edward III. held out the castle of Dunbar against the English. She appeared on the battlements with a white handkerchief in her hands, and wiped the walls in derision where they had been struck by stones from the English engines. When Montague, earl of Salisbury, brought up to the walls a military engine, like the Roman *estudo*, called a sow, she exclaimed in rhime,

Beware Montagou,
For farrow shall thy sow.

A huge rock discharged from the battlements dashed the sow to pieces, and the English soldiers who escaped from its ruins were called by the countess, in derision, Montague's pigs.

The nature of the conferences between these high-minded heroines and their lovers was somewhat peculiar. Their delectations were in tales of warlike exploits, and in discourse of hunting and hawking. But when these topics were exhausted, they found in metaphysical discussions of nice questions concerning the passion of love, an endless source of interesting disquisition. The idea and definition of a true and pure passion, illustrated by an hundred imaginary cases devised on purpose, were managed in the same manner in which the schoolmen of the day agitated their points of metaphysical theology. The Scotists and the Thomists, whose useless and nonsensical debates cumbered the world with so many volumes of absurd disquisition upon the most extravagant points of polemical divinity, saw their theological labours rivalled in the courts of love, where the most abstract reasoning was employed in discussing subtile questions upon the exaggerated hopes, fears, doubts, and suspicions of lovers, the circumstances of whose supposed cases were often ridiculous, sometimes criminal, sometimes licentious, and almost always puerile and extravagant. These particulars will fall to be more fully illustrated under the article Troubadour. In the meanwhile, it is sufficient to state, that the discussions in the courts of love regarded such important and interesting questions as, Whether his love be most meritorious who has formed his passion entirely on hearing, or his who has actually seen his mistress? with others of a tendency equally edifying.

Extremes of every kind border on each other; and as the devotion of the knights of chivalry degenerated into superstition, the Platonic refinements and subtilties of amorous passion which they professed were sometimes compatible with very coarse and gross debauchery. We have seen that they derived from the Gothic tribes that high and reverential devotion to the female sex which forms the strongest tint in the manners of chivalry. But with the simplicity of these ancient times they lost their innocence; and woman, though still worshipped with enthusiasm, as in the German forests, did not continue to be (in all cases at least) the same pure object of worship. The marriage-tie ceased to be respected; and as the youthful knights had seldom the means or inclination to encumber themselves with wives and families, their lady-love was often chosen among the married ladies of the court. It is true, that such a connection was supposed to be consistent with all respect and honour, and was regarded by the world, and sometimes by the husband, as a high strain of Platonic sentiment, through which the character of its object in no respect suffered. But nature vindicated herself for the violence offered to her; and while the metaphysical students and pleaders in the courts of love professed to aspire but to the lip or hand of their ladies,

and to make a merit of renouncing all farther intrusion on their bounties, they privately indulged themselves in loves which had very little either of delicacy or sentiment. In the romance of the *Petit Jehan de Saintré*, that self-same Lady des Belles Cousines, who lectures so learnedly upon the seven mortal sins, not only confers on her deserving lover "le don d'amoureux merci," but enters into a very unworthy and disgraceful intrigue with a stout broad-shouldered abbot, into which no sentiment whatever can be supposed to enter. The romance of *Tirante the White*, praised by Cervantes as a faithful picture of the knights and ladies of his age, seems to have been written in an actual brothel, and, contrasted with others, may lead us to suspect that their purity is that of romance, its profligacy that of reality. This license was greatly increased by the crusades, from which the survivors of these wild expeditions brought back the corrupted morals of the East, to avenge the injuries they had inflicted on its inhabitants. Joinville has informed us of the complaints which Saint Louis made to him in confidence, of the debaucheries practised in his own royal tent, by his attendants, in this holy expedition. And the ignominious punishment to which he subjected a knight, detected in such excesses, shows what severe remedies he judged necessary to stem the increase of libertinism.

Indeed, the gross license which was practised during the middle ages may be well estimated by the vulgar and obscene language that was currently used in tales and fictions addressed to the young and noble of both sexes. In the romance of the *Round Table*, as Ascham sternly states, little was to be learned but examples of homicide and adultery, although he had himself seen it admitted to the antichamber of princes, when it was held a crime but to be possessed of the word of God. In the romance of *Amadis de Gaul*, and many others, the heroines, without censure or imputation, confer on their lovers the rights of a husband before the ceremony of the church gave them a title to the name. These are serious narrations, in which decorum, at least, is rarely violated; but the comic tales are of a grosser cast.

The *Canterbury Tales* of Chaucer contain many narratives, of which not only the diction, but the whole turn of the narrative, is extremely gross. Yet it does not seem to have occurred to the author, a man of rank and fashion, that they were improper to be recited, either in the presence of the prioress and her votaries, or in that of the noble knight who

> ——— of his port was meek as is a maid,
> And never yet no villany he said.

And he makes but a light apology for including the disasters of the *Millar of Trompington*, or of *Absalom the Gentle Clerk*, in the same series of narrations with the *Knight's Tale*. Many of Bandello's most profligate novels are expressly dedicated to females of rank and consideration; and, to conclude, the *Fabliaux*, published by Barbazan and Le Grand, are frequently as revolting, from their naked grossness, as interesting from the lively pictures which they present of life and manners. Yet these were the chosen literary pastimes of the fair and the gay, during the times of chivalry, listened to, we cannot but suppose, with an interest considerably superior to that exhibited by the yawning audience who heard the theses of the courts of love attacked and supported in logical form, and with metaphysical subtilty.

Should the manners of the times appear inconsistent in these respects which we have noticed, we must remember that we are ourselves variable and inconsistent animals, and that, perhaps, the surest mode of introducing and encouraging any particular vice, is to rank the corresponding virtue at a pitch unnatural in itself, and beyond the ordinary attainment of humanity. The vows of celibacy introduced profligacy among the Catholic clergy, as the high-flown and overstrained Platonism of the professors of chivalry favoured the increase of license and debauchery.

After the love of God and of his lady, the *preux chevalier* was to be guided by that of glory and renown. He was bound by his vow to seek out adventures of risk and peril, and never to abstain from the quest which he might undertake, for any unexpected odds of opposition which he might encounter. It was not indeed the sober and regulated exercise of valour, but its fanaticism, which the genius of chivalry demanded of its followers. Enterprises the most extravagant in conception, the most difficult in execution, the most useless when achieved, were those by which an adventurous knight chose to distinguish himself. There were solemn occasions also on which these displays of chivalrous enthusiasm were specially expected and called for. It is only sufficient to name the tournaments, single combats, and solemn banquets, at which vows of chivalry were usually formed and proclaimed.

The tournaments were uniformly performed and frequented by the choicest and noblest youth in Europe, until the fatal accident of Henry II. after which they fell gradually into disuse. It was in vain that, from the various accidents to which they gave rise, these dangerous amusements were prohibited by the heads of the Christian church. The popes, infallible as they were deemed, might direct, but could not curb, the military spirit of chivalry; they could excite crusades, but they could not abolish tournaments. Their laws, customs, and regulations, will fall properly under a separate article. It is here sufficient to observe, that these military games were of two kinds. In the most ancient, meaning "nothing in hate, but all in honour," the adventurous knights fought with sharp swords and lances as in the day of battle. Even then, however, the number of blows was usually regulated, or, in case of a general combat, some rules were laid down to prevent too much slaughter. The regulations of Duke Theseus for the tournament in Athens, as narrated by Chaucer in the *Knight's Tale*, may give a good example of these restrictions. When the combatants fought on foot, it was prohibited to strike otherwise than at the head or body; the number of strokes to be dealt with the sword and battle-axe were carefully numbered and limited, as well as the careers to be run with the lance. In these circumstances alone, the combats at *outrance*, as they were called, differed from encounters in actual war.

In process of time, the dangers of the solemn justs, held under the authority of princes, were modified by the introduction of arms of courtesy, as they were termed, lances, namely, without heads, and with round braces of wood at the extremity called *rockets*, and swords without points, and with blunted edges. But the risk continued great from bruises, falls, and the closeness of the defensive armour of the times, in which the wearers were often smothered. The weapons at *outrance* were afterwards chiefly used when knights of different and hostile countries engaged by appointment, or when some adventurous gallants took upon them the execution of an enterprise of arms (*pas d'armes*), in which they, as challengers, undertook, for a certain time, and under certain conditions, to support the honour of their country or their mistress against all comers. These enterprises often ended fatally, but the knights who undertook them were received in the foreign countries which they visited in accomplishment of their challenge, with the highest deference and honour; their arrival was considered as affording a sub-

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ject of sport and jubilee to all ranks; and when any mischance befel them, such as that of De Lindsay, who, in a tournament at Berwick, had his helmet nailed to his skull, by the truncheon of a lance which penetrated both, and died after devoutly confessing himself in the casque from which they could not disengage him, the knights who looked on prayed that God would vouchsafe them in his mercy a death so fair and so honourable. Stories of such challenges, with the minute details of the events of the combat, form frequent features in the histories of the age.

The contests of the tournament and the pas d'armes were undertaken merely in sport, and for thirst of honour. But the laws of the period afforded the adventurous knight other and more serious combats, in which he might exercise his valour. The custom of trying all doubtful cases by the body of a man, or, as it was otherwise expressed, by the judgment of God—in plain words, by referring the decision to the issue of a duel, prevailed universally among the Gothic tribes, from the highest antiquity. A *salvo* was devised for the obvious absurdity of calling upon the weak to encounter the strong, a churchman to oppose a soldier, or age to meet in the lists with activity and youth. It was held that either party might appear personally, or by his champion. This sage regulation gave exercise for the valour of the knights, who were bound by their oaths to maintain the cause of those who had no other protector. And, indeed, there is good reason to think that the inconveniences and injustice of a law so absurd in itself as that of judicial combat, were evaded and mitigated by the institutions of chivalry, since, among the number of knights who were eagerly hunting after opportunities of military distinction, a party incapable of supporting his own cause by combat could have little difficulty in finding a formidable substitute; so that no one, however bold and confident, could prosecute an unjust cause to the uttermost, without the risk of encountering some champion of the innocent party from among the number of hardy knights who traversed every country seeking ostensible cause of battle.

Besides these formal combats, it was usual for the adventurous knight to display his courage by stationing himself at some pass in a forest, on a bridge, or elsewhere, compelling all passengers to avouch the superiority of his own valour, and the beauty of his mistress, or otherwise to engage with him in single combat. When Alexius Comnenus received the homage of the crusaders, seated upon his throne, previous to their crossing the Hellespont, during the first crusade, a French baron seated himself by the side of the emperor of the East. He was reproved by Baldwin, and answered in his native language, "what ill-taught clown is this, who dares to keep his seat when the flower of the European nobility are standing around him!" The emperor, dissembling his indignation, desired to know the birth and condition of the audacious Frank. "I am," replied the baron, "of the noblest race of France. For the rest, I only know that there is near my castle a spot where four roads meet, and near it a church where men, desirous of single combat, spend their time in prayer till some one shall accept their challenge. Often have I frequented that chapel, but never met I one who durst accept my defiance." Thus the bridge of Rodomont, in the Orlando Furioso, and the valiant defiance which the knight of La Mancha hurled against the merchants of Toledo, who were bound to the fairs of Murcia, were neither fictions of Ariosto nor Cervantes, but had their prototypes in real story. The chivalrous custom of defying all and sundry to mortal combat subsisted in the borders until the days of Queen Elizabeth, when the worthy Bernard Gilpin found in his church of Houghton le Spring a glove hung over the altar, which he was informed indicated a challenge to all who should take it down. The remnants of the judicial combats, and the enterprises of arms, may be found in the duels of the present day. In former days they still more resembled each other; for, in the seventeenth century, not only the seconds on each side regularly engaged, but it was usual to have more seconds, even to the number of five or six; a custom pleasantly ridiculed by Lord Chesterfield in one of the papers of *The World*. It is obvious that an usage at once so ridiculous and so detrimental to the peace and happiness of society must give way, in proportion to the progress of common sense. The custom is in general upon the wane, even as far as respects single combat between men who have actually given or taken offence at each other. The general rules of good-breeding prevent causes of such disagreement from arising in the intercourse of society; and the forward duellist, who is solicitous in seeking them out, is generally accounted a vulgar and ferocious, as well as a dangerous character. At the same time, the habits derived from the days of chivalry still retain a striking effect on our manners, and have fully established a graceful as well as useful punctilio, which tends on the whole to the improvement of society. Every man is under the impression, that neither his strength, his wealth, his station, nor his wit, will excuse him from answering, at the risk of his life, any unbecoming encroachment on the civility due to the weakest, the poorest, the least important, or the most modest member of the society in which he mingles. All too in the rank and station of gentlemen are forcibly called upon to remember that they must resent the imputation of a voluntary falsehood as the most gross injury; that the rights of the weaker sex demand protection from every one who would hold a good character in society. In short, from the wild and overstrained courtesies of chivalry has been derived our present system of manners. It is not certainly faultless, and it is guarded by penalties which we must often regret as disproportionably severe. Yet it has a grace and dignity unknown to classic times, when women were slaves, and men coarse and vulgar, or overbearing and brutal, as suited their own humour, without respect to that of the rest of society.

II. Such being the tone and spirit of chivalry, derived from love, devotion, and valour, we have next to notice the special forms and laws of the order, which will be found to correspond in every respect to the spirit which they were designed to foster.

Rules and forms of chivalry.

The education of the future knight began at an early period. The care of the mother, after the first years of early youth were past, was deemed too tender, and the indulgences of the paternal roof too effeminate, for the future aspirant to the honours of chivalry. "Do you not bless God," said the Lady Mabel to her husband, the noble Duke Guerin of Montglaive, as on a solemn feast they looked on their four hopeful sons, "do you not bless God, that has given you such a promising issue?" "Dame," replied Guerin, in the true spirit of the age, "so help me God and Saint Martin! nothing can do me greater despite than to look on these four great lurdanes, who, arrived at such an age, yet do nothing but eat the fat, and drink the sweet, and spend their time in idle amusement."[1] To counteract these habits of indulgence, the first step to the order of knighthood was the degree of PAGE.

[1] *L'Hystoire de Guerin de Montglaive.*

Chivalry.

The page.

The young and noble stripling, generally about his twelfth year, was transferred from his father's house to that of some baron or noble knight, sedulously chosen by the anxious parent as that which had the best reputation for good order and discipline. The children of the first nobles and high crown vassals were educated by the royal court. And, however the reins of discipline might be in particular cases relaxed, or become corrupted in latter days, the theory was uniformly excellent. The youth, who was to learn modesty, obedience, and address in arms and horsemanship, was daily exercised in the use of arms, beginning with such as were suited to his strength. He was instructed how to manage a horse with grace and dexterity; how to use the bow and the sword; how to manage the lance, an art which was taught by making him ride a career against a wooden figure holding a buckler, called a quintaine. This quintaine turned on an axis; and as there was a wooden sword in the other hand of the supposed opponent, the young cavalier, if he did not manage his horse and weapon with address, was liable to receive a blow when the shock of his charge made the quintaine spin round.

Besides these exercises, the noble youth was required to do the work which, in some respects, belonged to a menial, but not as a menial. He attended his lord during the chase, the rules of which, as an image of war, and as held the principal occupation of a gentleman during peace, were carefully inculcated. He was taught the principal blasts or notes of *venerie*, to be sounded when the hounds were uncoupled, when the prey was on foot, when he was brought to bay, and when he fell. This art did not tend solely to amusement. The "gentle damosel," to use the language of the times, learned to bear the fatigue, the hunger and thirst, which huntsmen are exposed to. By the necessity of encountering and dispatching a stag, a boar, or a wolf, at bay, he learned promptitude and courage in the use of his weapons. The accuracy with which he was required to study the attacks of the hunted animal's course gave him habits of attention and reflection. In the days and nights spent in the chase, amid wide and pathless forests, he acquired the art, so necessary to a soldier, of remarking and studying the face of the country. When benighted, he was taught to steer his course by the stars, if they were visible; if not, to make his couch with patience on the withered leaves, or in a tree. Had he lost his way by day-time, he distinguished the points of the compass by remarking which side of the trees were most covered with moss, and from which they threw their branches most freely; circumstances which, compared with the known course of the prevailing wind, afforded him the necessary information.

The ceremonial of the chase was to be acquired, as well as its arts. To brittle or break the deer (in French *faire la curée*), in plain terms, to flay and disembowel the stag, a matter in which much precision was required, and the rules of which were ascribed to the celebrated Sir Tristram of Lionesse, was an indispensable requisite of the page's education. Nor did his concern with the venison end here; he placed it on the table, waited during the banquet, and carved the ponderous dishes when required or permitted to do so. Much grace and delicacy, it was supposed, might be displayed on these occasions; and in one romance we read of the high birth and breeding of a page being ascertained, by his scrupulously declining to use a towel to wipe his hands, when washed, before he began to carve, and contenting himself with waving them in the air till they dried of themselves. It is perhaps difficult to estimate the force of this delicacy, unless by supposing that he had not a towel or napkin appropriated to his own separate use.

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Amidst these various instructions the page was often required to wait upon the ladies, rather as attending a sort of superior beings, to whom adoration and obsequious service were due, than as ministering to the convenience of human creatures like himself. The most modest demeanour, the most profound respect, was to be observed in the presence of these fair idols. Thus the veneration due to the female character was taught to the acolyte of chivalry, by his being placed so near female beauty, yet prohibited the familiarity which might discover female weakness. Love frequently mingled with this early devotion, and the connection betwixt some lady of distinction and her gallant knight is often, in romantic fiction, supposed to have originated from some early affection. In a romance called *The Golden Thread* (of which we have only seen a modern edition in German, but which has many features of originality), when the daughter of the count bestows her annual gifts on her father's household, she gives the page Leofried, in derision, a single thread of gold tissue. To show the value which he places upon the most minute memorial, coming from such a hand, the youth opens a wound in his bosom, and deposits the precious thread in the neighbourhood of his heart. The Dame des Belles Cousines, whom we have already mentioned, was assuredly not the only lady of high rank who was tempted to give a handsome young page the benefit of her experience in completing his education. This led the way to abuse; and the custom of breeding up youths as pages in the houses of the great, although it survived the decay of chivalry, was often rather the introduction to indolence, mischief, and debauchery, than to useful knowledge and the practice of arms. The proper purposes of this preliminary part of chivalrous education are well given by one of the characters in Ben Jonson's *New Inn;* and he is answered by another, who alleges, with satire resembling that of Juvenal, the modern corruptions of the order of pages. Lord Lovel has requested mine host to give him his son for a page. The host answers, by declaring he would rather hang his child with his own hand

> Than damn him to that desperate course of life.
> *Lovel.* Call you that desperate which, by a line
> Of institution from our ancestors,
> Hath been derived down to us, and received
> In a succession, for the noblest way
> Of breeding up our youth in letters, arms,
> Fair mein, discourses, civil exercises,
> And all the blazon of a gentleman?
> Where can he learn to vault, to ride, to fence,
> To mar his body gracefully, to speak
> His language purer, or to turn his mind
> Or manners more to the harmony of nature,
> Than in those nurseries of nobility?
> *Host.* Aye, that was when the nursery's self was noble,
> And only virtue made it not the market.

And he replies by enumerating instances of the decay of honour among the nobles, and of the debauchery of their household pages. In La Noue's *Political and Military Discourses* is a similar complaint of the hazards to which the morals of young gentlemen were exposed while acting in this domestic capacity. Nevertheless the custom of having young gentlemen thus bred, continued in a certain degree down to the last century, although those destined to such employments became by degrees of a lower quality. In some few instances the institution was maintained in its purity; and the page, when leaving the family in which he was educated, usually obtained a commission. The last instance we know was that of a gentleman bred a page in the family of the Duchess of Buccleuch and Monmouth, who died, during the reign of George III. a general officer in his majesty's service.

Chivalry.

The squire.

When advancing age and experience in the use of arms had qualified the page for the hardships and dangers of actual war, he was removed from the lowest to the second gradation of chivalry, and became an *Escuyer*, Esquire, or SQUIRE. The derivation of this phrase has been much contested. It has been generally supposed to be derived from its becoming the official duty of the esquire to carry the shield (*escu*) of the knight his master, until he was about to engage the enemy. Others have fetched the epithet (more remotely certainly) from *scuria*, a stable, the charger of the knight being under the especial care of the squire. Others again ascribe the derivation of the word to the right which the squire himself had to carry a shield, and to blazon it with armorial bearings. This, in later times, became almost the exclusive meaning attached to the appellative esquire; and, accordingly, if the phrase now means anything, it means a gentleman having right to carry arms. There is reason, however, to think that this is a secondary meaning of the word, for we do not find the word escuyer applied as a title of rank, until so late as the Ordonnance of Blois, in 1579.

The candidate for the honours of chivalry, now an immediate attendant on the knight or nobleman, was withdrawn from the private apartments of the ladies, and only saw them upon occasions of stated ceremony. In great establishments there were squires of different ranks, and destined for different services; but we shall confine ourselves to those general duties which properly belonged to the office. The squire assisted his master in the offices at once of a modern valet de chambre and groom—he attended to dress and to undress him, trained his horses to the menage, and kept his arms bright and burnished. He did the honours of the household to the strangers who visited it; and the reputation of the prince or great lord whom he served was much exalted by the manner in which these courteous offices were discharged. In the words of Chaucer, describing the character of the squire,

> Curteis he was, lowly and servisable,
> And carf before his fader at the table.

The squire was also expected to perfect himself in the accomplishments of the period, and not only to be a master of the ceremonial of the feast, but to be capable of enlivening it by his powers of conversation. He was expected to understand chess, draughts, and other domestic games. Poetry and music, if he had any turn for these beautiful arts, and whatever other accomplishments could improve the mind or the person, were accounted to grace his station. And accordingly Chaucer's squire, besides that he was "singing or fluting all the day,"

> —Could songs make, and well indite,
> Just, and eke dance, and well pourtray and write.

Unquestionably few possessed all these attributes; but the poet, with his usual precision and vivacity, has given us the picture of a perfect esquire.

To understand the squires' mode of life more particularly, it is necessary to consider that which was led in the courts and castles of the middle ages. Froissart has given us a very striking account of the mode of house-keeping in the family of Gaston, earl of Foix, a prince whose court was considered as a first-rate nursery for the noble youth; and, from his lively description, we may in some measure conceive the mode in which the esquires spent their time. Froissart abode in his house above twelve weeks, much recommended to the favourable notice of the earl, by his having brought with him a book containing all the songs, ballads, and virilays, which Wencislaus of Bohemia, the gentle Duke of Brabant, had made, and the historian himself had compiled or transcribed. "Every night after supper," says Froissart, "I read thereon to him, and while I read there was none durst speak any thing to interrupt me, so much did the earl delight in listening." The quotation necessary to describe the Earl of Foix, and the economy of his household, must necessarily be a long one, but it is a picture by the hand of an inimitable artist, of a school of chivalry when chivalry was at its highest pitch, and we are unwilling to destroy the likeness by abridging it.

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"This erle Gascone of Foix, with whom I was, at that tyme, he was of a fyftie yere of age and nyne: and, I say, I have in my tyme sene many knights, kynges, princes, and others, but I neuer saw none like him of personage, nor of so fayre forme, nor so well made, his vysage fayre, sanguyne, and smylyng, his eyen gray and amorous, wher as he lyst to set his regarde; in euery thyng he was so parfite that he can not be praised to moche; he loued that ought to be beloued, and hated that ought to be hated: he was a wyse knyght, of highe enterprise, and of good counsayle; he neuer had myscreant with hym; he sayd many orisons every day, a nocturn of the psalter, matyns of our Lady, of the Holy Goost, and of the crosse, and dirigè euery day; he gaue fyue florins, in small monies, at his gate to poor folkes for the loue of God; he was large and courtesse in gyftes; he could ryght well take where it parteyned to hym, and to delyuer agayne wher as he ought; he loued hoũdes of all beestes, wynter and somer he loued huntyng; he neuer loued folly, outrage, nor foly larges; euery moneth he wolde knowe what he spended; he tooke in his countre to receyue his reuenwes, and to serue him, notable persóns, that is to saye, xii. récyuours, and euer fro 11. monethes to two monethes, two of them shulde serue for his receyte; for, at the two monethes end, he wolde change and put other two into that offiyce; and one that he trusted best shulde be his comptroller, and to hym all other shulde accompt, and the comptroller shulde accõpt to hym by rolles and bokes written, and the comptes to remayne still with therle: he had certeyne cofers in his chambre, out of the whiche oftetymes he wolde take money to gyve to lordes, knightes, and squyers, suche as came to hym, for none shulde departe from him without some gift, and yet dayly he multiplyed his treasure, to resyst the aduẽtures and fortunes that he douted; he was of good and easy acquayntance with every man, and amorously wolde speke to thẽ; he was short in counsayle, and answers; he had four secretaries, and at his rising they must ever be redy at his hande, without any callynge; and whan any letter were delyuered him, and that he had reed it, than he wolde calle them to write agayne, or els for some other thynge. In this estate therle of Foix liued. And at mydnight, whan he came out of his chambre into the hall to supper, he had ever before him xii. torches brennyng, borne by xii. varlettes standying before his table all supper; they gaue a gret light, and the hall ever full of knightes and squyers, and many other tables dressed to suppe who wolde; ther was none should speke to hym at his table, but if he were called; his meate was lightlye wylde foule, the legges and wynges alonely, and in the day he dyd but lytell eate and drĩke; he had great pleasure in armony of instrumẽtes; he coude do it right well hymselfe, he wolde have songes song before him, he wolde gladlye se conseytes and fantesies at his table. And or I came to his court, I had been in many courtes of kynges, dukes, princes, erles, and great ladyes, but I was neuer in none y so well liked me, nor ther was none more reioysed in dedes of armes, than the erle dyde: there was sene in his hall, chãbre and court, knightes and squyers of honour goyng up and downe, and talking of armes and amours; all honour ther was found, all maner of tidynges of every realme and countre ther might be herde, for out

of every coūtre there was resort for the valyantnesse of this erle."[1]

While the courage of the young aspirant to the honours of knighthood was animated, and his emulation excited, by the society in which he was placed, and the conversation to which he listened,—while everything was done which the times admitted to refine his manners, and, in a certain degree, to cultivate his understanding,—the personal exercises to which he had been trained while a page were now to be pursued with increasing assiduity, proportional to the increase of his strength. "He was taught," says a historian, speaking of Bouçicaut, while a squire, "to spring upon a horse, while armed at all points; to exercise himself in running; to strike for a length of time with the axe or club; to dance and throw somersets, entirely armed, excepting the helmet; to mount on horseback behind one of his comrades, by barely laying his hands on his sleeve; to raise himself betwixt two partition walls to any height, by placing his back against the one, and his knees and hands against the other; to mount a ladder, placed against a tower, upon the reverse or under side, solely by the aid of his hands, and without touching the rounds with his feet; to throw the javelin, to pitch the bar;" to do all, in short, which could exercise the body to feats of strength and agility, in order to qualify him for the exploits of war. For this purpose also, the esquires had their tourneys separate and distinct from those of the knights. They were usually solemnized on the eve of the more formal and splendid tournaments, in which the knights themselves displayed their valour; and lighter weapons than those of the knights, though of the same kind, were employed by the esquires. But, as we shall presently notice, the most distinguished among the esquires were (notwithstanding the high authority of the knight of La Mancha to the contrary) frequently admitted to the honours and dangers of the more solemn encounter.

In actual war the page was not expected to render much service, but that of the squire was important and indispensable. Upon a march, he bore the helmet and shield of the knight, and led his horse of battle, a tall heavy animal, fit to bear the weight of a man in armour, but which was led in hand upon a march, while the knight rode an ambling hackney. The squire was also qualified to perform the part of an armourer, not only lacing his master's helmet and buckling his cuirass, but also closing with a hammer the rivets by which the various pieces were united to each other. This was a point of the utmost consequence; and many instances occur of mischances happening to celebrated warriors when the duty was negligently performed. In the actual shock of battle the esquire attended closely on the banner of his master, or on his person, if he were only a knight bachelor, kept pace with him during the melée, and was at hand to remount him when his steed was slain, or relieve him when oppressed by numbers. If the knight made prisoners, they were the charge of the esquire; if the esquire himself fortuned to make one, the ransom belonged to his master.

On the other hand, the knights who received these important services from their esquires were expected to display towards them that courteous liberality which made so distinguished a point of the chivalrous character. Lord Audley led the van of the Black Prince's army at the battle of Poitiers, attended by four squires, who had promised not to fail him. They distinguished themselves in the front of that bloody day, leaving such as they overcame to be made prisoners by others, and ever pressing forwards where resistance was offered. Thus they fought in the chief of the battle, until Lord James Audley was sorely wounded, and his breath failed him. At the last, when the battle was gained, the four faithful esquires bore him out of the press, disarmed him, and staunched and dressed his wounds as they could. As the Black Prince called for the man to whom the victory was in some measure owing, Lord Audley was borne before him in a litter, when the prince, after having awarded to him the praise and renown above all others who fought on that day, bestowed on him five hundred marks of yearly revenue, to be assigned out of his heritage in England. Lord Audley accepted of the gift with due demonstration of gratitude; but no sooner was he brought to his lodging, than he called before him the four esquires by whom he had been so gallantly seconded, and the nobles of his lineage, and informed his kinsmen, "Sirs, it has pleased my lord the prince to bestow on me five hundred marks of heritage, of which I am unworthy; for I have done him but small service. Behold, Sirs, these four squires, which have always served me truly, and specially this day; the honour that I have is by their valour. Therefore, I resign to them and their heirs for ever, in like manner as it was given to me, the noble gift which the prince hath assigned me." The lords beheld each other, and agreed it was a proof of great chivalry to bestow so royal a gift, and gladly undertook to bear witness to the transfer. When Edward heard these tidings, he sent for Lord Audley, and desired to know why he had bestowed on others the gift he had assigned him, and whether it had not been acceptable to him: "Sir," said Lord Audley, "these four squires have followed me well and truly in several severe actions, and at this battle they served me so well, that had they done nothing else, I had been bound to reward them. I am myself but a single man; but, by aid of their united strength and valour, I was enabled to execute the vow which I had made to give the onset in the first battle in which the king of England or his sons should be present; and had it not been for them, I must have been left dead on the field. This is the reason I have transferred your highnesses bounty, as to those by whom it was best deserved." The Black Prince not only approved of and confirmed Lord Audley's grant, but conferred upon him, not to be outdone in generosity, a yearly revenue of six hundred marks more, for his own use.[2] The names of the esquires who thus distinguished themselves, and experienced such liberality at the hands of their leader, were Delves of Doddington, Dutton of Dutton, Fowlishurst of Crewe, and Hawkestone of Wreynehill, all Cheshire families. This memorable instance may suffice to show the extent of gratitude which the knights entertained for the faithful service of their squires; but it also leads us to consider some other circumstances relating to the order of esquire.

Although, in its primitive and proper sense, the state of esquire was merely preparatory to that of knighthood, yet it is certain that many men of birth and property rested content with attaining that first step, and, though greatly distinguished by their feats of arms, never rose, nor apparently sought to rise, above the rank which it conferred. It does not appear that any of the esquires of Lord Audley were knighted after the battle of Poitiers, although there can be no doubt that their rank, as well as their exploits, entitled them to expect that honour. The truth seems to be, that it may frequently have been more convenient, and scarcely less honourable, to remain in the unenvied and unpretending rank of esquire, than to aspire to that of knighthood, without a considerable fortune to supply the expenses of that dignity. No doubt, in theory,

[1] Froissart's *Chronicles*, translated by Lord Berners.

[2] Froissart. Barne's *History of Edward III.*

the simplest knight-bachelor was a companion, and in some degree equal with princes. But, in truth, we shall presently see, that, where unsupported by some sort of income to procure suitable equipment and retainers, that dignity was sometimes exposed to ridicule. Many gallant gentlemen, therefore, remained esquires, either attached to the service of some prince or eminent nobleman, or frequently in a state of absolute independence, bringing their own vassals to the field, whom, in such cases, they were entitled to muster under a *penoncele*, or small triangular streamer, somewhat like the naval pendant of the present day. The reader of history is not, therefore, to suppose, that where he meets with an esquire of distinguished name, he is therefore necessarily to consider him as a youthful candidate for the honour of knighthood, and attending upon some knight or noble. This is, indeed, the primitive, but not the uniform meaning of the title. So many men of rank and gallantry appear to have remained esquires, that, by degrees, many of the leading distinctions between them and the knights were relaxed or abandoned. In Froissart's *Chronicles* we find that esquires frequently led independent bodies of men, and, as we have before hinted, mingled with the knights in the games of chivalry; the difference chiefly consisting in title, precedence, the shape of the flag under which they arrayed their followers, and the fashion of their armour. The esquires were permitted to bear a shield, emblazoned, as we have already seen, with armorial bearings. There seems to have been some difference in the shape of the helmet; and the French esquire was not permitted to wear the complete hauberk, but only the shirt of mail, without hood or sleeves. But the principal distinction between the independent esquire (terming him such who was attached to no knight's service) and the knight, was the spurs, which the esquire might wear of silver, but by no means gilded.

To return to the esquires most properly so termed, their dress was, during their period of probation, simple and modest, and ought regularly to have been made of brown, or some other uniform and simple colour. This was not, however, essential. The garment of Chaucer's squire was embroidered like a meadow. The petit Jehan de Saintré was supplied with money by his mistress to purchase a silken doublet and embroidered hose. There is also a very diverting account, in the *Memoirs of Bertrand de Guesclin*, of the manner in which he prevailed on his uncle, a covetous old churchman, to assign him money for his equipment on some occasion of splendour. We may therefore hold, that the sumptuary laws of squirehood were not particularly attended to, or strictly enforced.

A youth usually ceased to be a page at fourteen, or a little earlier, and could not regularly receive the honour of knighthood until he was one and twenty. But if their distinguished valour anticipated their years, the period of probation was shortened. Princes of the blood-royal, also, and other persons of very high eminence, had this term abridged, and sometimes so much so as to throw a ridicule upon the order of knighthood, by admitting within "the temple of honour," as it was the fashion of the times to call it, children who could neither understand nor discharge the duties of the office to which they were thus prematurely called.

Knights. The third and highest rank of chivalry was that of knighthood. In considering this last dignity, we shall first inquire how it was conferred; secondly, the general privileges and duties of the order; thirdly, the peculiar ranks into which it was finally divided, and the difference betwixt them.

The investiture. Knighthood was, in its origin, an order of a republican, or at least an oligarchic nature; arising, as has been shown, from the customs of the free tribes of Germany, and, in its essence, not requiring the sanction of a monarch. On the contrary, each knight could confer the order of knighthood upon whomsoever preparatory noviciate and probation had fitted to receive it. The highest potentate sought the *accolade*, or stroke which conferred the honour, at the hands of the worthiest knight whose achievements had dignified the period. Thus Francis I. requested the celebrated Bayard, *the Good Knight without reproach or fear*, to make him; an honour which Bayard valued so highly, that, on sheathing his sword, he vowed never more to use that blade, except against Turks, Moors, and Saracens. The same principle was carried to extravagance in a romance, where the hero is knighted by the hand of Sir Lancelot of the Lake, when dead. A sword was put into the hand of the skeleton, which was so guided as to let it drop on the neck of the aspirant. In the time of Francis I. it had already become customary to desire this honour at the hands of greatness rather than valour, so that the king's request was considered as an appeal to the first principles of chivalry. In theory, however, the power of creating knights was supposed to be inherent in every one who had reached that dignity. But it was natural that the soldier should desire to receive the highest military honour from the general under whose eye he was to combat, or from the prince or noble at whose court he passed as page and squire through the gradations of his noviciate. It was equally desirable, on the other hand, that the prince or noble should desire to be the immediate source of a privilege so important. And thus, though no positive regulation took place on the subject, ambition on the part of the aspirant, and pride and policy on that of the sovereign princes and nobles of high rank, gradually limited to the latter the power of conferring knighthood, or drew at least an unfavourable distinction between the knights dubbed by private individuals, and those who, with more state and solemnity, received the honoured title at the hand of one of high rank. Indeed, the change which took place respecting the character and consequences of the ceremony, naturally led to a limitation in the right of conferring it. While the order of knighthood merely implied a right to wear arms of a certain description, and to bear a certain title, there could be little harm in intrusting, to any one who had already received the honour, the power of conferring it on others. But when this highest order of chivalry conferred not only personal dignity, but the right of assembling under the banner, or pennon, a certain number of soldiers,—when knighthood implied not merely personal privileges, but military rank,—it was natural that sovereigns should use every effort to concentrate the right of conferring such distinction in themselves, or their immediate delegates. And latterly it was held, that the rank of knight only conferred those privileges on such as were dubbed by sovereign princes.

The times and place usually chosen for the creation of knights were favourable to the claim of the sovereigns to be the proper fountain of chivalry. Knights were usually made either on the eve of battle, or when the victory had been obtained; or they were created during the pomp of some solemn warning or grand festival. In the former case, the right of creation was naturally referred to the general or prince who led the host; and in the latter, to the sovereign of the court where the festival was held. The forms in these cases were very different.

When knights were made in the actual field of battle, little solemnity was observed, and the form was probably the same with which private individuals had, in earlier times, conferred the honour on each other. The novice, armed at all points, but without helmet, sword, and spurs, came before the prince or general at whose hands he was to receive knighthood, and kneeled down, while two per-

Chivalry. sons of distinction, who acted as his godfathers, and were supposed to become pledges for his being worthy of the honour to which he aspired, buckled on his gilded spurs, and belted him with his sword. He then received the accolade, a slight blow on the neck, with the flat of the sword, from the person who dubbed him, who, at the same time, pronounced a formula to this effect; "I dub thee knight, in the name of God and St Michael (or in the name of the Father, Son, and Holy Ghost). Be faithful, bold, and fortunate." The new-made knight had then only to take his place in the ranks of war, and endeavour to distinguish himself by his forward gallantry in the approaching action, when he was said to win his spurs. It is well known that, at the battle of Cressy, Edward III. refused to send succours to the Black Prince, until he should hear that he was wounded or dismounted, being determined he should, on that memorable day, have full opportunity to *win his spurs*. It may be easily imagined, that on such occasions the courage of the young knights was wound up to the highest pitch; and, as many were usually made at the same time, their gallantry could not fail to have influence on the fortune of the day. At the siege of Tholouse (1159), Henry II. of England made thirty knights at once, one of whom was Malcolm IV. king of Scotland. Even on these occasions the power of making knights was not understood to be limited to the commander-in-chief. At the fatal battle of Homildown, in 1401, Sir John Swinton, a warrior of distinguished talents, observing the slaughter made by the English archery, exhorted the Scots to rush on to a closer engagement. Adam Gordon, between whose family and that of Swinton a deadly feud existed, hearing this sage counsel, knelt down before Swinton, and prayed him to confer on him the honour of knighthood, which he desired to receive from the wisest and boldest knight in the host. Swinton conferred the order; and they both rushed down upon the English host, followed only by a few cavalry. If they had been supported, the attack might have turned the fate of the day. But none followed their gallant example, and both champions fell. It need hardly be added, that the commander, whether a sovereign prince or not, equally exercised the privilege of conferring knighthood. In the old ballad of the battle of Otterburn, Douglas boasts that, since he had entered England, he had

With brand dubb'd many a knight.

But it was not in camps and armies alone that the honours of knighthood were conferred. At the *Cour Plenière*, a high court to which sovereigns summoned their crown vassals at the solemn festivals of the church, at the various occasions of solemnity which occurred in the royal family, from marriage, birth, baptism, and the like, the monarch was wont to confer on novices in chivalry its highest honour, and the ceremonies used on such investiture added to the dignity of the occasion. It was then that the full ritual was observed which, on the eve of battle, was necessarily abridged or omitted. The candidates watched their arms all night in a church or chapel, and prepared for the honour to be conferred on them, by vigil, fast, and prayer. They were solemnly divested of the brown frock, which was the appropriate dress of the squire; and having been bathed, as a symbol of purification of heart, they were attired in the richer garb appropriate to knighthood. They were then solemnly invested with the appropriate arms of a knight; and it was not unusual to call the attention of the novice to a mystical or allegorical explanation of each piece of armour as it was put on. These exhortations consisted in strange and extravagant parallels betwixt the temporal and spiritual state of warfare, in which the metaphor was hunted down in every possible shape. The under dress of the knight was a close jacket of chamois leather, over which was put the mail shirt, composed of rings of steel artificially fitted into each other, as is still the fashion in some parts of Asia. A suit of plate armour was put on over the mail shirt, and the legs and arms were defended in the same manner. Even this accumulation of defensive armour was by some thought insufficient. In the combat of the Infantes of Carrion with the champions of the Cid, one of the former was yet more completely defended, and to little purpose.

Onward into Ferrand's breast the lance's point is driven
Full upon his breastplate, nothing would avail;
Two breastplates Ferrand wore, and a coat of mail,
The two are riven in sunder, the third stood him in stead,
The mail sunk in his breast, the mail and the spear head;
The blood burst from his mouth, that all men thought him dead.[1]

The novice being accoutred in his knightly armour, but without helmet, sword, and spurs, a rich mantle was flung over him, and he was conducted in solemn procession to the church or chapel in which the ceremony was to be performed, supported by his godfathers, and attended with as much pomp as circumstances admitted. High mass was then said, and the novice, advancing to the altar, received from the sovereign the accolade. The churchman present, of highest dignity, often belted on his sword, which, for that purpose, had been previously deposited on the altar; and the spurs were sometimes fastened on by ladies of quality. The oath of chivalry was then taken, to be loyal to God, the king, and the ladies. Such were the outlines of the ceremony, which, however, was varied according to circumstances. A king of Portugal knighted his son in presence of the dead body of the Marquis of Marialva, slain in that day's action, and impressively conjured the young prince to do his duty in life and death, like the good knight who lay dead before him. Alms to the poor, largesses to the heralds and minstrels, a liberal gift to the church, were necessary accompaniments to the investiture of a person of rank. The new-made knight was conducted from the church with music and acclamations, and usually mounted his horse and executed some curvets in presence of the multitude, couching his lance, and brandishing it as if impatient to open his knightly career. It was at such times also that the most splendid tournaments were executed, it being expected that the young knights would display the utmost efforts to distinguish themselves. Such being the solemnities with which knighthood was conferred, it was no wonder that the power of conferring it should, in peace as well as in war, be almost confined to sovereign princes, or nobles who nearly equalled them in rank and independence. By degrees these restrictions were drawn more and more close, and at length it was held that none but a sovereign, or a commander-in-chief displaying the royal banner, and vested with plenary and vice-regal authority, could confer the degree of knighthood. Queen Elizabeth was particularly jealous of this part of her prerogative; and nothing more excited her displeasure and indignation against her favourite Essex, than the profuseness with which he distributed the honour at Cadiz, and afterwards in Ireland. These anecdotes, however, belong to the decay of chivalry.

Arms and privileges of a knight.

The knight had several privileges of dignity and importance. He was associated into a rank wherein kings and princes were in one sense only his equals. He took precedence in war and in counsel, and was addressed by

[1] See Translations from the Spanish Metrical Romance on the subject of the Cid, appended to Mr Southey's *Cid*.

Chivalry. the respectful title of *Messire* in French, and *Sir* in English, and his wife by that of Madame and Dame. A knight was also, in point of military rank, qualified to command any body of men under a thousand. His own service was performed on horseback, and in complete armour of many various fashions, according to the taste of the warriors and the fashion of the age. Chaucer has enumerated some of these varieties.

With him ther wenten knights many on.
Som wol ben armed in an habergeon,
And in a brest plate, and in a gipon;
And som wol have a pair of plates large;
And som wol have a pruse sheld, or a targe;
Some wol ben armed on his legges wele,
And have an axe, and some a mace of stele.
Ther n'is no newe guise, that it n'as old.
Armed they weren, as I have you told,
Everich after his opinion.

The weapons of offence, however, most appropriate to knighthood were the lance and sword. They had frequently a battle-axe or mace at their saddle-bow, a formidable weapon even to men sheathed in iron like themselves. The knight had also a dagger, which he used when at close quarters. It was called the dagger of mercy, probably because, when unsheathed, it behoved the antagonist to crave mercy or to die. The management of the lance and of the horse was the principal requisite of knighthood. To strike the foeman either on the helmet or full upon the breast with the point of the lance, and at full speed, was accounted perfect practice; to miss him, or to break a lance across, *i. e.* athwart the body of the antagonist, without striking him with the point, was accounted an awkward failure; to strike his horse, or to hurt his person under the girdle, was conceived a foul or felon action, and could only be excused by the hurry of a general encounter. When the knights, from the nature of the ground, or other circumstances, alighted to fight on foot, they used to cut some part from the length of their spears, in order to render them more manageable, like the pikes used by infantry. But their most formidable onset was when mounted and "in host." They seem then to have formed squadrons not unlike the present disposition of cavalry in the field,—their squires forming the rear rank, and performing the part of serrefiles. As the horses were trained in the tourneys and exercises to run upon each other without flinching, the shock of two such bodies of heavy-armed cavalry was dreadful, and the event usually decided the battle; for, until the Swiss showed the superior steadiness which could be exhibited by infantry, all great actions were decided by the men-at-arms. The yeomanry of England, indeed, formed a singular exception; and, from the dexterous use of the long bow, to which they were trained from infancy, were capable of withstanding and destroying the mail-clad chivalry both of France and Scotland. Their shafts, according to the exaggerating eloquence of a monkish historian, Thomas of Walsingham, penetrated steel coats from side to side, transfixed helmets, and even splintered lances and pierced through swords! But against every other pedestrian adversary, the knights, squires, and men-at-arms had the most decided advantage, from their impenetrable armour, the strength of their horses, and the fury of their onset. To render success yet more certain, and attack less hazardous, the horse, on the safety of which the rider so much depended, was armed *en barbe*, as it was called, like himself. A masque made of iron covered the animal's face and ears; it had a breastplate, and armour for the croupe. The strongest horses were selected for this service; they were generally stallions, and to ride a mare was reckoned base and unknightly.

To distinguish him in battle, as his face was hid by the helmet, the knight wore above his armour a surcoat, as it was called, like a herald's coat, on which his arms were emblazoned. Others had them painted on the shield, a small triangular buckler of light wood, covered with leather, and sometimes plated with steel, which, as best suited him, the knight could either wield on his left arm, or suffer to hang down from his neck, as an additional defence to his breast, when the left hand was required for the management of the horse. The shape of these shields is preserved, being that on which heraldric coats are most frequently blazoned. But it is something remarkable, that no one of those *heater*[1] shields has been preserved in the Tower, or, so far as we know, in any English collection. The helmet was surmounted by a crest, which the knight adopted after his own fancy. There was deadly offence taken if one knight, without right, assumed the armorial bearings of another; and history is full of disputes on that head, some of which terminated fatally. The heralds were the persons appealed to on these occasions, when the dispute was carried on in peace; and hence flowed the science, as it was called, of heraldry, with all its fantastic niceties. By degrees the crest and device became also hereditary, as well as the bearings on the shield. In addition to his armorial bearings, the knight distinguished himself in battle by shouting out his war-cry, which was echoed by his followers. It was usually the name of some favourite saint, united with that of his own family. If the knight had followers under his command, they re-echoed his war-cry, and rallied round his pennon or flag at the sound. The pennon differed from the penoncel, or triangular streamer which the squire was entitled to display, being double the breadth, and indented at the end like the tail of a swallow. It presented the appearance of two penoncels united at the end next the staff, a consideration which was not perhaps out of view in determining its shape. Of course, the reader will understand that those knights only displayed a pennon who had retainers to support and defend it, the mounting this ensign being a matter of privilege, not of obligation.

Froissart's heart never fails to overflow when he describes the encounter of a body of men-at-arms, arrayed in the manner we have described; he dwells with enthusiasm on the leading circumstances. The waving of banners and pennons, the dashing of spurs into the sides of chargers, and their springing forward to battle; the glittering of armour, the glancing of plumes, the headlong shock and splintering of the lances, the swords flashing through the dust over the heads of the combatants, the thunder of the horses' feet and the clash of armour, mingled with the war-cry of the combatants and the groans of the dying, form the mingled scene of tumult, strife, and death, which the canon has so frequently transferred to his chivalrous pages.

It was not in war alone that the adventurous knight was to acquire fame. It was his duty, as we have seen, to seek adventures throughout the world, whereby to exalt his own fame and the beauty of his mistress, which inspired such deeds. In our remarks upon the general spirit of the institution, we have already noticed the frantic enterprises which were seriously undertaken and punctually executed by knights desirous of a name. On these occasions, the undertaker of so rash an enterprise often owed his life to the sympathy of his foes, who had great respect for any one engaged in the discharge of a vow of

[1] So called because resembling in shape the heater of a smoothing-iron.

chivalry. When Sir Robert Knowles passed near Paris, at the head of an English army, in the reign of Edward III. the following remarkable incident took place:

"Now it happened, one Tuesday morning, when the English began to decamp, and had set fire to all the villages wherein they were lodged, so that the fires were distinctly seen from Paris, a knight of their army, who had made a vow the preceding day, that he would advance as far as the barriers and strike them with his lance, did not break his oath, but set off with his lance in his hand, his target on his neck, and completely armed except his helmet, and, spurring his steed, was followed by his squire on another courser, carrying the helmet. When he approached Paris, he put on the helmet, which his squire laced behind. He then galloped away, sticking spurs into his horse, and advanced prancing to strike the barriers. They were then open, and the lords and barons within imagined he intended to enter the town; but he did not so mean, for having struck the gates according to his vow, he checked his horse and turned about. The French knights who saw him thus retreat, cried out to him, 'Get away! get away! thou hast well acquitted thyself.' As for the name of this knight I am ignorant of it, nor do I know from what country he came; but he bore for his arms gules à deux fousses noir, with une bordure noir non endentée.

"However, an adventure befel him, from which he had not so fortunate an escape. On his return he met a butcher on the pavement in the suburbs, a very strong man, who had noticed him as he had passed him, and who had in his hand a very sharp and heavy hatchet with a long handle. As the knight was returning alone, and in a careless manner, the valiant butcher came on one side of him, and gave him such a blow between the shoulders, that he fell on his horse's neck: he recovered himself, but the butcher repeated the blow on his head, so that the axe entered it. The knight, through excess of pain, fell to the earth, and the horse galloped away to the squire, who was waiting for his master in the fields at the extremity of the suburbs. The squire caught the courser, but wondered what was become of his master; for he had seen him gallop to the barriers, strike them, and then turn about to come back. He therefore set out to look for him; but he had not gone many paces before he saw him in the hands of four fellows, who were beating him as if they were hammering on an anvil. This so much frightened the squire, that he dared not advance further, for he saw he could not give him any effectual assistance: he therefore returned as speedily as he could.

"Thus was this knight slain; and those lords who were posted at the barriers had him buried in holy ground. The squire returned to the army, and related the misfortune which had befallen his master. All his brother warriors were greatly displeased thereat." (Johnes's *Froissart*, vol. ii. p. 63.)

An equally singular undertaking was that of Galeazzo of Mantua, as rehearsed by the venerable Doctor Paris de Puteo, in his treatise *De Duello et Re Militari*, and by Brantome in his *Essay on Duels.* Queen Joan of Naples, at a magnificent feast given in her castle of Gaeta, had given her hand to Galeazzo for the purpose of opening the ball. The dance being finished, the gallant knight kneeled down before his royal partner, and, in order to make fitting acknowledgment of the high honour done him, took a solemn vow to wander through the world wherever deeds of arms should be exercised, and not to rest until he had subdued two valiant knights, and had presented them prisoners at her royal footstool, to be disposed of at her pleasure. Accordingly, after a year spent in visiting various scenes of action in Brittany, England, France, Burgundy, and elsewhere, he returned like a falcon with his prey in his clutch, and presented two prisoners of knightly rank to Queen Joan. The queen received the gift very graciously; and, declining to avail herself of the right she had to impose rigorous conditions on the captives, she gave them liberty without ransom, and bestowed on them, over and above, several marks of liberality. For this she is highly extolled by Brantome and Dr Paris, who take the opportunity of censuring the very opposite conduct of the canons of St Peter's Church at Rome, upon whom a certain knight had bestowed a prisoner taken in single combat. These ungracious churchmen received the gift as if it had been that of a wild beast for a menagerie, permitting the poor captive the freedom of the church indeed, but prohibiting him to go one step beyond the gate. In which condition, worse than death, they detained the vanquished knight for some time, and were justly blamed, as neither understanding Christian charity nor gentleman-like courtesy.

We return to consider the duties of a knight. His natural and proper element was war; but in time of peace, when there was no scope for the fiery spirit of chivalry, the knights attended the tourneys proclaimed by different princes, or, if these amusements did not occur, they themselves undertook feats of arms, to which they challenged all competitors. The nature of these challenges will be best understood from an abridged account of the *pas d'armes*, called the *Justs* of Saint Inglebert, or Sandyng Fields. This emprize was sustained by three gallant knights of France, Bouçicaut, Reynold de Roy, and Saint Py or Saimpi. Their articles bound them to abide thirty days at Saint Inglebert, in the marches of Calais, there to undertake the encounter of all knights and squires, Frenchmen, or strangers who should come hither, for the breaking of five spears, sharp, or with rockets, at their pleasure. On their lodgings they hung two shields called of peace and war, with their armorial blazons on each. The stranger desiring to just was invited to come or send, and touch which shield he would. The weapons of courtesy were to be employed if he chose the shield of peace, if that of war, the defenders were to give him the desired encounter with sharp weapons. The stranger knights were invited to bring some nobleman with them, to assist in judging the field; and the proclamation concludes with an entreaty to knights and squires strangers, that they will not hold this offer as made for any pride, hatred, or ill-will, but only that the challengers do it to have their honourable company and acquaintance, which with their whole heart they desire. They were assured of a fair field, without fraud or advantage; and it was provided that the shields used should not be covered with iron or steel. The French king was highly joyful of this gallant challenge (although some of his council doubted the wisdom of permitting it to go forth), and exhorted the challengers to regard the honour of their prince and realm, and spare no cost at the solemnity, for which he was willing to contribute ten thousand francs. A number of knights and squires came from England to Calais to accept this gallant invitation; and at the entrance of the "fresh and joly month of May," the challengers pitched three green pavilions in a fair plain between Calais and the Abbey of Saint Inglebert. Two shields hung before each pavilion, with the arms of the owner.

"On the 21st of the month of May, as it had been proclaimed, the three knights were properly armed, and their horses properly saddled, according to the laws of the tournament. On the same day those knights who were in Calais sallied forth, either as spectators or tilters, and, being arrived at the spot, drew up on one side. The place of the tournament was smooth, and green with grass.

"Sir John Holland was the first who sent his squire to touch the war-target of Sir Bouçicaut, who instantly issued from his pavilion completely armed. Having mounted his horse, and grasped his spear, which was stiff and well steeled, they took their distances. When the two knights had for a short time eyed each other, they spurred their horses, and met full gallop with such a force that Sir Bouçicaut pierced the shield of the Earl of Huntingdon, and the point of his lance slipped along his arm, but without wounding him. The two knights, having passed, continued their gallop to the end of the list. This course was much praised. At the second course, they hit each other slightly, but no harm was done; and their horses refused to complete the third.

"The Earl of Huntingdon, who wished to continue the tilt, and was heated, returned to his place, expecting that Sir Bouçicaut would call for his lance; but he did not, and showed plainly he would not that day tilt more with the earl. Sir John Holland, seeing this, sent his squire to touch the war-target of the Lord de Saimpi. This knight, who was waiting for the combat, sallied out from his pavilion, and took his lance and shield. When the earl saw he was ready, he violently spurred his horse, as did the Lord de Saimpi. They couched their lances, and pointed them at each other. At the onset, their horses crossed; notwithstanding which, they met; but by this crossing, which was blamed, the earl was unhelmed. He returned to his people, who soon re-helmed him; and having resumed their lances, they met full gallop, and hit each other with such a force in the middle of their shields, that they would have been unhorsed had they not kept tight seats by the pressure of their legs against their horses' sides. They went to the proper places, where they refreshed themselves, and took breath.

"Sir John Holland, who had a great desire to shine at this tournament, had his helmet braced, and re-grasped his spear; when the Lord de Saimpi, seeing him advance on the gallop, did not decline meeting, but, spurring his horse on instantly, they gave blows on their helmets, that were luckily of well-tempered steel, which made sparks of fire fly from them. At this course, the Lord de Saimpi lost his helmet; but the two knights continued their career, and returned to their places.

"This tilt was much praised, and the English and French said, that the Earl of Huntingdon, Sir Bouçicaut, and the Lord de Saimpi, had excellently well justed, without sparing or doing themselves any damage. The earl wished to break another lance in honour of his lady, but it was refused him. He then quitted the lists to make room for others, for he had run his six lances with such ability and courage as gained him praise from all sides." (Johnes's *Froissart*, vol. iv. p. 143.)

The other justs were accomplished with similar spirit. Sir Peter Courtney, Sir John Russell, Sir Peter Sherburn, Sir William Clifton, and other English knights, sustaining the honour of their country against the French, who behaved with the greatest gallantry; and the whole was regarded as one of the most gallant enterprises which had been fulfilled for some time.

Besides these dangerous amusements, the unsettled and misruled state of things during the feudal times found a gentle knight anxious to support the oppressed and to put down injustice, and, agreeably to his knightly vow, frequent opportunities to exercise himself in the use of arms. There was everywhere to be found oppressors to be chastised, and evil customs to be abolished; and the knight's occupation not only permitted, but actually bound him to volunteer his services in such cases. We shall err greatly if we suppose that the adventures told in romance are as fictitious as its magic, its dragons, and its fairies. The machinery was indeed imaginary, or rather, like that of Homer, it was grounded on the popular belief of the times. But the turn of incidents resembled, in substance, those which passed almost daily under the eye of the narrator. Even the stupendous feats of prowess displayed by the heroes of these tales, against the most overwhelming odds, were not without parallel in the history of the times. When men fought hand to hand, the desperate exertions of a single champion, well mounted and armed in proof, were sometimes sufficient to turn the fate of a disputed day; and the war-cry of a well-known knight struck terror farther than his arms. The advantage possessed by such an invulnerable champion over the half-naked infantry of the period, whom he might pursue and cut down at his pleasure, was so great, that in the insurrection of the peasants called the *Jâcquerie*, the Earl of Foix and the Captal de Buche, their forces not being nearly as one to ten, hesitated not to charge these disorderly insurgents with their men-at-arms, and were supposed to have slain nearly seven thousand, following the execution of the fugitives with as little mercy as the peasants had showed during the brief success of their rebellion.

The right which crown vassals claimed and exercised, of imposing exorbitant tolls and taxes within their domains, was often resisted by the knights-errant of the day, whose adventures in fact approached much nearer to Don Quixote than perhaps our readers are aware of. For although the knight of La Mancha was perhaps two centuries too late in exercising his office of redresser of wrongs, and although his heated imagination confounded ordinary objects with such as were immediately connected with the exercise of chivalry, yet, at no great distance from the date of the inimitable romance of Cervantes, real circumstances occurred of a nature nearly as romantic as the achievements which Don Quixote aspired to execute. In the more ancient times, the wandering knight could not go far without finding some gentleman oppressed by a powerful neighbour, some captive immured in a feudal dungeon, some orphan deprived of his heritage, some traveller pillaged, some convent or church violated, some lady in need of a champion, or some prince engaged in a war with a powerful adversary; all of which incidents furnished fit occasion for the exercise of his valour. By degrees, as order became more generally established, and the law of each state began to be strong enough for the protection of the subject, the interference of these self-authorized and self-dependent champions, who, besides, were in all probability neither the most judicious nor moderate, supposing them to be equitable, mediators, became a nuisance rather than an assistance to civil society; and undoubtedly this tended to produce those distinctions in the order of knighthood which we are now to notice.

Different orders of knighthood.

The most ancient, and originally the sole order of knighthood, was that of the knight-bachelor. This was the proper degree conferred by one knight on another, without the interference either of prince, noble, or churchman; and its privileges and duties approached nearly to those of the knight-errant. Were it possible for human nature to have acted up to the pitch of merit required by the statutes of chivalry, this order might have proved for a length of time a substitute for imperfect policy, a remedy against feudal tyranny, a resource for the weak when oppressed by the strong. Unquestionably, in many individual instances, knights were all that we have described them. But the laws of chivalry, like those of the ascetic orders, while announcing a high tone of virtue and self-denial, unfortunately afforded the strongest temptations to those who professed its vows, to abuse the character which they assumed. The degree of knighthood was easily attained, and did not subject the warrior on whom it was

granted to any particular tribunal in case of his abusing the powers which it conferred. Thus the knight became, in many instances, a wandering and licentious soldier, carrying, from castle to castle, and from court to court, the offer of his mercenary sword, and frequently abusing his character, to oppress those whom his oath bound him to protect. The license and foreign vices imported by those who had returned from the crusades, the poverty also to which noble families were reduced by these fatal expeditions, all aided to throw the quality of knight-bachelor lower in the scale of honour, when unsupported by birth, wealth, or the command of followers.

The poorest knight-bachelor, however, long continued to exercise the privileges of the order Their title of bachelor (or *bas chevalier*, according to the best derivation) marked that they were early held in inferior estimation to those more fortunate knights who had extensive lands and numerous vassals. They either attached themselves to the service of some prince or rich noble, and were supported at their expense, or they led the life of mere adventurers. There were many knights who, like Sir Gaudwin in the romance of *Partenopex de Blois*, subsisted by passing from one court, camp, and tournament, to another, and contrived even, by various means open to persons of that profession, to maintain, at least for a time, a fair and goodly appearance.

> So riding, they o'ertake an errant knight
> Well horsed, and large of limb, Sir Gaudwin hight;
> He nor of castle nor of land was lord,
> Houseless he reap'd the harvest of the sword:
> And now, not more on fame than profit bent,
> Rode with blythe heart unto the tournament,
> For cowardice he held it deadly sin,
> And sure his mind and bearing were akin.
> The face an index to the soul within,
> It seem'd that he, such pomp his train bewray'd,
> Had shap'd a goodly fortune by his blade;
> His knaves were, point device, in livery dight,
> With sumpter-nags, and tents for shelter in the night.

These bachelor-knights, as Mr Rose has well described Sir Gaudwin, set their principal store by valour in battle; and perhaps it was the only quality of chivalry which they at all times equally prized and possessed. Their boast was to be the children of war and battle, living in no other atmosphere but what was mingled with the dust of conflict and the hot breath of charging steeds. A "gentle bachelor" is so described in one of the *Fabliaux* translated by Mr Way:

> What gentle bachelor is he,
> Sword-begot in fighting field,
> Rock'd and cradled in a shield,
> Whose infant food a helm did yield.

His restless gallantry in tournament and battle—the rapidity with which he traversed land and sea, from England to Switzerland, to be present at each remarkable occasion of action—with his hardihood in enduring every sort of privation—and his generosity in rewarding minstrels and heralds—his life of battle and turmoil—and his deeds of strength and fame—are all enumerated. But we hear nothing of his redressing wrongs, or of his protecting the oppressed. The knight-bachelor, according to this picture, was a valiant prize-fighter, and lived by the exercise of his weapons.

In war, the knight-bachelor had an opportunity of maintaining, and even of enriching himself, if fortunate, by the ransom of such prisoners as he happened to make in battle. If in this way he accumulated wealth, he frequently employed it in levying followers, whose assistance, with his own, he hired out to such sovereigns as were willing to set a sufficient price on his services. In time of peace, the tournaments afforded, as we have already observed, a certain means of income to these adventurous champions. The horses and arms of the knights who succumbed on such occasions were forfeited to the victors, and these the wealthy were always willing to reclaim by a payment in money. At some of the achievements in arms the victors had the right, by the conditions of the encounter, to impose severe terms on the vanquished, besides the usual forfeiture of horse and armour. Sometimes the unsuccessful combatant ransomed himself from imprisonment, or other hard conditions, by a sum of money; a transaction in which the knight-bachelors, such as we have described them, readily engaged. These adventurers used to call the sword which they used in tourneys their *gagne-pain*, or bread-winner, as itinerant fiddlers of our days denominate their instruments.

> Dont i est gagne-pain nommée
> Car par li est gagnies li pains.
> *Pelerinage du Monde*, par Guigneville.

Men of such roving and military habits, subsisting by means so precarious, and lying under little or no restraint from laws, or from the social system, were frequently dangerous and turbulent members of the commonwealth. Every usurper, tyrant, or rebel, found knights-bachelors to espouse his cause, in numbers proportioned to his means of expenditure. They were precisely the "landless resolutes," whom any adventurer of military fame or known enterprise could easily collect

> For food and diet to some enterprise
> That hath a stomach in't.

Sometimes knights were found who placed themselves directly in opposition to all law and good order, headed independent bands of depredators, or, to speak plainly, of robbers, seized upon some castle as a place of temporary retreat, and laid waste the country at their pleasure. In the disorderly reigns of Stephen and of King John, many such leaders of banditti were found in England. And France, in the reign of John and his successors, was almost destroyed by them. Many of these leaders were knights or squires, and almost all pretended that in their lawless license they only exercised the rights of chivalry, which permitted, and even enjoined, its votaries to make war without any authority but their own, whenever a fair cause of quarrel occurs.

These circumstances brought the profession of knight-bachelor into suspicion, as in other cases the poverty of those who held the honour exposed it to contempt in their person. The sword did not always reap a good harvest; an enterprise was unfortunate, or a knight was discomfited. In such circumstances he was obliged to sell his arms and horse, and endure all the scorn which is attached to poverty. In the beautiful lay of Lanval, and in the corresponding tale of Gruelan, the story opens with the picture of the hero reduced to indigence, dunned by his landlord, and exposed to contempt by his beggarly equipment. And when John de Vienne and his French men-at-arms returned from Scotland, disgusted with the poverty and ferocity of their allies, without having had any opportunity to become wealthy at the expense of the English, and compelled before their departure to give satisfaction for the insolencies which they committed towards the inhabitants, "divers knights and squires had passage and so returned, some into Flanders, and as wind and weather would drive them, without horse and harness, right poor and feeble, cursing the day that ever they came into Scotland, saying that never man had so hard a voyage." (Berner's *Froissart*, vol. ii. (reprint) p. 32.) The frequent prohibition of tournaments, both by the church and by the more peaceful sovereigns, had also its necessary effect in impoverishing the knights-bachelors, to whom,

Chivalry. as we have seen, these exhibitions afforded one principal means of subsistence. This is touched upon in one of the French *fabliaux*, as partly the cause of the poverty of a chevalier, whose distresses are thus enumerated:

> Listen, gentles, while I tell
> How this knight in fortune fell:
> Lands nor vineyards had he none,
> Justs and war his living won;
> Well on horseback could he prance,
> Boldly could he break a lance,
> Well he knew each warlike use;
> But there came a time of truce,
> Peaceful was the land around,
> Nowhere heard a trumpet sound,
> Rust the shield and faulchion hid,
> Just and tourney were forbid,
> All his means of living gone,
> Ermine mantle had he none,
> And in pawn had long been laid
> Cap and mantle of brocade,
> Harness rich and charger stout,
> All were eat and drunken out.[1]

As the circumstances which we have mentioned tended to bring the order of knight-bachelor in many instances into contempt, the great and powerful attempted to entrench themselves within a circle which should be inaccessible to the needy adventurers whom we have described. Hence the institution of knights-banneret was generally received.

Knights-banneret. The distinction betwixt the knight-banneret and the knight-bachelor was merely in military rank and precedence, and the former may rather be accounted an institution of policy than of chivalry. The bachelor displayed, or was entitled to display, a pennon or forked ensign. The knight-banneret had the right of raising a proper *banner*, from which his appellation was derived. He held a middle rank beneath the barons or great feudatories of the crown, and above the knights-bachelors. The banner from which he took his title was a flag squared at the end, which, however, in strictness, was oblong, and not an exact square on all the sides, which was the proper emblem of a baron. Du Tillet reports, that the Count de Laval challenged Sir Raoul de Couequens' right to raise a square banner, being a banneret, and not a baron; and adds, that he was generally ridiculed for this presumption, and called the knight with the square ensign. The circumstance of the encroachment plainly shows, that the distinction was not absolutely settled; nor have we found the ensign of the bannerets anywhere described, except as being generally a square standard. Indeed, it was only the pennon of the knight a little altered; for he who aspired to be a banneret received no higher gradation in chivalry, as attached to his person, and was inducted into his new privileges merely by the commander-in-chief, upon the eve of battle, cutting off the swallow-tail or forked termination of the pennon.

In the appendix to Joinville's *Memoirs*, there is an essay on the subject of the bannerets, in which the following account of them is quoted from the ancient book of Ceremonies:—

"Comme un bachelier peut lever banniere, et devenir banneret.

"Quant un bachelier a grandement servi et suivy la guerre, et que il a assez terre, et que 'il puisse avoir gentilshommes, ses hommes, et pour accompagner sa banniere, il peut licitement lever banniere, et non autrement. Car nul homme ne doit porter ne lever banniere en bataille, s'il n'a du moins cinquante hommes d'armes, tous ses hommes et les archiers et arbalestriers qui y appartiennent. Et s'il les a 'il doit à la première bataille, ou il se trouvera, apporter un pennon de ses armes, et doit venir au connestable, ou aux marischaux, ou à celui qui sera lieutenant de l'ost pour le prince, requirer qu'il porte banniere; et s'il lui octroient, doit sommer les heraux pour tesmoignage, et doivent couper la queüe du pennon, et alors le doit porter et lever avant les autres bannieres, au dessoubs des autres barons.

There is this same ceremonial, in a chapter respecting the banneret, in these terms:—

"Comme se doit maintenir un banneret en bataille.

"Le banneret doit avoir cinquante lances, et les gens de trait qui y appartiennent: c'est à savoir les xxv. pour lui, et sa banniere garder. Et doit estre sa banniere dessoubs des barons. Et s'il y a autres banniere, ils doivent mettre leurs bannieres à l'onneur, chacun selon son endroit, et pareillement tout homme qui porte banniere."

Froissart, always our best and most amusing authority, gives an account of the manner in which the celebrated Sir John Chandos was made banneret by the Black Prince, before the battle of Navarete. The whole scene forms a striking picture of an army of the middle ages moving to battle. Upon the pennons of the knights, penoncels of the squires, and banners of the barons and bannerets, the army formed, or, in modern phrase, dressed its line. The usual word for the attack was, "Advance banners, in the name of God and Saint George."

"When the sun was risen, it was a beautiful sight to view these battalions, with their brilliant armour glittering with its beams. In this manner they nearly approached to each other. The prince, with a few attendants, mounted a small hill, and saw very clearly the enemy marching straight towards them. Upon descending this hill, he extended his line of battle in the plain, and then halted.

"The Spaniards, seeing the English had halted, did the same, in order of battle; then each man tightened his armour, and made ready as for instant combat.

"Sir John Chandos advanced in front of the battalions, with his banner uncased in his hand. He presented it to the prince, saying, 'My Lord, here is my banner; I present it to you, that I may display it in whatever manner shall be most agreeable to you; for, thanks to God, I have now sufficient lands that will enable me so to do, and maintain the rank which it ought to hold.'

"The prince, Don Pedro being present, took the banner in his hands, which was blazoned with a sharp stake gules, on a fixed argent; after having cut off the tail to make it square, he displayed it, and returning it to him by the handle, said, 'Sir John, I return you your banner; God give you strength and honour to preserve it.'

"Upon this, Sir John left the prince, went back to his men, with the banner in his hand,—'Gentlemen, behold my banner and yours; you will therefore guard it as it becomes you.' His companions, taking the banner, replied with much cheerfulness, that 'if it pleased God and St George, they would defend it well, and act worthily of it, to the utmost of their abilities.'

"The banner was put into the hands of a worthy English squire, called William Allestry, who bore it with honour that day, and loyally acquitted himself in the service. The English and Gascons soon after dismounted on the heath, and assembled very orderly together, each lord under his banner or pennon, in the same battle-array as when they passed the mountains. It was delightful to see and examine these banners and pennons, with the noble army that was under them."

It should not be forgotten, that Sir John Chandos exerted himself so much to maintain his new honour, that, advancing too far among the Spaniards, he was unhorsed,

[1] See the original in the republication of Barbazan's *Fabliaux*, vol. iii. p. 410.

and having grappled with a warrior of great strength, called Martin Ferrand, he fell undermost, and must have been slain, had he not bethought him of his dagger, with which he stabbed his gigantic antagonist. (Johnes's *Froissart*, vol. i. p. 731.)

A banneret was expected to bring into the field at least thirty men-at-arms, that is, knights or squires mounted, and in complete order, at his own expense. Each man-at-arms, besides his attendants on foot, ought to have a mounted crossbow-man, and a horseman armed with a bow and axe. Therefore the number of horsemen alone who assembled under a banner was at least three hundred, and, including followers on foot, might amount to a thousand men. The banneret might indeed have arrayed the same force under a pennon; but his accepting a banner bound him to bring out that number at least. There is no room, however, to believe that these regulations were very strictly observed.

In the reign of Charles VII. the nobles of France made a remonstrance to the king, setting forth that their estates were so much wasted by the long and fatal wars with England, that they could no longer support the number of men attached to the dignity of banneret. The companies of men-at-arms, which had hitherto been led by knights of that rank, and the distinction between knights-bannerets and knights-bachelors, were altogether disused from that period.[1] In England the title survived, but in a different sense. Those who received knighthood in a field of battle, where the royal standard was displayed, were called knights-banneret. Thus King Edward VI. notices in his *Journal*, that after the battle of Pinkie, " Mr Brian Sadler and Vane were made bannerets."

Companions in arms.

The distinction of banneret was not the only subdivision of knighthood. The special privileged fraternities, orders, or associations of knights, using a particular device, or embodied for a particular purpose, require also to be noticed. These might in part be founded upon the union which knights were wont to enter into with each other as " companions in arms," than which nothing was esteemed more sacred. The partners were united for weal and woe, and no crime was accounted more infamous than to desert or betray a companion at arms. They had the same friends and the same foes; and as it was the genius of chivalry to carry every virtuous and noble sentiment to the most fantastic extremity, the most extravagant proofs of fidelity to this engagement were often exacted or bestowed. The beautiful romance of *Ames and Amelien*, in which a knight slays his own child to make a salve with its blood, to cure the leprosy of his brother in arms, turns entirely on this extravagant pitch of sentiment.

To this fraternity only two persons could, with propriety, bind themselves. But the various orders, which had in view particular objects of war, or were associated under the authority of particular sovereigns, were also understood to form a bond of alliance and brotherhood amongst themselves.

The great orders of the Templars and Knights-Hospitallers of Saint John of Jerusalem, as well as that of the Teutonic Knights, were military associations, formed, the former for defence of the Holy Land, and the latter for conversion (by the edge of the sword, of course) of the Pagans in the north of Europe. They were managed by commanders or superintendents, and by a grand master, forming a sort of military republic, the individuals of which were understood to have no distinct property or interest from the order in general. But the system and history of these associations will be found under the proper heads. It is here only necessary to notice them as subdivisions of the knighthood or chivalry of Europe.

Other subdivisions arose from the various associations, also called orders, formed by the different sovereigns of Europe, not only for the natural purpose of drawing around their persons the flower of knighthood, but often with political views of much deeper import. The romances which were the favourite reading of the time, or which, at least, like the servant in the comedy, the nobles " had read to them," and which were on all occasions quoted gravely, as the authentic and authoritative records of chivalry, afforded the most respectable precedents for the formation of such fraternities under the auspices of sovereign princes; the Round Table of King Arthur, and the Paladins of Charlemagne, forming cases strictly in point. Edward III., whose policy was equal to his love of chivalry, failed not to avail himself of these precedents, not only for the exaltation of military honour and exercise of warlike feats, but questionless that he might draw around him, and attach to his person, the most valiant knights from all quarters of Europe. For this purpose, in the year 1344, he proclaimed, as well in Scotland, France, Germany, Hainault, Spain, and other foreign countries, as in England, that he designed to revive the Round Table of King Arthur, offering free conduct and courteous reception to all who might be disposed to attend the splendid justs to be held upon that occasion at Windsor Castle. This solemn festival, which Edward proposed to render annual, excited the jealousy of Philip de Valois, king of France, who not only prohibited his subjects to attend the Round Table at Windsor, but proclaimed an opposite Round Table to be held by himself at Paris. In consequence of this interference the festival of Edward lost some part of its celebrity, and was diminished in splendour and frequency of attendance. This induced King Edward to establish the memorable Order of the Garter. Twenty-six of the most noble knights of England and Gascony were admitted into this highly honourable association, the well-known motto of which (*Honi soit qui mal y pense*) seems to apply to the misrepresentations which the French monarch might throw out respecting the Order of the Garter, as he had already done concerning the festival of the Round Table. There was so much dignity, as well as such obvious policy, in selecting from the whole body of chivalry a select number of champions, to form an especial fraternity under the immediate patronage of the sovereign,—it held out such a powerful stimulus to courage and exertion to all whose eyes were fixed on so dignified a reward of ambition,—that various orders were speedily formed in the different courts of Europe, each having its own peculiar badges, emblems, and statutes. To enumerate these is the task of the herald, not of the historian, who is only called upon to notice their existence and character. The first effect of these institutions on the spirit of chivalry in general was doubtless favourable, as holding forth to the knighthood a high and honourable prize of emulation. But when every court in Europe, however petty, had its own peculiar order and ceremonial, while the great potentates established several, these dignities became so common as to throw into the shade the order of knights-bachelors, the parent and proper degree of chivalry, in comparison to which the others were mere innovations. The last distinction introduced, when the spirit of chivalry was almost totally extinguished, was the degree of knight-baronet.

Baronet.

The degree of baronet, or hereditary knighthood, might have been with greater propriety termed an inferior rank of noblesse than an order of chivalry. Nothing can be more

[1] See the works of Pasquier, Du Tillet, Le Gendre, and other French antiquaries.

Chivalry. alien from the original idea of chivalry than that knighthood could be bestowed on an infant, who could not have deserved the honour, or be capable of discharging its duties. But the way had been already opened for this anomaly by the manner in which the orders of foreign knighthood had been conferred upon children and infants in nonage. Some of these honours were also held by right of blood, the Dauphin of France, for example, being held to be born a knight of the Holy Ghost without creation; and men had already long lost sight of the proper use and purpose of knighthood, which was now regarded and valued only as an honorary distinction of rank, that imposed no duties, and required no qualifications, or period of preliminary noviciate. The creation of this new dignity, as is well known, was a device of James I. to fill those coffers which his folly and profusion had emptied; and although the pretext of a Nova Scotia or of an Ulster settlement was used as the apology for the creation of the order, yet it was perfectly understood that the real value given was the payment of a certain sum of money. The cynical Osborne describes this practice of the sale of honours, which, in their origin, were designed as the reward and pledge of chivalrous merit, with satirical emphasis.

"At this time the honour of knighthood, which antiquity reserved sacred as the cheapest and readiest jewel to present virtue with, was promiscuously laid on any head belonging to the yeomandry (made addle through pride and a contempt of their ancestor's pedigree), that had but a court friend, or money to purchase the favour of the meanest able to bring him into an outward roome, when the king, the fountaine of honour, came downe, and was uninterrupted by other businesse; in which case it was then usuall for him to grant a commission for the chamberlaine or some other lord to do it."

Degradation. Having noticed the mode in which knighthood was conferred, and the various subdivisions of the order in general, it is proper to notice the mode in which a knight might be degraded from his rank. This forfeiture might take place from crimes either actually committed, or presumed by the law of arms. The list of crimes for which a knight was actually liable to degradation corresponded to his duties. As devotion, the honour due to ladies, valour, truth, and loyalty, were the proper attributes of chivalry, so heresy, insults or oppression of females, cowardice, falsehood, or treason, caused his degradation. And heraldry, an art which might be said to bear the shield of chivalry, assigned to such degraded knights and their descendants peculiar bearings, called in blazonry abatements, though it may be doubted if these were often worn or displayed.

The most common case of a knight's degradation occurred in the appeal to the judgment of God by the single combat in the lists. In the appeal to this awful criterion, the combatants, whether personally concerned or appearing as champions, were understood, in martial law, to take on themselves the full risk of all consequences; and as the defendant or his champion, in case of being overcome, was subjected to the punishment proper to the crime of which he was accused, so the appellant, if vanquished, was, whether a principal or substitute, condemned to the same doom to which his success would have exposed the accused. Whichever combatant was vanquished, he was liable to the penalty of degradation; and if he survived the combat, the disgrace to which he was subjected was worse than death. His spurs were cut off close to his heels with a cook's cleaver; his arms were bafted and reversed by the common hangman; his belt was cut to pieces, and his sword broken. Even his horse showed his disgrace, the animal's tail being cut off close to the rump, and thrown on a dunghill. The death-bell tolled, and the funeral service was said, for a knight thus degraded, as for one dead to knightly honour. And if he fell in the appeal to the judgment of God, the same dishonour was done to his senseless corpse. If alive, he was only rescued from death to be confined in the cloister. Such at least were the strict rules of chivalry, though the courtesy of the victor, or the clemency of the prince, might remit them in favourable cases. Chivalry.

Knights might also be degraded without combat, when convicted of a heinous crime. In Stowe's *Chronicle*, we find the following minute account of the degradation of Sir Andrew Harclay, created Earl of Carlisle by Edward II., but afterwards accused of traitorous correspondence with Robert the Bruce, and tried before Sir Anthony Lucy.

"He was ledde to the barre as an earle morthily apparelled, with his sword girt about him, horsed, booted, and spurred, and unto whom Sir Anthony spake in this manner. Sir Andrew (quoth he), the king, for thy valiant service, hath done thee great honour, and made thee Earle of Carlile; since which tyme, thou, as a traytor to thy lord the king, leddest his people, that shoulde have holpe him at the battell of Heighland, awaie by the county of Copland, and through the earledom of Lancaster, by which meanes, our lorde the king was discomfitted there of the Scottes, through thy treason and falsenesse; whereas, if thou haddest come betimes, he hadde had the victorie: and this treason thou committedst for y^e great summe of golde and silver that thou receivedst of James Dowglasse, a Scot, the king's enemy. Our lord the king will, therefore, that the order of knighthood, by the which thou receivedst all thine honour and worship uppon thy bodie, be brought to nought, and thy state undone, that other knights, of lower degree, may after thee beware, and take example truely to serve.

"Then commanded he to hesne his spurres from his heeles, then to break his sword over his head, which the king had given him to keepe and defend his land therewith, when he made him earle. After this, he let unclothe him of his furred tabard, and of his hoode, of his coate of armes, and also of his girdle; and when this was done, Sir Anthony sayde unto him, Andrewe (quoth he), now art thou no knight, but a knave; and, for thy treason, the king will that thou shalt be hanged and drawne, and thyne head smitten off from thy bodie, and burned before thee, and thy bodie quartered: and thy head being smitten off, afterwarde to be set upon London bridge, and thy foure quarters shall be sent into foure good townes of England, that all other may beware by thee. And as Anthony Lucy hadde sayde, so was it done in all things, on the last daie of October."

III. We are arrived at the third point proposed in our arrangement, the causes, namely, of the decay and extinction of chivalry. Decay of chivalry.

The spirit of chivalry sunk gradually under a combination of physical and moral causes; the first arising from the change gradually introduced into the art of war, and the last from the equally great alteration produced by time in the habits and modes of thinking in modern Europe. Chivalry began to dawn in the end of the tenth and beginning of the eleventh century. It blazed forth with high vigour during the crusades, which indeed may be considered as exploits of national knight-errantry, or general wars, undertaken on the very principles which actuated the conduct of individual knights adventurers. But its most brilliant period was during the wars between France and England; and it was unquestionably in those kingdoms that the habit of constant and honourable opposition, unembittered by rancour or personal hatred, gave the fair-

est opportunity for the exercise of the virtues required from him whom Chaucer terms a very perfect gentle knight. Froissart frequently makes allusions to the generosity exercised by the French and English to their prisoners, and contrasts it with the dungeons to which captives taken in war were consigned, both in Spain and Germany. Yet both these countries, and indeed every kingdom in Europe, partook of the spirit of chivalry in a greater or less degree; and even the Moors of Spain caught the emulation, and had their orders of knighthood as well as the Christians. But, even during this splendid period, various causes were silently operating the future extinction of the flame, which blazed thus wide and brightly.

An important discovery, the invention of gunpowder, had taken place, and was beginning to be used in war, even when chivalry was in its highest glory. It is said Edward III. had field-pieces at the battle of Cressy, and the use of guns is mentioned even earlier. But the force of gunpowder was long known and used ere it made any material change in the art of war. The long-bow continued to be the favourite, and it would seem the more formidable missile weapon, for well nigh two centuries after guns had been used in war. Still every successive improvement was gradually rendering the invention of fire-arms more perfect, and their use more decisive of the fate of battle. In proportion as they came into general use, the suits of defensive armour began to be less generally worn. It was found, that these cumbrous defences, however efficient against lances, swords, and arrows, afforded no effectual protection against these more forcible missiles. The armour of the knight was gradually curtailed to a light head-piece, a cuirass, and the usual defences of men-at-arms. Complete harness was only worn by generals and persons of high rank, and that rather, it would seem, as a point of dignity than for real utility. The young nobility of France, especially, tired of the unwieldy steel coats in which their ancestors sheathed themselves, adopted the slender and light armour of the German Reiters or mercenary cavalry. They also discontinued the use of the lance; in both cases contrary to the injunctions of Henry IV. and the opinion of Sully. At length, the arms of the cavalry were changed almost in every particular from those which were proper for chivalry; and as, in such cases, much depends upon outward show and circumstance, the light-armed cavalier, who did not carry the weapons or practise the exercises of knighthood, laid aside, at the same time, the habits and sentiments peculiar to the order.

Another change of vital importance arose from the institution of the bands of gens-d'armes or men-at-arms in France, constituted, as we have observed, expressly as a sort of standing army, to supply the place of bannerets, bachelors, squires, and other militia of early times. It was in the year 1445 that Charles VII. selected, from the numerous chivalry of France, fifteen companies of men-at-arms, called Les Compagnies d'Ordonnance, to remain in perpetual pay and subordination, and to enable the sovereign to dispense with the services of the tumultuary forces of chivalry which, arriving and departing from the host at pleasure, collecting their subsistence by oppressing the country, and engaging in frequent brawls with each other, rather weakened than aided the cause they professed to support. The regulated companies, which were substituted for these desultory bands, were of a more permanent and manageable description. Each company contained a hundred men-at-arms, and each man-at-arms was to be what was termed a *lance garnie*, that is, a mounted spearman, with his proper attendants, being four archers, and a varlet, called a *coustillier*. Thus, each company consisted of six hundred horse, and the fifteen bands amounted to fifteen thousand cavalry. The charge of national defence was thus transferred from the chivalry of France, whose bold and desperate valour was sometimes rendered useless by their independent wilfulness and want of discipline, to a sort of regular forces, whose officers (a captain, lieutenant, and an ensign in each company) held command, not in virtue of their knighthood or banner right, but being direct commissions from the crown, as in modern times. At first, indeed, these bands of regulated gens-d'armes were formed of the same materials as formerly, though acting under a new system. The officers were men of the highest rank; the archers, and even the varlets, were men of honourable birth. When the Emperor Maximilian proposed that the French gens-d'armes should attempt to storm Padua, supported by the German lance-knechts, or infantry, he was informed by Bayard, that if the French men-at-arms were employed, they must be supported by those of the Germans, and not by the lance-knechts, because, in the French companies of ordonnance, every soldier was a gentleman. But, in the reign of Charles IX., we find the change natural to such a new order of things was in complete operation. The king was content to seek, as qualifications for his men-at-arms, personal bravery, strength, and address in the use of weapons, without respect to rank or birth; and, probably, in many instances, men of inferior birth were preferred to fill up the ranks of these regulated bands. Monluc informs us in his *Commentaries*, that he made his first campaign, as an archer, in the Marechal de Foix's company of gens-d'armes: "A situation much esteemed in these days, when many nobles served in that capacity. At present, the rank is greatly degenerated." The complaints of the old noblesse, says Mezerai, were not without reason. Mean carabineers, they said, valets, and lacqueys, were recruited in companies, which were put on the same footing with the ancient corps of gens-d'armes, whose officers were all barons of high rank, and almost every man-at-arms a gentleman by birth. These complaints, joined with the charge against Catharine of Medicis, that she had, by the creation of twenty-five new members of the order of St Michael, rendered its honours as common as the cockle-shells on the sea-shore, serve to show how early the first rude attempt at establishing a standing and professional army operated to the subversion of the ideas and privileges of chivalry. According to La Noue, it would seem that, in his time, the practice still prevailed of sending youths of good birth to serve as pages in the gens-d'armes; but, from the sort of society with whom they mixed in service of that sort, their natural spirit was rather debased, and rendered vulgar and brutal, than trained to honour and gallantry.

Civil wars in France and England.

A more fatal cause had, however, been for some time operating in England as well as France, for the destruction of the system we are treating of. The wars of York and Lancaster in England, and those of the Huguenots and of the League, were of a nature so bitter and rancorous, as was utterly inconsistent with the courtesy, fair play, and gentleness, proper to chivalry. Where different nations are at strife together, their war may be carried on with a certain degree of moderation. "During the foreign wars between France and Spain, especially in Piedmont," says La Noue, "we might often see a body of spears pass a village, where the peasants only interrupted their village dance to offer them refreshments; and, in a little after, a hostile troop receive, from the unoffending and unoffended inhabitants, the same courtesy. The two bodies would meet and fight gallantly, and the wounded of both parties would be transferred to the same village, lodged in the same places of accommodation, receive the same attention, and rest peaceably on each other's good faith till again able to take the field." He contrasts this

generosity with the miserable oppression of the civil wars, carried on by murdering, burning, and plundering friend and foe, armed and unarmed; alleging, all the while, the specious watchwords of God's honour, the king's service, the Catholic religion, the gospel, our country. In the end, he justly observes, "the soldiers become ravenous beasts, the country is rendered desert, wealth is wasted, the crimes of the great become a curse to themselves, and God is displeased." The bloody wars of the Rose in England, the execution of prisoners on each side, the fury and animosity which allowed no plea of mercy or courtesy, were scarce less destructive to the finer parts of the spirit of chivalry in England than those of the Huguenots in France.

But the civil wars not only operated in debasing the spirit of chivalry, but in exhausting and destroying the particular class of society from which its votaries were drawn. To be of noble birth was not indeed absolutely essential to receiving the honour of knighthood, for men of low descent frequently attained it; but it required a distinguished display of personal merit to raise them out of the class where they were born; and the honours of chivalry were, generally speaking, appropriated to those of fair and gentle parentage. The noble families, therefore, were the source from which chivalry drew recruits; and it was upon the nobles that the losses, proscriptions, and forfeitures of the civil wars chiefly fell. We have seen that in France their poverty occasioned their yielding up the privilege of military command to the disposal of the crown. In England it was fortunately not so much the crown as the commons who rose on the ruins of feudal chivalry; but it is well known that the civil wars had so exhausted the English nobility, as to enable Henry VII. to pass his celebrated statutes against those hosts of retainers, which struck, in fact, at the very root of their power. And thus Providence, whose ways bring good out of evil, laid the foundation of the future freedom of England in the destruction of what had long been its most constitutional ground of defence, and in the subjugation of that system of chivalry which, having softened the ferocity of a barbarous age, was now to fall into disuse, as too extravagant for an enlightened one.

Change of manners.

In fact, it was not merely the changes which had taken place in the constitution of armies and fashion of the fight, nor the degraded and weak state of the nobles, but also, and in a great degree, the more enlightened manners of the times, and the different channels into which enthusiasm and energy were directed, which gradually abolished the sentiments of chivalry. We have seen that the abstract principles of chivalry were, in the highest degree, virtuous and noble, nay, that they failed by carrying to an absurd, exaggerated, and impracticable point, the honourable duties which they inculcated. Such doctrines, when they fail to excite enthusiasm, become exploded as ridiculous. Men's minds were now awakened to other and more important and complicated exercises of the understanding, and were no longer responsive to the subjects which so deeply interested their ancestors of the middle ages. Sciences of various kinds had been rekindled in the course of the sixteenth century; the arts had been awakened in a style of perfection unknown even to classical ages. Above all, religion had become the interesting study of thousands; and the innovating doctrines of the reformers, while hailed with ecstacy by their followers, rejected as abominations by the Catholics, and debated fiercely by both parties, involved the nobility of Europe in speculations very different from the *arrets* of the court of love, and demanded their active service in fields more bloody than those of tilt and tournament. When the historians or disputants on either side allude to the maxims of chivalry, it is in terms of censure and ridicule; yet, if we judge by the most distinguished authorities on either side, the reformers rejected as sinful what the Catholics were contented to brand as absurd. It is with no small advantage to the Huguenots,—to that distinguished party which produced Sully, D'Aubigné, Coligni, Duplessis-Mornay, and La Noue, that we contrast the moral severity with which they pass censure on the books of chivalry, with the licentious flippancy of Brantome, who ridicules the same works on account of the very virtues which they inculcate. From the books of *Amadis de Gaul*, refining, as he informs us, upon the ancient vanities of Perceforest, Tristan, Giron, &c., La Noue contends, the age in which he lived derived the recommendation and practice of incontinence, of the poison of revenge, of neglect of sober and rational duty, desperate blood-thirstiness, under disguise of search after honour, and confusion of public order. "They are instructions," he says, "of Apollyon, who, being a murtherer from the beginning, delighteth wholly in promoting murther." "Of the tournaments," he observes that "such spectacles, rendering habitual the sight of blows and blood, had made the court of France pitiless and cruel." "Let those," he exclaims, "who desire to feed their eyes with blood, imitate the manner of England, where they exercise their cruelty on brute beasts, bringing in bulls and bears to fight with dogs, a practice beyond comparison far more lawful than the justs of chivalry."[1]

It is curious to contrast the opinions of La Noue, a stern and moral reformer, and a skilful and brave soldier as France ever produced, although condemning all war that did not spring out of absolute necessity, with those of Brantome, a licentious courtier, who mixed the popish superstitions, which stood him instead of religion, with a leaven of infidelity and blasphemy. From the opinions he has expressed, and from what he has too faithfully handed down as the manners of his court and age, it is plain that all which was valuable in the spirit of chivalry had been long renounced by the French noblesse. To mark this declension, it is only necessary to run over the various requisites already pointed out as necessary to form the chivalrous character, and contrast them with the opinions held in the end of the sixteenth century, in the court of the descendants of Saint Louis.

The spirit of devotion which the rules of chivalry inculcated was so openly disavowed, that it was assigned as a reason for preferring the character of Sir Tristram to that of Sir Lancelot, that the former is described in romance as relying, like Mezentius, upon his own arm alone; whereas Lancelot, on engaging in fight, never failed to commend himself to God and the saints, which, in the more modern opinions of the gallants of France, argued a want of confidence in his own strength and valour.

The devotion with which the ancient knights worshipped the fair sex was held to be as old-fashioned and absurd as that which they paid to heaven. The honours paid to chastity and purity in the German forests, and transferred as a sacred point of duty to the sons of chivalry, were as little to be found in the court of France, according to Brantome, as the chastity and purity to which it was due. The gross and coarse sensuality which we have seen engrafted upon professions of Platonic sentiment, became finally so predominant, as altogether to discard all marks of sentimental attachment; and from the time of Catharine of Medicis, who trained her maids of honour as courtezans, the manners of the court of France seem to have been inferior in decency to those of a well-regulated bagnio. The sort of respect which these ladies were deemed

[1] *Discourses, Political and Military*, translated out of the French of La Noue, 1587.

entitled to may be conjectured by an anecdote given by Lord Herbert of Cherbury, whose own character was formed upon the chivalrous model which was now become obsolete. As he stood in the trenches before a besieged place, along with Balagny, a celebrated duellist of the period, between whom and Lord Herbert some altercation had formerly occurred, the Frenchman, in a bravade, jumped over the entrenchment, and, daring Herbert to follow him, ran towards the besieged place, in the face of a fire of grape and musquetry. Finding that Herbert outran him, and seemed to have no intention of turning back, Balagny was forced to set the example of retreating. Lord Herbert then invited him to an encounter upon the old chivalrous point, which had the fairer and more virtuous mistress; to which proposition Balagny replied by a jest so coarse, as made the Englishman retort that he spoke like a mean debauchee, not like a cavalier and man of honour. As Balagny was one of the most fashionable gallants of his time, and, as the story shows, ready for the most hair-brained achievements, his declining combat upon the ground of quarrel chosen by Lord Herbert is a proof how little the former love of chivalry accorded with the gallantry of these later days.

Bravery, the indispensable requisite of the *preux chevalier*, continued, indeed, to be held in the same estimation as formerly; and the history of the age gave the most brilliant as well as the most desperate examples of it, both in public war and private encounter. But courage was no longer tempered with the good faith and courtesy, *La bonta dei gli cavalieri antichi*, so celebrated by Ariosto. There no longer existed those generous knights, that one day bound the wounds of a generous enemy, guided him to a place of refuge, and defended him on the journey, and which, on the next, hesitated not to commit itself in turn to the power of a mortal foe, without fear that he would break the faithful word he had pawned for the safety of his enemy. If such examples occur in the civil wars of France, they were dictated by the generosity of individuals who rose above the vices of their age, and were not demanded, as matters of right, from all who desired to stand well in public opinion. The intercourse with Italy, so fatal to France in many respects, failed not to imbue her nobility with the politics of Machiavel, the coarse licentiousness of Aretin, and the barbarous spirit of revenge, which held it wise to seek its gratification, not in fair encounter, but *per ogni modo*, in what manner soever it could be obtained. Duels, when they took place, were no longer fought in the lists, or in presence of judges of the field, but in lonely and sequestered places. Inequality of arms was not regarded, however great the superiority on one side. "Thou hast both a sword and dagger," said Quelus to Antragues, as they were about to fight, "and I have only a sword."—"The more thy folly," was the answer, "to leave thy dagger at home. We came to fight, not to adjust weapons." The duel accordingly went forward, and Quelus was slain, his left hand (in which he should have had his dagger) being shockingly cut in attempting to parry his antagonist's blows without that weapon. The challenged person having a right to choose his weapons, often endeavoured to devise such as should give him a decidedly unfair advantage. Brantome records with applause the ingenuity of a little man, who, being challenged by a tall Gascon, made choice of a gorget so constructed that his gigantic adversary could not stoop his neck so as to aim his blows right. Another had two swords forged of a temper so extremely brittle, that unless used with particular caution, and in a manner to which he daily exercised himself, the blade must necessarily fly in pieces. Both these ingenious persons killed their man with very little risk or trouble, and no less applause, it would seem, than if they had fought without fraud and covine. The seconds usually engaged, and when one of the combatants was slain, his antagonist did not hesitate to assist his comrade in opposing by odds him who remained. The *little French Lawyer* of Fletcher turns entirely on this incident. By a yet more direct mode of murder, a man challenged to a duel was not always sure that his enemy was not to assassinate him by the assistance of ruffians at the place of rendezvous, of which Brantome gives several instances without much censure. The plighted word of an antagonist by no means insured against treachery to the party to whom it was given. De Rosne, a gentleman well skilled in the practice and discipline of the wars, receiving a challenge from De Fargy, through the medium of a young man, who offered to pledge his word and faith for the fair conduct of his principal, made an answer which Brantome seems to approve as prudential. "I should be unwilling," he replied, "to trust my life upon a pledge on which I would not lend twenty crowns." In many cases no ceremony was used, but the nobles assassinated each other without scruple or hesitation. Brantome gives several stories of the Baron des Vitaux, and terms his detestable murders bold and brave revenges. But it would be endless to quote examples. It is enough to call to the reader's recollection the bloody secret of the massacre of St Bartholomew, which was kept by such a number of the Catholic noblemen for two years, at the expense of false treaties, promises, and perjuries innumerable, and the execution which followed on naked, unarmed, and unsuspecting men, in which so many gallants lent their willing swords.

In England, the free tone of the government, and the advantage of equal laws, administered without respect of persons, checked similar enormities, which, however, do not appear to have been thought in all cases inconsistent with the point of honour, which, if not, as in France, totally depraved from the ancient practices of chivalry, might probably have soon become so. Sir John Ayres did not hesitate to attack Lord Herbert with the assistance of his servants; and the outrage upon the person of Sir John Coventry, which gave rise to the Coventry act against cutting and maiming, evinced the same spirit of degenerate and blood-thirsty revenge. Lord Sanquhar having lost an eye in a trial of skill with a master of defence, conceived that his honour required that he should cause the poor man to be assassinated by ruffians in his own school; but as this base action met its just reward at the gallows, the spirit of Italian revenge was probably effectually checked by such a marked example. At the gallows, the unfortunate nobleman expressed his detestation for the crime, which he then saw in all its enormity. Before his trial he said the devil had so blinded his understanding that he could not understand that he had done amiss, or otherwise than befitting a man of high rank and quality, having been trained up to the court, and living the life of a soldier, which sort of men, he said, stood more on a point of honour than religion. The feelings of chivalry must have been indeed degraded, when so base an assassination was accounted a point of honour. In Scotland, the manners of which country, as is well observed by Robertson, strongly resembled those of France, the number of foul murthers during the sixteenth century was almost incredible, and indeed assassination might be termed the most general vice of the sixteenth century.

From these circumstances, the total decay of chivalrous principle is sufficiently evident. As the progress of knowledge advanced, men learned to despise its fantastic refinements; the really enlightened, as belonging to a system inapplicable to the modern state of the world; the licentious, fierce, and subtile, as throwing the barriers of

affected punctilio betwixt them and the safe, ready, and unceremonious gratification of their lust or their vengeance. The system, as we have seen, had its peculiar advantages during the middle ages. Its duties were not, and indeed could not always be performed in perfection, but they had a strong influence on public opinion; and we cannot doubt that its institutions, virtuous as they were in principle, and honourable and generous in their ends, must have done much good and prevented much evil. We can now only look back on it as a beautiful and fantastic piece of frostwork, which has dissolved in the beams of the sun. But though we look in vain for the pillars, the vaults, the cornices, and the fretted ornaments of the transitory fabric, we cannot but be sensible that its dissolution has left on the soil valuable tokens of its former existence. We do not mean, nor is it necessary to trace, the slight shades of chivalry which are yet received in the law of England. An appeal to combat in a case of treason was adjudged in the celebrated case of Ramsay and Lord Reay, in the time of Charles I. An appeal of murder seems to have been admitted as legal within a recent period, though it has subsequently been abolished by statute; but it is not in such issues, rare as they must be, that we ought to trace the consequences of chivalry. We have already shown that its effects are rather to be sought in the general feeling of respect to the female sex; in the rules of forbearance and decorum in society; in the duties of speaking truth and observing courtesy; and in the general conviction and assurance that, as no man can encroach on the property of another without accounting to the laws, so none can infringe on his personal honour, be the difference of rank what it may, without subjecting himself to personal responsibility. It will be readily believed that, in noticing the existence of duelling as a relic of chivalry, we do not mean to discuss the propriety of the custom. It is our happiness that the excesses to which this spirit is liable are checked by the laws which wisely discountenance the practice; for although the severity of the laws sometimes give way to the force of public opinion, they still remain an effectual restraint, in every case where the circumstances argue either wanton provocation or unfair advantage. It is to be hoped that, as the custom of appealing to this Gothic mode of settling disputes is gradually falling into disuse, our successors may enjoy the benefit of the general urbanity, decency, and courtesy which it has introduced into the manners of Europe, without having recourse to a remedy not easily reconciled to law or to Christianity. (W. S—TT.)

Court of CHIVALRY, a court formerly held before the lord high constable and earl marshal of England jointly, with both civil and criminal jurisdiction, but no power to enforce its decisions by fine or imprisonment, not being a court of record.

CHIVASSO, a small city of Piedmont, kingdom of Sardinia, province of Turin, in a fertile plain on the left bank of the Po, 15 miles N.E. of Turin. It was formerly considered as the key of Piedmont, and was strongly fortified, but is now only inclosed by a single wall with two gates leading to two suburbs. The front of the church of *San Pietro* is decorated with ornaments and entire statues in terra cotta, of great elegance, but much defaced. Of the ancient palace of the Counts of Montferrat, an octagonal tower still remains. Pop. 8000.

CHLAMYS, in *Antiquity*, a woollen cloak, or rather a scarf, worn by the Greeks as well as by the Oriental races with whom they were connected. It was sometimes of purple, inwrought with gold, and was the appropriate costume of military chiefs, though likewise used by other persons, by actors on the stage, and sometimes by children. It corresponded nearly to the Roman *lacerna* and *paludamentum;* and indeed the use of the chlamys itself was to some extent adopted by the Romans during the imperial period. The chlamys is frequently represented in the antique sculptures.

CHLOE, a surname of Demeter (Ceres), signifying the Blooming, under which title, as the protectress of the springing corn and grass, she was honoured by the Athenians with a festival called Chloeia, on which occasion a goat was sacrified with much mirth and rejoicing.

CHLORINE. See CHEMISTRY.

CHLORIS, in *Grecian Mythology*, the wife of Zephyrus, and the goddess of flowers, identical with the Roman Flora.

Also the name given to Melibœa, daughter of Niobe, on account of the pallor of her countenance when terror-stricken at the destruction of her brothers and sisters. See NIOBE.

Another Chloris, the daughter of Amphion of Orchomenos, was the wife of Neleus king of Pylos, and mother of Nestor.

CHLOROFORM, an article of the materia medica, used by medical men for various purposes, but principally to produce a state of anæsthesia or painlessness in surgical and obstetric operations, and in different forms of disease. *Definition.*

The fluid to which the name of chloroform is given was nearly simultaneously discovered in 1831–32 by Guthrie in America, Soubeiran in France, and Liebig in Germany. Its true chemical composition, however, was not ascertained till Dumas and Peligot directed their attention to the subject in 1834–35. *Composition.* It consists ultimately of 2 atoms of carbon, 1 of hydrogen, and 3 of chlorine. But in accordance with the generally received opinion of chemists, it may be more correctly described as composed of 3 atoms of chlorine, and 1 atom of formyle; and hence the names given to it of chloroform, chloroformyle, formychloride, or perchloride of formyle. *Origin of the name.* In other words, it is regarded as a compound of chlorine with formyle, while the latter is the hypothetic base of formic acid, or of that fluid capable of reducing the oxides of the noble metals, which Samuel Fischer long ago distilled from the body of the red ant, or *formica rufa* (hence the name formic and formyle), and which Marggraf, Arvidson, Richter, Gehlen, and others have subsequently more elaborately examined.

When Guthrie, Soubeiran, and Liebig first discovered chloroform in the course of their chemical experiments and inquiries, and when Dumas and Peligot subsequently worked out its true chemical composition, their sole and only object was the investigation of a subject in philosophical chemistry. They laboured for the pure love of the extension of knowledge; they had no idea that the substance to which they called the attention of their chemical brethren would or could be turned to any practical purpose, or that it possessed any physiological or therapeutic effects on the animal economy. Those who use the *cui bono* argument against philosophical investigations, on the ground that at first they may appear to yield no practical benefit, will find that argument fully refuted in this as in many other instances; for here we have a chemical compound which for many years after its discovery was merely interesting as a matter of scientific curiosity and research, becoming latterly an article of great importance and extensive manufacture, as a medicinal agent by which human

Chloroform.

suffering and agony may be annulled under some of the most trying circumstances in which human nature is ever placed.

Modes of preparation.

Chloroform may be obtained by various processes; as, 1, by passing a stream of chlorine gas into an alkaline solution of caustic potass; 2, by decomposing chloral with the agency of aqueous fixed alkalies; 3, by heating acetate of potass or acetate of soda with chloride of lime; 4, by boiling chloroacetic acid with aqueous ammonia; 5, by decomposing chloride of methyl by chlorine in a vessel exposed to the sun's rays; 6, by distilling alcohol, pyroxilic or wood spirit, or acetone with chloride of lime, &c. &c. Some vegetable oils, as those of turpentine, lemons, bergamot, peppermint, &c., when heated with chloride of lime and water, yield chloroform. When manufactured on a large scale, chloroform is prepared by distilling a mixture consisting of six parts of chloride of lime, or common bleaching powder, in thirty parts of water, and one part of alcohol. The fluid which passes over separates into two layers, the lower of which is chloroform; and the upper layer consists principally of a solution of weak spirit. The chloroform, before it can be safely used, requires, however, to be much purified. For, 1st, in order to remove the water and alcohol mixed with it, it is shaken up with about half its volume of strong sulphuric acid, slowly added; and, 2dly, to remove the acid, the chloroform is redistilled from milk of lime. Sometimes it is redistilled a third or even a fourth time, after being allowed to stand over quicklime, in order to render it completely pure, and of the requisite specific gravity. For other methods, and full details as to the manufacture of chloroform on the large scale, we need only refer to the pharmacopœias and dispensatories, and the various text-books on chemistry.

Physical and chemical properties.

It is a clear, colourless, limpid liquid; heavy, and of a specific gravity varying from 1·480 to 1·500; not inflammable; very volatile; it boils at 140° Fahr., and remains liquid and transparent at 4° Fahr. The density of its vapour is 4·13, or it is about four times heavier than atmospheric air. It has a fragrant, ethereal, fruit-like odour, and a slightly acrid, but at the same time intensely sweet, saccharine taste. It dissolves very sparingly in water, to which it imparts its sweet odour and taste; but it mixes in all proportions with alcohol. It is a powerful solvent, speedily dissolving camphor, gutta-percha, wax, resins, &c.

Impurities.

Chloroform is often found in the market very impure, and containing empyreumatic oils, aldehyde, chlorine, free muriatic acid, &c. When so contaminated, its medicinal use, by inhalation, is liable to be attended by headache, cough, nausea, &c. It deserves to be particularly known that the purest chloroform will sometimes spontaneously decompose if left exposed for a length of time to the combined influence of heat and light. Hence, when the liquid is kept for medical purposes, and particularly in warm climates, it is a matter of importance to keep it in a dark and cool place.

Physiological effects.

When inhaled in small quantities only, and slowly, the influence of chloroform upon the system is exhilarating and intoxicating, like the influence of alcohol or any diffusible stimulant.

When inhaled in larger and continuous doses, with the view of suspending pain in surgical, obstetrical, or medical practice, its effects are generally as follows:—After a few inhalations there supervenes a feeling of warmth and exhilaration, radiating from the heart towards the extremities, but generally perceived first in the extremities themselves. In most persons this feeling is speedily followed by a sensation of vibratory thrilling and benumbing throughout the body, and by affections of the organs of sense, as by loud whirring noises in the ears, or brilliant lights before the eyes. After one or two additional inhalations there is a rapid loss of sensation and voluntary motion, and at last a total suspension of consciousness. The state induced is a condition of deep artificial sleep. During this anæsthetic sleep, the relation between the mental condition of the patient and his unsusceptibility to the feeling of pain differs much in different individuals, and is greatly regulated by the amount of dose that is used. When the dose is at last full and complete, and such as is now usually given before most great surgical operations, no mental action appears to go on, or, at least, none whatever is remembered. In other persons, however, and especially when the dose is not so great and complete, though all consciousness of pain is suspended, the mind is still active as in dreams; and occasionally, though rarely, this peculiarity is observable—that the same type of dream recurs to the same individual every time he is subjected to the anæsthetic vapour. Sometimes when the dose of chloroform is not sufficiently great, a patient will wince or cry out under the use of the surgeon's knife or cautery, and afterwards on awaking declare that he has felt nothing. In such cases a certain amount of sensibility and consciousness appear to remain, but the memory of the patient subsequently retains no recollection whatever of any circumstances that have happened during his temporary anæsthetic sleep. Persons occasionally will talk ramblingly when subjected to an incomplete dose; but this rarely happens, except some of those around are conversing and exciting the patient; and it can be readily arrested by an additional dose of the anæsthetic, and by enforcing quietude. In other persons again, sometimes, when the dose is small, sensation is found to be suspended, and freedom from pain obtained, whilst still a greater or less amount of mental consciousness and intellectual activity and clearness remains. Their sensibility to suffering is more or less completely deadened, while their intelligence is preserved. The muscles of voluntary motion usually become more and more relaxed as the intensity of the anæsthetic effect increases, and at last their action can always be thoroughly suspended—a matter of great surgical moment in relation to the reduction of dislocations. But occasionally, before this total relaxation is produced, a state of spasm supervenes, particularly if the patient is held and restrained, or excited by talking and noises during the inhalation of the chloroform. Generally the pulse is increased in frequency during the first inhalations, but when the system is fully brought under the influence of the anæsthetic it decreases to its natural standard, or even becomes slower than natural; and few persons are able to bear with total impunity the wounds of a severe surgical operation until the anæsthetic vapour is given to such an extent as to have reduced the pulse to this degree. The respiration, though unaffected at first, becomes slower and deeper as the influence of the anæsthetic increases; and usually it is rendered soporose before any great surgical operation is begun. The temperature of the body decreases when the action of the chloroform is long continued.

The rapidity with which the effects of chloroform upon the mind and body disappear is perhaps not less wonderful than the rapidity with which they supervene. Generally the awakening from the anæsthetic sleep is in the course of a few minutes after the inhalation is arrested. When the patient is left undisturbed, he usually awakes to a state of perfect consciousness; but sometimes, particularly if roused artificially or too early, a few minutes will elapse before he is perfectly master of his own state and situation. When the drug used is pure no headache follows. In some cases there is left a tendency to sleep.

Therapeutic uses.

The inhalation of chloroform is now extensively employed by professional men to fulfil various purposes in the practices of surgery, midwifery, medicine, and medical jurisprudence.

In Surgery.

In surgery it is employed with different indications, as, 1. And principally, to annul and abolish the pain and agony attendant upon the various chirurgical operations, whether

Chloroform. these operations are performed with the knife, caustic, ligature, or otherwise. But the surgeon finds great value in its use in other matters of practice, as, 2. In enabling him to make a far clearer examination and more accurate diagnosis in some difficult cases of injury and disease, such as fractures, dislocations, stone, &c. 3. By the total relaxation which a full dose produces, the reduction of dislocations, herniæ, &c., is much simplified and facilitated. 4. The removal of patients who have suffered severe injuries or wounds, to their homes or to hospitals (a matter often attended with much and exhausting suffering), has now, by the previous use of chloroform, been often accomplished without pain and without danger. 5. The agony attendant upon the daily dressing of large wounds, as those made by burns, amputations, &c., has been abolished by its employment. 6. Under the use of chloroform amputations and other operations, required after severe injuries and wounds, are sometimes capable of being performed when, without it, the state of shock and depression would otherwise totally forbid operative interference. And lastly, the mortality accompanying surgical operations has been in a marked degree diminished and lessened since the general introduction of anæsthetics.

In Midwifery. Various important objects are gained by the accoucheur through the employment of chloroform in midwifery. 1. By its use he is enabled to save the mother from the suffering attendant upon the process of common parturition in the human female, and that without placing his patient in a degree of anæsthesia by any means so deep, and hence so dangerous, as is required in surgery. 2. In morbid or difficult cases of labour, requiring manual or instrumental interference, the state of anæsthesia enables him to apply that interference without pain to his patient, and generally with much greater facility to himself. 3. By its aid the process of obstetric diagnosis is, in many circumstances of doubt and difficulty, very greatly improved and facilitated. 4. By its relaxing effects it renders the dilatation of the maternal canals more easy, especially where these canals have any tendency to spasmodic rigidity and contraction. 5. In cases where arrestment of uterine action is a matter of great importance, as in the operation of version, &c., a very complete and very deep dose of chloroform enables us to attain this object far better and more speedily than by opium or other means. 6. Chloroform seems generally capable of reducing and keeping in abeyance one of the most common and most fatal complications in difficult labour, namely, puerperal convulsions. And, lastly, by saving the constitution of the patient from the pain attendant on the process of human parturition, it saves her strength and constitution, expedites her convalescence, and renders her proportionably less liable to the various affections which occur in the puerperal state.

In Medicine. The inhalation of chloroform has been employed in medicine for various purposes:—1. As an anodyne or anæsthetic in severe and exhausting pains, whether inflammatory or neuralgic; as in earache, toothache, pleurodyne, tic, &c. 2. As a narcotic in cases of delirium tremens, of puerperal and other forms of mania, and in other diseases where there is wakefulness and excitement. 3. As an antispasmodic in colic, dysmenorrhœa, laryngismus, asthma, hooping cough, the pains attendant on the passage of biliary and renal calculi, in chorea, tetanus, hysteria, and in infantile and other forms of convulsion. 4. In small doses as a diffusible stimulant to arrest the first commencement of the rigor in ague, in ephemeral fever, &c., and to support the excitement of the system where the stomach will not bear wine or other stimulants. Lastly, it has been used, particularly by some German and French physicians, in inflammatory affections alike of the head, chest, and abdomen. In the hospital of Frankfort and elsewhere small and frequently repeated inhalations of chloroform have been extensively employed in inflammation of the lungs, with the effect, it is alleged, of more marked relief to the cough pain, and fever, and a more speedy resolution of the disease than under any other treatment with which it was contrasted. It will probably ere long be applied to other uses in medicine.

Chloroform, administered by the stomach and not by the lungs, is also used by physicians. The usual dose of the drug when swallowed is from five to twenty drops, dissolved in a mucilaginous or oily liquid. In this form it exerts in a less marked but in a more prolonged degree the same therapeutical effects as the inhalation of the drug by the lungs.

In Legal medicine. In the detection of feigned diseases, as in pretended paralysis and contractions of limbs, in simulated deafness, &c., chloroform has been successfully used by army surgeons and others.

Other anæsthetic agents. Various chemical gases and vapours beside chloroform have been found when inhaled to possess the effect of producing, some in a more, others in a less marked degree, a state of anæsthetic insensibility and sleep. Among these we may enumerate protoxide of nitrogen (the "laughing gas" of Sir Humphry Davy), olefiant gas, light carburetted hydrogen, bisulphuret of carbon, chloride of hydrocarbon, or Dutch liquid, aldehyde, acetone, coal and rock naphtha, benzoine, and various ethers, as the nitric, acetic, hydrochloric, formic and other ethers, but particularly sulphuric ether.

It has also been supposed that the odour and vapours of some vegetable substances can exert an anæsthetic effect. We shall afterwards see that the ancients believed that the odour of mandragora, and that vapours arising from the concentrated juices of henbane, hemlock, &c., were capable of producing insensibility to surgical operations. Knowing the soporific effects of the common puff-ball (*Lycoperdon bovista*) upon the working bee, we some years ago made repeated trials of the effects of it, but without ever producing any very marked degree of anæsthesia in man. Since that time it has been tried by Mr Richardson and others, but, we believe, without any greater success.

Advantages of chloroform. The advantages which chloroform possesses over the other anæsthetic agents hitherto discovered are various. A smaller, and hence a more portable quantity of chloroform than of other anæsthetics is required in order to produce the state of anæsthesia; its action is more perfect and more certain; it exerts in ordinary doses no such depressing effects on the heart and general system as most of those chemical compounds which we have enumerated do; it acts rapidly, and consequently with a comparative short stage of excitement; its inhalation is infinitely more agreeable than the inhalation of most other anæsthetic gases or vapours; its odour is rapidly evanescent, and does not adhere to the clothes of those near it, giving it in this respect no small advantage with the busy physician over the persistent and disagreeable smell of sulphuric ether, &c.; it is cheaper than any other known anæsthetic; and, lastly, no special instrument requires to be used in its exhibition.

Dose, and mode of exhibition. To produce such a complete anæsthetic effect as is required for most surgical operations a larger and more rapid dose is necessary than in obstetric practice; whilst in midwifery the drug requires to be given in smaller quantities, but for a far greater stretch of time than in surgery. Numerous forms of instruments have been proposed for the exhibition of chloroform by inhalation, but they merely complicate the process; and certainly the simplest as well as the safest apparatus is a piece of sponge, or a towel or handkerchief.

In Surgery. Two or three fluid drachms of the liquid diffused upon the interior of a towel or pocket handkerchief, arranged in a somewhat concave form in the hand of the exhibitor, and applied over the mouth and nose of the patient, generally

Chloroform.

suffice to produce speedy and complete anæsthesia. If such an effect does not follow, an additional dose ought to be poured on the handkerchief at the end of a minute or two, for the drug rapidly evaporates. At first the moistened handkerchief ought to be held at the distance of half an inch or an inch from the face of the patient to allow free access of air to the mouth and nostrils, and afterwards it should be gradually approached nearer. At last it should touch the face except at one side where the fingers interpose between the face and it, to allow of a sufficient access of atmospheric air. In order that the patient may be brought speedily under the influence of the drug, and with as short an excited stage as possible, the vapour should be allowed to pass into the air tubes by both the mouth and nostrils, and all means of compressing either of these two cavities by the fingers or instruments must be strictly avoided. It should always be remembered that the vapour of chloroform is about four times heavier than atmospheric air, and hence the handkerchief or towel should be held in such a position over the mouth and nostrils, or so adjusted about the lower part of the face as to allow the vapour, by its mere gravitation, to fall into the air passages. Not unfrequently, at the moment when the patient is first becoming insensible, he will suddenly withdraw his face, or forcibly push aside the handkerchief with his hand; but the handkerchief should be instantly so reapplied as to allow the vapour to gravitate towards, and be drawn into the mouth and nostrils; and a few additional inhalations will now, after this point of excitement, render the patient quite insensible. The tests of the patient being fully anæsthetized that are usually most relied upon in practice, consist of induced slowness of the pulse, or some degree of noise or sopor in the respiration. Either or both of these phenomena, viz., slowness of the pulse, or some noise in the respiration, indicate that the patient is sufficiently insensible for undergoing any surgical operation, and the chloroform handkerchief must be withdrawn as soon as they supervene. Subsequently, only smaller and intermitting doses of the vapour are in general required in order to maintain an adequate state of anæsthesia during the performance of the operation. The principal error committed in using chloroform in surgery consists in giving it at first in such small doses, or so slowly, as to keep up a state of excitement instead of inducing a true state of anæsthesia; and a still more grievous error is sometimes committed in commencing the use of the knife before the pulse or respiration is affected, and consequently while the patient is not yet sufficiently anæsthetized.

Exhibition in Midwifery.

In midwifery practice there are two leading peculiarities in regard to the exhibition of chloroform, viz., first, that it is given to the patient only when the parturient actions or pains are present, and is always totally and entirely withdrawn in the intervals between these contractions or pains. The neglect of this simple but all-important rule has led, on the part of some practitioners, to much error and misconception regarding the effects and utility of chloroform in midwifery. But, secondly, the drug does not require to be given in such large and full doses in midwifery as in surgery, except where severe obstetric operations are to be performed. And, as ample experience has now shown, it may be given in common obstetric practice with perfect safety for two, four, six, or more hours, if the two simple rules alluded to above be duly followed.

In medical diseases.

When used in the treatment of medical diseases, chloroform is sometimes employed for a much longer time than in either midwifery or surgery. Patients suffering under tetanus, peritonitis, &c., have sometimes been kept more or less under its influence for two, three, or more continuous days. We have seen a child affected with infantile convulsions of such severity as to defy all other means, kept under the agency of chloroform with slight intermissions, to allow of food being taken, &c., for fourteen days, with the effect of arresting the fits, and ultimately saving the life of the little patient.

We have as yet found no human being capable of withstanding the anæsthetic effect of chloroform, though sometimes in exceptional cases a much larger dose is required than in others; and the actual amount necessary in any case can be judged of only by the actual effects of the drug, and not by any rules as to its mere measurement or quantity.

Contra-indications.

There are perhaps few morbid states which entirely contra-indicate the use of chloroform when required as an anæsthetic agent. It is generally, however, believed that marked disease of the valves of the heart, or fatty degeneration of the walls of that organ, and diseased states of the brain, form reasons for avoiding its employment. It should not be given in large doses—as for surgical operations—shortly after meals; otherwise sickness and vomiting of the contents of the stomach are liable to follow. A little previous fasting usually prevents this complication.

Cautions.

In the way of caution in the employment of chloroform, the points that demand the principal attention are the following:—1. The drug employed should be as pure as possible, and free from those various deleterious ingredients that are sometimes found mixed up with it, and which are liable to produce cough, headache, &c. 2. In its exhibition there ought always to be allowed to enter with the vapour of chloroform a free intermixture of atmospheric air, the fingers of the exhibitor being for this purpose always kept placed at one side between the face of the patient and the chloroformed towel or handkerchief; and, 3. Its action should always be suspended, and the handkerchief or instrument containing it instantly removed, whenever snoring and stertor supervenes in the respiration, or when the pulse becomes languid, and falls much below the natural standard; or when the face and lips greatly alter in their colour either to pallor or lividity.

Dangers.

The exhibition of chloroform, as of every other potent drug used in medicine, is liable to be attended with danger and death, provided it be given in too large or in too long continued doses. Like most other valued medicinal agents, it is powerful for evil as well as for good. But its occasional disagreement with, or deleterious influence upon one in 10,000 or 20,000 patients, is no sound argument against other patients benefiting from its employment. It has been calculated, from the returns of the registrar-general, that every year in England and Wales alone some 300 or 400 human beings are poisoned with opium; but certainly no one would argue that this is any reason why opium, the most valuable remedy in our pharmacopœia, should not be given to other human beings in proper doses and in proper cases. Patients have often sunk under the depressing effects of calomel, antimony, digitalis, &c.; but such accidents, while they teach us very strong lessons of caution, form no reason why these most useful drugs should be banished from the pharmacopœia. Many persons are annually drowned in bathing; but no reasonable man would argue from such unfortunate occurrences that this powerful means of maintaining and restoring health be therefore abandoned and forsaken. Deaths certainly ever and anon occur in patients subjected to the influence of chloroform, but assuredly only very rarely indeed when a pure drug and all proper precautions are used. Perhaps the exhibition of any other potent medicinal agent in the materia medica, exhibited in equally full doses to as many hundreds of thousands of patients as have now inhaled full doses of chloroform, would have been followed by more accidents and deaths than have been witnessed in the use of this anæsthetic agent. When we consider the immense extent to which chloroform has already been employed in all quarters of the world in medicine, in surgery, and in midwifery, the frequent great im-

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purity of the drug, and the little care which has sometimes been observed in its use, the wonder perhaps really is, that so few accidents have happened from its employment. And as a counter-balance to these accidents, we know from statistical evidence the fact, that in the absolute, it has been a great means, not only of saving human suffering, but also of saving human life, by diminishing in a marked ratio the danger and fatality attendant upon surgical operations and diseased states. Thus, let us take amputation of the thigh as an example. Out of 987 cases of this operation, collected by Mr Phillips, 435 proved fatal, or 44 in every 100 died. But out of 144 amputations of the thigh performed upon patients in an anæsthetic state, only 27 proved fatal, or 25 in 100 died. According to this computation the number of persons saved from death in amputation of the thigh by the patients being anæsthetized during the operation, amounts to 19 lives in every 100 operations performed, or to 190 lives out of every 1000 such operations.

All the patients that die under the hand of the operator when chloroform is used do not necessarily die from the effects of the chloroform upon the constitution. In several of the recorded cases, the dose given was far too small to have had any such fatal effect. Before the time that anæsthetics came to be used in surgery, deaths on the operation table ever and anon occurred. Such cases have been recorded by Brodie, Cooper, Home, Travers, &c. &c., but they excited no marked share of professional attention, as they were generally supposed to be accidents against which no caution could be of any use. Of late years, and since chloroform has been employed, they have usually been directly and at once ascribed to the deleterious action of the chloroform. The week after the anæsthetic effect of chloroform was discovered in Edinburgh, a patient suddenly died upon the operating table in the infirmary of that city, immediately after the first incisions for the reduction of a hernia were made, and before the operation was finished. Fortunately, from special casual circumstances, chloroform was not used in this case, or otherwise the drug would doubtlessly have been blamed for the result. We know of two other cases in the same city in which, since the introduction of chloroform, patients have died during or immediately after surgical operations, and in both of which, from accident rather than any other cause, chloroform did not happen to be used or to be at hand for use.

Treatment for overdose.

When in any case too powerful and large a dose of chloroform is given, the means of recovery which ought to be pursued are chiefly the following:—1. The instant removal of the chloroform handkerchief or instrument, and of everything containing the liquid, from the neighbourhood of the patient. 2. The supine position. 3. The free access of pure air to his face. 4. If necessary, the performance and continuance of artificial respiration by alternate compression and relaxation of the walls of the chest, or other means, taking special care at the same time to pull forward the tongue in the first instance, provided it has fallen backwards on the top of the windpipe. Some authorities have recommended the use of galvanism if an apparatus be at hand, the inhalation of oxygen or ammonia, inversion of the body, &c. No liquid should be poured into the mouth of the patient till he is able to swallow.

Local anæsthesia.

Instead of being inhaled so as to produce a constitutional anæsthetic effect, chloroform is sometimes used locally in the form of a liquid or vapour with the view of obtunding the sensibility of that individual part of the body only to which the agent is directly applied. The local application of chloroform alone, or mixed with oil, is one of the most powerful local sedatives which the materia medica possesses; and as such often relieves rheumatic, neuralgic, and other pains, when applied to the suffering part. But in the human subject, the degree of partial and superficial local anæsthesia which is capable of being produced by chloroform liquid or vapour is never sufficiently great to allow of the part being cut or operated upon without pain. All late experience has gone to prove the truth of this observation in regard to man. But in some of the lower animals complete local and limited anæsthesia can be readily induced by the local application of chloroform. For example—in the articulata, as in the common earthworm and the centipede, the application of chloroform to the head or tail of the animal or to individual medial rings will render the parts touched altogether anæsthetic, whilst the remainder of the body retains its natural state. Latterly, in the human subject, it has been proposed by Dr James Arnott to produce local anæsthesia, before some minor surgical operations, by previously freezing or frost-biting the affected part by the application of a strong frigorific mixture. In most people no inconsiderable amount of pain attends this process of sudden local freezing; the part frozen is not in a condition admitting of easy surgical interference with common instruments, and the state of anæsthesia does not extend beyond the skin and subcutaneary cellular tissue.

History of anæsthetics.

The vapour of chloroform was first proposed by Dr Simpson as an anæsthetic agent in surgery and midwifery in 1847. For a year previously, the vapour of sulphuric ether had been used to a considerable extent both in America and Europe, for the purpose of inducing insensibility to pain in surgical operations. It was first practically adopted for this purpose in 1846 by Dr Morton, a dentist at Boston in America. Subsequently Dr Charles T. Jackson of that city claimed the merit of having suggested to Dr Morton sulphuric ether as an agent capable of producing insensibility to pain. But the power of producing, by the vapour of sulphuric ether, an insensibility exactly like that produced by the inhalation of nitrous oxide gas, had been long previously known. The fact had been already often published by several American authorities, as by Godwin (1822), Mitchell (1832), Professor Samuel Jackson (1833), Wood and Bache (1834). Richard Pearson was the first to suggest the inhalation of suphuric ether in medicine in 1795; and he then described its employment in some cases of phthisis, asthma, hooping cough, &c. The sedative effects of its inhalation in these affections have been noticed by almost every author who has written at any length on the Materia Medica during the first half of the present century. In 1816 Nysten proposed and described a special instrument for the inhalation of sulphuric ether.

The idea, however, of saving by some artificial means the human body from the pains and tortures inflicted by the knife of the surgeon, is by no means a thought either first broached or first acted upon in recent times. For the production of anæsthesia a variety of measures had been suggested, and some used long before sulphuric ether and chloroform were applied to this purpose. In 1828 Dr Hickman appears to have proposed the inhalation of diluted carbonic acid gas as an agent capable of inducing insensibility in surgical operations; and the anæsthetic properties of carbonic acid have been long known and often witnessed in the experiments constantly performed before travellers on the dogs which are so often made to breathe this gas in the Grotto del Cane near Naples. In 1800 Sir Humphry Davy threw out a hint as to the possibility of applying nitrous oxide as an anæsthetic. In 1784 Dr Moore attempted to produce local anæsthesia in limbs requiring amputation or other operations, by previously compressing and obtunding the nerves of the implicated extremity—an idea, however, which was suggested long before Moore's time by Ambrose Parè. In the sixteenth and seventeenth centuries various authorities, as Valverdi, Hoffman, &c., suggested the possibility of producing temporary anæsthesia during surgical operations, by a plan sometimes successfully adopted by modern robbers, viz., by such an amount of "garotting" or compression of the vessels of the

neck as would produce the requisite amount of stupor and coma. Some surgeons also proposed to induce before operat'ng a state of fainting, and consequently of insensibility, by a previous profuse blood-letting, &c. The administration of a large opiate has been also repeatedly suggested and tried by various authorities; but the amount of dose required to produce true anæsthesia and insensibility to the pain of a surgical operation was found to be far too large to be free from imminent danger to the life of the patient.

Ancient anæsthetics.

But at a still earlier date different medicinal agents seem to have been suggested, and practically employed too, for the purpose of producing a state of anæsthesia during surgical operations. These agents were sometimes used in the form of odours or vapours, or by inhalation; and sometimes they were administered by the stomach. Two different drugs appear to have been more particularly used at different epochs with the view of inducing insensibility to the agony and torture otherwise following the surgeon's knife, viz., preparations, 1. of Indian hemp (*Cannabis sativa* var. *Indica*); and 2. of mandragora (*Atropa Mandragora*).

The anodyne, ecstatic, and anæsthetic effects of Indian hemp, and of the various preparations made from it, as bang, hachish, &c., have been long known in Africa and Asia. "The bang (as Sir Joseph Banks observed half a century ago) is prepared and, I believe, used in all parts of the East from Morocco to China. In Barbary (he adds) it is always taken, if it can be procured, by criminals condemned to suffer amputation; and it is said to enable those miserables to bear the rough operations of an unfeeling executioner, more than we Europeans can the keen knife of our most skilful surgeons." M. Julien lately pointed out to the French Academy an old Chinese work proving that 1500 years ago a preparation of hemp or ma-yo was employed medicinally in China to annul the pain attendant upon cauterization and surgical operations. The wonderful power of endurance of the Hindu Suttee appears to have been sometimes procured by the influence of this powerful drug. Some high biblical commentaries maintain that the gall and vinegar or myrrhed wine offered to our Saviour immediately before his crucifixion was a preparation, in all probability, of hemp, which was in these, as well as in later times, occasionally given to criminals before punishment or execution—while 700 years previously it is possibly spoken of, according to the same authorities, by the prophet Amos as the "wine of the condemned."

The symptoms described by Homer as produced on Ulysses and his companions by their drinking of the Egyptian nepenthes are far more like the effects of hemp than of any other known agent. Herodotus twice mentions the ecstatic influence which the inhalation of the vapour of burning hemp produces upon the Scythians and Massagetans, who, according to his account, breathed it for the purposes of excitement and inebriation.

The other plant mentioned—the mandragora—is now banished from the materia medica, but its therapeutic virtues certainly seem to call for some renewed investigation. Most of the old Greek and Roman physicians and writers, such as Galen, Aretæus, Celsus, &c., ascribe to it strong soporific powers; and several of them, but especially Dioscorides, Pliny, and Apuleius, describe its decoction or tincture as endowed with such anæsthetic powers that those drinking a proper dose of it are insensible to the pains of the surgeon's knife and cautery. It is given (writes Dioscorides eighteen centuries ago) "to cause insensibility (ποιεῖν ἀναισθησίαν), in those who are to be cut or cauterized; for being thrown into a deep sleep they do not perceive pain." The observations of Pliny, Apuleius, &c., are to the same effect. In the twelfth and thirteenth centuries Hugo of Lucca used, and his pupil Theodoric (who died in 1298) has described a somniferous ball or sponge, "Spongia somnifera," the vapours raised from which were capable, when inhaled, of setting patients into an anæsthetic sleep during surgical operations. This somniferous ball was, in the first instance, made by filling and imbibing a sponge with dried extracts of mandragora, opium, and other sedatives; and when required for use the sponge was dipped for a time in hot water, and the patient made to breathe the vapour thus raised from it till an anæsthetic sleep was produced. A modern French surgeon, M. Dauriol, states that he has successfully induced a state of anæsthesia in various surgical patients by the means described 600 years ago by Theodoric. Why the mandragora fell into disuse as an anæsthetic agent in surgery does not appear in any professional records. Aretæus, after speaking of the deep and long-continued sopor produced by drinking an infusion of mandragora, adds, that occasionally danger results from using it, and the patient may die convulsed. The frequency and the fear of such results may probably have been the cause of its anæsthetic employment in surgery falling into abeyance. Chamappe, a French surgeon who wrote in 1538, tells us that at that time "some surgeons give, like Theodoric, soporiferous medicines to their patients that they may not feel the incisions of the scalpel;" and he describes the "somniferous sponge" of Hugo as adapted for this purpose. But already towards the end of the same century, Ambrose Parè, the celebrated Parisian surgeon, alludes to the exhibition of mandragora "to avert the pain attendant upon the amputation of a limb" as a practice only used "formerly" by operators, and apparently as not followed in his own day. An early English author, Bulleyn (1579) describes the possibility of setting patients into an anæsthetic state during lithotomy, &c., by the use of mandragora; but at the same time he speaks of the sleep thus artificially produced as "a trance or a deepe terrible dreame."

The older authors do not always give explicit accounts of the substances and preparations which they recommend for use as anæsthetic agents. Occasionally, they affect an air of secrecy and mystery with regard to their composition and character. Thus, in the 8th book of his Natural Magic (1608), Baptista Porta gives various receipts for medicines which produce sleep, insanity, &c. Amongst others, he describes a "sleeping apple" (*Pomum somnificum*), made with mandragora, opium, &c., and the smelling of which binds, he avers, the eyes with a deep sleep. Subsequently, he states, that there can be extracted from soporific plants "a quintessence which must be kept in leaden vessels, very closely stopped, that it may not have the least vent, lest it fly out. When (he continues) you would use it, uncover it, and hold it to a sleeping man's nostrils, whose breath will suck up this subtle essence, which will so besiege the castle of his senses that he will be overwhelmed with a most profound sleep, not to be shook off without much labour. After sleep, no heaviness will remain in his head, nor any suspicion of art. These things (Porta adds) are manifest to a wise physician; to a wicked one, obscure." Meissner relates, at considerable detail, that towards the close of the seventeenth century, a secret remedy was exhibited by Weiss to Augustus II. of Poland, while his majesty was asleep, and during the state of anæsthesia thus induced the king's diseased foot was amputated. The operation was done without the royal patient's consent, and its performance was not discovered by him till the following morning.

The former general belief in the idea that a degree of anæsthetic and prolonged sleep could be induced artificially by certain medicated potions and preparations, is shown by the frequency with which the circumstance is alluded to by our own older poets and story-tellers, and made part of the machinery in the popular romance and drama. In the history of Taliesin (one of the antique Welsh tales, contained in the Mabinogion), Rhun is described as having set the maid of the wife of Elphin into a deep sleep with a powder put into her drink, and as having then cut off one of her

fingers when she was in this state of artificial anæsthesia. Shakspeare, besides alluding more than once to the soporific property of mandragora, describes with graphic power in Romeo and Juliet, and in Cymbeline, the imagined effects of subtle distilled potions, supposed capable of inducing, without danger, a prolonged state of death-like sleep or lethargy. And Middleton, in his tragedy of "Women, beware Women," published in 1657, pointedly and directly alludes, in the following lines, to the practice of anæsthesia in ancient surgery:—

> "I'll imitate the pities of old surgeons
> To this lost limb—who, ere they show their art,
> Cast one asleep, then cut the diseased part."

Indeed, the whole past history of anæsthetics is interesting as a remarkable illustration of the acknowledged fact that science has sometimes for a long season altogether lost sight of great practical thoughts, from being unprovided with proper means and instruments for carrying out these thoughts into practical execution; and hence, it ever and anon occurs that a supposed modern discovery is only the rediscovery of a principle already sufficiently known to other ages or other remote nations of men. (J. Y. S.)

CHLOROSIS (χλωρός, pale green), green-sickness—a disease of females, which is characterized by a peculiar sallowness of the complexion, debility, dyspepsia, &c. The best remedies are tonics, exercise in the open air, cold bathing, and similar means calculated to restore vigour to the constitution.

CHOCOLATE, a nutritive preparation of the kernels of the cacao nut, usually sweetened with sugar, and aromatized with vanilla, cinnamon, or cloves. It is prepared by triturating in a heated mortar the roasted kernels, which thus, from the oil they contain, assume a pasty consistence; and this paste is then shaped into cakes or sticks in moulds of tin. If necessary, water may be added during the process of trituration. It is either eaten solid, or dissolved in boiling water or milk. Cacao, under its native name of *chocolate*, had been used for ages as a beverage among the Mexicans previous to the conquest of their country by the Spaniards in 1520; and had long been known in some of the West India Islands before it reached France in 1661, and whence, a few years later, it was introduced into Britain.

CHOCTAW INDIANS. See AMERICA, vol. ii. p. 680.

CHODOWIECKI, DANIEL, a celebrated engraver and painter, was born at Dantzic in 1726, and settled at Berlin. His spirited etchings, chiefly executed for books, are very numerous. Among his best works is the engraving of the unfortunate family of Calas. (See CALAS.) Chodowiecki was appointed director of the Royal Academy at Berlin, and died in 1801.

CHŒNIX, in *Antiquity*, a Greek measure of capacity, apparently of several sizes, varying from about 1½ to nearly 4 pints English.

CHOERINÆ, in *Antiquity*, small sea-shells used by the Athenian dicasts in voting.

CHOERILUS, an Athenian tragic poet, who flourished B.C. 500, and was contemporary with Thespis and Æschylus. He gained the tragic prize 13 times, but all his works have perished.

CHOERILUS of Samos, about B.C. 480–400, an epic poet. who wrote on the wars of the Greeks with the Persians. He is said to have been intimate with Herodotus, and he died at the Court of Archelaus.

CHOEROPOTAMUS, a fossil genus of *pachyderm*, allied to the *Peccary*, but of larger size. It was discovered by Cuvier in the gypsum of the Paris basin.

CHOIR (χορος, Lat. *chorus*), that part of a church or cathedral where choristers sing divine service. It is separated from the chancel, and also from the nave. The choir was separated from the nave in the time of Constantine, and in the twelfth century it was inclosed with walls; but the ancient balustrades have been since restored. The choir in nunneries is a large hall separated by a grate from the body of the church, where the nuns chant the service. Choir is also used to denote a band of singers in any church.

CHOISY-SUR-SEINE, or *Choisy le Roi*, a town of France, on the left bank of the Seine, 6 miles S.E. of Paris. Pop. 4000. It is a pleasantly situated and thriving manufacturing town, producing glass and china wares, morocco leather, soap, and chemicals.

CHOLERA, usually supposed to be derived from the two Greek words χολή and ῥέω, bile flux, but more probably from the Greek word χόλερα, a rain-gutter, when the affix of the word *morbus* showed it was the disease which was spoken of, and not the channel for water. Two principal forms of this disease occur: the first, the ordinary bilious or autumnal cholera; the other, the epidemic, malignant, or Asiatic cholera. In the bilious cholera, which prevails to a greater or less extent every autumn, violent vomiting and purging occur, but the discharges contain a large quantity of bilious matter. There is much pain in the stomach and bowels, with more or less spasm of the muscles of the abdomen and extremities, with great prostration of strength, &c. In epidemic or malignant cholera, after the contents of the stomach and bowels are evacuated, the discharges consist of a nearly colourless fluid, filled with flocculi, and resemble water in which rice has been boiled. No bile nor urine is secreted; the whole surface of the body is cold, shrunk, collapsed, with a leaden cadaverous hue, and severe spasms both of the muscles of the abdomen and of the extremities. This stage of collapse and prostration sometimes occurs quite suddenly, but usually is preceded by ordinary diarrhœa, or bowel complaint, of some hours or days continuance. When the person rallies from the stage of collapse, he usually passes through a febrile stage before returning to health, as if the cholera were but a plague variety of epidemic typhus fever.

Malignant cholera has been long known in India; but it is commonly stated that it has only been of late years that it has extended its ravages over the rest of the world. Like all epidemic plagues, it has in its course followed the great leading tracks of commerce or of the march of armies, stealing slowly but surely along the banks of rivers, the great roads, and the lines of traffic, and attacking in succession city after city. No barriers, natural or artificial, nor military cordons have been able to arrest its progress in the slightest degree. It has crossed rivers, mountains, seas, and deserts, always falling most heavily on the inhabitants of those towns, hamlets, or houses where deficient drainage and ventilation, accumulations of putrescent matters, want of personal cleanliness, and intemperance, were most prevalent. In the European cities it has selected as its especial site all the usual haunts of typhus fever, and has attacked the inhabitants of almost every locality where typhus fever was known to prevail and be endemic. It has ever shown itself most fatal in the neighbourhood of rivers and marshes; and the able report of Mr Farr on the cholera in England clearly demonstrates that in London the mortality from cholera bore an exact arithmetical ratio to the height of the districts above the level of the Thames: the higher above the level of the Thames the less was the mortality from the disease.

When this virulent disease attacks an army or a town, the most effectual remedy seems to be to leave the ground or town immediately, and scatter the people over the face of the country. Even in crowded cities it has been found that by removing the inhabitants from the localities where it breaks out, and locating them in airy and well ventilated and well drained situations, they remain free from the disease, which they could not do were the disease contagious in the proper sense of the word.

As to treatment, when the disease prevails epidemically, the very first symptoms of diarrhœa must be watched and treated instantly by the usual remedies, as chalk mixture, or with tincture of catechu and opium. When the disease passes to the stage of collapse, it is remarkable that, whether treated or not, just about a half recover; and as the disease abates, this proportion increases to two-thirds. The treatment by salines, that is repeated drinks of carbonate of soda and tartaric or citric acid, and also the administration of diluted sulphuric acid, 20 to 40 drops every half-hour, have been highly praised as the remedies most likely to conduct the patient through the disease; and where a fair trial has been made of these remedies, they happen to have answered the purpose better than any others. (J. S-K.)

CHOLET, a town of France, department of Maine-et-Loire, arrondissement and 12 miles S.S.E. of Beaupréau. Pop. 7539. It has extensive manufactures of woollen, linen, and cotton goods, with bleachfields, dyeworks, &c.

CHOPIN (French, *chopine*), a liquid measure in Scotland and France, equal to half a Scotch pint.

CHORAGIC, pertaining to the ancient chorus. Hence *choragic monument* signifies a monument erected in honour of the choragus who gained the prize for the exhibition of the best theatrical or musical entertainment at the festival of Bacchus. The remains of two very fine monuments of this kind still exist at Athens.

CHORAGUS, in *Antiquity*, an officer at Athens who presided over the chorus in the theatre and at religious solemnities, and defrayed the greater part of the expenses.

CHORASSAN, or KHORASSAN. See KHORASSAN.

CHORD, or CORD (Latin *chorda*, Greek χορδή, an intestine, of which strings were made), primarily denotes a slender rope or string. When used to denote the string of a musical instrument it is generally written *chord*; and when applied to an ordinary string or small rope it is written *cord*.

CHORD, in *Geometry*, a right line drawn from one end of an arc of a circle to the other.

Chord, in *Music*. See MUSIC.

CHOREA (χορός, a chorus—the ancient accompaniment to dancing), the medical name for the disease commonly called St Vitus's Dance.

CHOREGRAPHY (χορεία, dancing, γράφω, to describe), the art of representing by signs the various motions and gestures in dancing, as music is represented by notes.

CHORIAMBUS, in ancient poetry, a foot consisting of four syllables, of which the first and fourth are long, and the second and third short; or a foot consisting of a trochæus and iambus.

CHORLEY, a market-town of Lancashire, 28 miles S.S.E. of Lancaster, and 210 miles from London by the North-Western railway. It stands on the Chor, and on the Liverpool and Leeds canal. Pop. (1851) 8907. The town is well built, and abundantly supplied with water from a reservoir into which the stream is thrown up by steam machinery. It has an ancient parish church in the Norman style, a handsome Gothic church, a Roman Catholic and other chapels, grammar-school, town-hall, &c. There are also numerous mills for the manufacture of cotton yarn, muslins, jaconets, and fancy goods; with bleachfields, print-works, &c. In the vicinity are coal, lead, and iron mines, and slate and stone quarries.

CHORUS, in the ancient drama. See DRAMA.

CHORUS, in *Music*, a composition of two, three, four, or more parts, each of which is intended to be sung by a plurality of voices. Choruses are made to follow a piece of music sung by one individual, or in parts by single or at least only a few voices, and, as it were, bring to a climax the joy, adoration, grief, or any other sentiment or passion therein expressed. The choruses of Handel, particularly those in his oratorio of the "Messiah," are considered as the finest compositions of the kind, and, when well performed with complete orchestral accompaniments, produce the most triumphant effect of which music is capable. Chorus is also applied to those who sing the parts.

CHOTYN or CHOCZIM, a strongly fortified town of European Russia, province of Bessarabia, situated on a hill on the right bank of the Dniester, 16 miles S.W. of Kamenetz. Pop. 8000. In 1739 the Russians here defeated the Turks and took possession of the town; which was subsequently restored to the Turks in 1769. It again fell into the hand of the Russians, and was once more restored by the peace of Kainardgi in 1774. The united armies of the Russians and Austrians, after a siege, compelled it to surrender in 1788; but it reverted to the Turks at the peace of Jassy in 1792. It was finally ceded by Turkey to Russia, along with Bessarabia and part of Moldavia, in 1812.

CHOUGH (pronounced *chuff*), a fowl of the genus Corvus. The Cornish chough is nearly of the size of the crow, which it resembles in plumage; but its bill, legs, and feet, are red. The jackdaw also is sometimes called by this name.

CHOUS (χοεύς, χοῦς), in *Antiquity*, a Greek liquid measure, equal to the Roman *congius*, and containing six sextarii, or nearly six pints English. Suidas mentions a smaller measure under the name of χοῦς, equal to only two sextarii. Chous is supposed to have been originally the common name for a drinking cup.

CHRISM (χρῖσμα, from χρίω *to anoint*), in the Roman and Greek Churches, oil consecrated by the bishop, and used in the administration of baptism, confirmation, ordination, and extreme unction. It is prepared on Holy Thursday with much ceremony. That used in ordination is more usually styled *unction*. *CHRISM Pence*, *CHRISMATIS Denarii*, or *CHRISMALES Denarii*, was a tribute anciently paid to the bishop by the parish clergy, for their chrism.

CHRIST (χριστός, *anointed*), THE ANOINTED—an appellation given to the Saviour of the world, and synonymous with the Hebrew MESSIAH. (See JESUS.) It was a custom of antiquity to consecrate persons to the prophetical, sacerdotal, and regal offices by anointing them with oil. This custom is preserved even to modern times, at the consecration of sovereigns and ecclesiastics.

Order of CHRIST, a military order, founded by Dionysius I. Portugal. They had their residence at first at Castromarin, but afterwards removed to the city of Thomar, as being nearer to the Moors of Andalucia and Estremadura.

Another military order of this name was instituted in 1205, by Albert, bishop of Riga, with the object of defending the new Christian converts of Livonia, who were persecuted by the Pagans. On their cloaks were represented a sword and a cross, and hence they were also denominated Brothers of the Sword.

CHRISTCHURCH, a parliamentary borough and market-town of Hampshire, England, situated at the confluence of the Avon and Stour, about half a mile from where their united streams fall into Christchurch bay, 20 miles S.W. of Southampton, and 100 miles from London. The town takes its name from its church and priory, founded early in the Saxon era. Some fragments of the priory walls are still standing; and the church, which is in the form of a cross, is a very interesting specimen of the Norman style, with a square tower at its west end commanding an extensive prospect. It also contains some curious ancient monuments. Christchurch had returned two members to parliament from the time of Elizabeth; but, by the Reform act, the number was reduced to one. Pop. (1851) of parliamentary borough 7475; of old borough 1877. Electors (1851–2) 313. It has some manufactures of watch-springs and hosiery, and a salmon fishery. On account of a shifting bar, where there is a depth of not more than five or six feet, the harbour is accessible only at spring tides to small coasting vessels. There is a double tide in the bay every 12 hours. In the vicinity

Christiania ‖ Christianity.

there are remains of a camp, with several tumuli and barrows.

CHRISTIANIA, the capital of Norway, province of Aggerhuus, stands at the northern extremity of the Christiania fiord, on the Agger, in N. Lat. 59. 55. E. Long. 10. 49. Pop. (1845) 26,141. The city is built on an agreeable slope facing the south, and graduating into the country by means of innumerable villas intermingled with wood, and usually built in commanding situations. The entire aspect of the town and surrounding scenery is exceedingly pleasing and peculiar. The town is regularly laid out, the streets wide and straight, crossing each other at right angles, and the houses are all built of brick or stone, though few of them have any pretensions to architectural beauty. The castle of Aggerhuus, containing the regalia and national records, is picturesquely situated on a bold promontory at its southern extremity, commanding at once the fiord and the greater part of the town. The ramparts are laid out in walks, and form an agreeable promenade. The principal public buildings are the new palace, the Storthing or legislative hall, cathedral, theatre, free-masons' hall, &c. The university, founded in 1811, is attended by about 800 students, and has a library of 130,000 volumes, excellent museums, astronomical and magnetical observatories, and a botanic garden. There are also a military academy and other schools, a military hospital, a lunatic and two orphan asylums, town-hall, exchange, a bank, and various literary and scientific societies. It has manufactures of woollen goods, tobacco, hardware, leather, paper, and soap, &c.; several distilleries and breweries; and an extensive trade in timber, fish, and other northern produce. The town has four suburbs, in which the houses are mostly of wood, these not being prohibited there as in the town. Christiania takes its name from Christian IV., by whom the city was founded close upon the site of the ancient city of Opslo, which, with the exception of the episcopal palace and a few houses, was entirely destroyed by fire in 1624. Opslo was founded in 1058 by King Harald Haardraade, and rose to be the third city of the kingdom. Upon the union of Norway with Denmark it became the capital of the former.

CHRISTIANITY.

Origin of the word.

CHRISTIANITY, the religion of Jesus Christ. The word is analogically derived, as other abstracts from their concretes, from the adjective *Christian*, which again is formed from the name Χριστός, *Christus*, the Anointed.

For the evidences and doctrines of Christianity see THEOLOGY.

For the general characteristics, early establishment, and corruptions of Christianity, see the third PRELIMINARY DISSERTATION.

Progress of Christianity.

The history of the world presents no phenomenon so remarkable as the rise and early progress of Christianity. Originating in a country not remarkable for any political, commercial, or literary influence; emanating from one who occupied an humble sphere in the community amidst which he appeared; and announced, in the first instance, by men of mean extraction, of no literary culture, and not endowed with any surpassing gifts of intellect; it nevertheless spread so rapidly that in an incredibly short period of time it had been diffused throughout the whole of the civilized world, and in the fourth century of its existence became the recognised and established religion of the Roman empire. When it is remembered that this result was achieved not only without the aid of any worldly influence, but in the face of the keenest opposition on the part of all the learning, wealth, wit, and power of the most enlightened and the mightiest nations of the earth, the conclusion is strongly forced upon us that a power beyond that of man was concerned in its success, and that its early and unexampled triumphs afford an incontestable proof of its inherent truth and its divine origin.

Mr Gibbon's reasoning.

To avoid this conclusion, deists have laboured to show that there were certain causes of a purely human kind which operated to the production of this result, and are sufficient to account for it. Of these attempts the most famous is that of Gibbon, who, in the fifteenth chapter of his great work, has discussed at length the causes of the growth of Christianity. He specifies five secondary causes, as he terms them, to which he insinuates the whole success of Christianity may be traced; and though he does not formally deny the divine origin of that religion, he leaves this altogether out of view, and plainly suggests that such a belief is in no degree necessitated by the facts of the case. The notoriety which his attack upon Christianity in this chapter has acquired renders it desirable that we should examine the causes which he has assigned as sufficient to account for the early success of the gospel.

The causes.

The secondary causes to which he ascribes these effects are, first, the inflexible and intolerant zeal of the Christians, derived from the Jewish religion, but purified from the narrow and unsocial spirit, which, instead of inviting, deterred the Gentiles from embracing the law of Moses; secondly, the doctrine of a future life, improved by every additional circumstance which could give weight and efficacy to that important truth; thirdly, the miraculous powers ascribed to the primitive church; fourthly, the pure and austere morals of the Christians; and, fifthly, the union and discipline of the Christian republic, which gradually formed an independent and increasing state in the heart of the Roman empire.

But before entering upon the examination of Mr Gibbon's causes in the order in which they are here enumerated, we beg leave to remark, that we cannot perceive the propriety of denominating some of these *secondary* causes, since the miraculous powers ascribed to the primitive church, if they were real, must have constituted a primary cause, and if fallacious, could have been no cause at all, except of its complete subversion. As little can we conceive how such an able and learned author could imagine a zeal strictly and properly inflexible and intolerant, as qualified to produce any other effect than the destruction of the system which they are allowed to have been anxious to promote. But our estimate of the causes assigned by Mr Gibbon will be more fully developed as we proceed in our first examination of them.

First cause.

In pointing out the connection between the first of these causes, and the effects which he represents as arising from it, this learned and ingenious writer observes, that the religion of the Jews does not seem to have been intended to be propagated among the heathens; and that the conversion of proselytes was rather accidental than consistent with the general spirit of the institutions of Judaism. The Jews were, of consequence, studious to preserve themselves as a peculiar people. Their zeal for their own religion was intolerant, narrow, and unsocial. In Christianity, when it made its appearance in the world, all the better part of the predominant spirit of Judaism was retained; but whatever might have a tendency to confine its influence within narrow limits was laid aside. Christians were to maintain the doctrines and adhere to the constitutions of their religion with sacred fidelity. They were not to violate their allegiance to Jesus by entertain-

ing or professing any reverence for Jupiter or any other of the heathen deities; it was not even necessary for them to comply with the positive and ceremonial institutions of the law of Moses, although these were acknowledged to have been of divine origin. The zeal, therefore, which their religion inculcated, was inflexible. It was even intolerant: for they were not to content themselves with professing Christianity and conforming to its laws; they were to labour with unremitting assiduity, and to expose themselves to every difficulty and every danger, in converting others to the same faith. But the same circumstances which rendered it thus intolerant, communicated to it a more liberal and a less unsocial spirit than that of Judaism. The religion of the Jews was intended only for the few tribes; Christianity was intended to become a catholic religion—its advantages were to be offered to all mankind. All the different sects which arose among the primitive Christians uniformly maintained the same zeal for the propagation of their own religion, and the same abhorrence for every other. The orthodox, the Ebionites, the Gnostics, and other sects, were all equally animated with the same exclusive zeal, and the same abhorrence of idolatry, which had distinguished the Jews from other nations.

Such is the general purport of what Mr Gibbon advances concerning the influence of the first of these secondary causes in the propagation of Christianity. It would be uncandid to deny, that his statement of facts appears, in this instance, to be almost fair, and his deductions tolerably logical. The first Christians were remarkable for their detestation of idolatry, and for the generous and disinterested zeal with which they laboured to convert others to the same faith. The first of these principles, no doubt, contributed to maintain the dignity and purity of Christianity; and the second to disseminate it throughout the world. But the facts which he relates are scarcely consistent throughout. He seems to represent the zeal of the first Christians as so hot and intolerant, that they could have no social intercourse with those who still adhered to the worship of heathen deities. But if so, how could they propagate their religion? Nay, we may even ask, how could they live? If they could not mingle with the heathens in the transactions either of peace or war; or witness the marriage or the funeral of the dearest friend, if a heathen; or practise the elegant arts of music, painting, eloquence, or poetry; or venture to use freely in conversation the language of Greece or of Rome; it is not easy to see what opportunities they could have had of disseminating their religious sentiments. If, in such circumstances, and observing rigidly such a tenor of conduct, they were yet able to propagate their religion with such amazing success as they are said to have done, they must surely either have practised some wonderful arts unknown to us, or have been assisted by the supernatural operation of divine power. But all the historical records of that period, whether sacred or profane, concur in proving that the primitive Christians in general did not retire with such religious horror from all intercourse with the heathens. They refused not to serve in the armies of the Roman empire. They appealed to heathen magistrates, and submitted respectfully to their decisions. The husband was often a heathen, and the wife a Christian; or, conversely, the husband a Christian, and the wife a heathen. These are facts so universally known and admitted, that we need not quote authorities in proof of them.

This distinguished writer appears, therefore, not to have stated the facts which he produces under this head with sufficient precision, nor to have reasoned from them correctly. Had the zeal of the first Christians been as intolerant as he represents it, it must have been highly unfavourable to the propagation of their religion; all their wishes to make converts would, in that case, have been counteracted by their unwillingness to mix, in the ordinary intercourse of life, with those who were to be converted. Their zeal, and the liberal spirit of their religion, were indeed secondary causes which contributed to its propagation; but their zeal was by no means so ridiculously intolerant as this writer would have us believe; for if it had, it must have produced effects directly opposite to those which he ascribes to it.

Second cause.

In illustrating the influence of the next of these secondary causes to which he ascribes the propagation of Christianity, Mr Gibbon displays no less ingenuity than in tracing the nature and the effects of the first. The doctrine of a future life, improved by every additional circumstance which can give weight and efficacy to that important truth, makes a conspicuous figure in the Christian system; and it is a doctrine highly flattering to the natural hopes and wishes of the human heart.

Though the heathen philosophers were not unacquainted with this doctrine, yet to them the spirituality of the human soul, its capacity of existence in a separate state from the body, its immortality, and its prospect of lasting happiness in a future life, rather appeared things possible and desirable, than truths fully established upon solid grounds. These doctrines, Mr Gibbon would persuade us, had no influence on the moral sentiments and general conduct of the heathens. Even the philosophers who amused themselves with displaying their eloquence and ingenuity on these splendid themes, did not allow them to influence the tenor of their lives; while the great body of the people, who were occupied in pursuits very different from the speculations of philosophy, and were unacquainted with the questions discussed in the schools, were scarcely ever at pains to reflect whether they consisted of a material and a spiritual part, or whether their existence was to be prolonged beyond the term of the present life; and they could not regulate their lives by principles which they did not know.

In the popular superstitions of the Greeks and Romans, the doctrine of a future state was not omitted. Mankind were not only flattered with the hopes of continuing to exist beyond the term of the present life, but different conditions of existence were promised or threatened, in which retributions for their conduct in life were to be enjoyed or suffered. Some were exalted to heaven, and associated with the gods; others were rewarded with less illustrious honours, and a more moderate state of happiness, in Elysium; while those who by their conduct in life had merited, not rewards, but punishments, were consigned to Tartarus. Such were the ideas of a future state which formed part of the popular superstitions of the Greeks and Romans. But these notions produced only a very faint impression on the minds of those among whom they prevailed. They were not truths supported by evidence; they were not even plausible; they were in fact a tissue of absurdities; they had not therefore a greater influence on the morals, than the more refined speculations of the philosophers. Even the Jews, whose religion and legislation were communicated from heaven, were in general, till within a very short period before the propagation of the gospel, as imperfectly acquainted with the doctrine of a future state as the Greeks and Romans. This doctrine formed no distinct part of the law of Moses, and it is but darkly intimated in the other parts of the Old Testament.

The rude tribes who inhabited ancient Gaul, and some other nations not more civilized than these, entertained ideas of a future life much clearer than those of the Greeks, the Romans, or even the Jews.

Christianity, however, explained and inculcated the

truth of this doctrine in all its splendour and all its dignity. It exhibited an alluring, yet not absurd, view of the happiness of a future life. It conferred new horrors on the place of punishment, and added new severity to the tortures to be inflicted, in another world. The authority on which it taught these doctrines, and displayed these views, was such as to silence doubt, and to command implicit belief. What added to the influence of the doctrine of a future state of existence, thus explained and inculcated, was, that the first Christians confidently prophesied and sincerely believed that the end of the world, the consummation of all things, was fast approaching, and that the generation then present would live to witness that awful event. Another circumstance which contributed to render this doctrine favourable to the propagation of Christianity was, that the first Christians dealt damnation without remorse, and almost without making any exceptions, on all who died in the belief of the absurdities of heathen superstition. Thus taught, and enforced with these additional and heightening circumstances, this doctrine, partly by presenting alluring prospects and exciting pleasing hopes, partly by working upon the fears of the human heart with representations of terror, operated in the most powerful manner in extending the influence of the Christian faith.

Here, however, facts are rather exaggerated, and the inferences unfairly deduced. It must be admitted that the speculations of the heathen philosophers did not fully and undeniably establish the doctrine of the immortality of the human soul; and hence their arguments could scarcely impress such a conviction of this truth as would influence in a very strong degree the moral sentiments and conduct. These arguments, however, were of such a kind that they must have produced some, nay a considerable influence. Several of the most illustrious among the heathen philosophers appear to have been so impressed with the belief of the soul's immortality, and of a future state of retribution, that their general conduct was constantly and in a high degree influenced by that belief. Socrates and Plato are eminent and well-known instances. And if, in such instances as these, the belief of the truths in question produced such effects, it may be fairly inferred, though we had no further evidence, that those characters were not singular in this respect. It is a truth acknowledged as unquestionable in the history of arts and sciences, that wherever any one person has cultivated these with extraordinary success, some of his contemporaries will always be found to rival his excellence, and a number of them will engage in the same pursuits. On this occasion we may venture, without hesitation, to reason upon the same principles. When the belief of the immortality of the human soul produced such illustrious patterns of virtue as a Socrates and a Plato, it must certainly have influenced the moral sentiments and conduct of many others, although in an inferior degree. Some who profess to believe the doctrines of Christianity, make this profession, even although they have never considered seriously whether they be true or false. But notwithstanding this, these truths still exert a powerful influence on the sentiments and manners of society in general. Thus, also, it appears that the doctrines of the ancient philosophy concerning a future life, and even the notions concerning Olympus, Elysium, and Tartarus, which formed part of the popular superstitions, produced a certain influence on the sentiments and manners of the heathens in general. That influence was often indeed inconsiderable, and not always beneficent; but still it seems to have been greater than Mr Gibbon is willing to allow. Christians have been sometimes at pains to exaggerate the absurdities of Pagan superstition, in order that the advantages of Christianity might acquire new value from the contrast. But here we find one who is at heart inimical to Christianity, displaying, and even exaggerating, these absurdities for a different purpose. The truth, however, may be safely admitted; and it is only when exaggerated that it can serve any purpose adverse to the authority of our holy religion. Mr Gibbon certainly represents the religious belief of the ancient Gauls, in respect to the immortality of the human soul and a future state, in too favourable a light. It is only because the system of superstition which prevailed among the barbarians is so imperfectly known, that it has been imagined to consist of more sublime doctrines than those of the popular superstitions of the Greeks and Romans. The evidence which Mr Gibbon produces in proof of what he asserts concerning these opinions of the ancient Gauls is partial, and far from being satisfactory. They did indeed assert and believe the soul to be immortal; but this doctrine was blended with a number of absurdities still grosser than those which characterized the popular religion of the Greeks and Romans. The latter was the superstition of a civilized people, among whom reason was unfolded and improved by cultivation, and whose manners were polished and refined. The former was that of barbarians, among whom reason was, as it were, in its infancy, and who were strangers to the improvements of civilization. Accordingly, when hasty observers found that those barbarians were not absolutely strangers to the idea of immortality, they were moved to undue admiration; their surprise at finding more than they expected confounded their understanding, and led them to misconceive and misrepresent. Hence, what ought to be ascribed to the savage ferocity of those rude tribes, has been attributed by mistake to the influence of their belief of a future state.

In the law of Moses, it must be allowed that this doctrine is not particularly explained nor earnestly inculcated. The author of the *Divine Legation of Moses* has founded upon this fact an ingenious theory, which we shall elsewhere have occasion to examine, and has supported it with great and various erudition. The reason why this doctrine was not more fully explained to the Jews, we shall not pretend to assign, at least in this place; but we cannot help thinking, that it was more generally known among the Jews than Mr Gibbon and Bishop Warburton are willing to allow. Though it be not strongly inculcated in their code of laws, yet there is some reason to think that it was known and generally prevalent among them long before the Babylonian captivity; and in different passages in the writings of Moses it is mentioned or alluded to in an unequivocal manner. In the history of the patriarchs, it appears that this doctrine was known to these "gray fathers;" and it seems to have had a strong influence on the mind of Moses himself. Were David and Solomon strangers to this doctrine? We cannot here specify minute particulars; but surely all the efforts of ingenuity must be insufficient to torture the Sacred Scriptures of the Old Testament, so as to prove that they contain nothing concerning the doctrine of a future state except in the writings of the later prophets, and that even in these it is only darkly insinuated. Were the Jews, in the earlier stage of their history, so totally secluded from all intercourse with other nations, that a doctrine of so much importance, and more or less known to all around, could not be communicated to them? The Pharisees admitted traditions, and set upon them an undue value; yet they appear to have been considered as the most orthodox of the different sects which prevailed among the Jews; for the Sadducees were regarded as innovators and infidels.

But though we are of opinion that the ingenious historian ascribes to the doctrine of the Greek and Roman phi-

losophers, concerning the immortality of the human soul, as well as the notices respecting a future state which formed part of the popular superstitions of those nations, less influence on the moral sentiments and conduct of mankind than what they really exerted; and though we cannot agree with him in allowing that the ideas of the immortality of the soul and of a future state, which were entertained by the Gauls and some other rude nations, were much superior in their nature, or much happier in their influence, than those of the Greeks and Romans; and though, from what is contained in the Old Testament, we are disposed to think that the Jews knew somewhat more concerning the immortality of the human soul, and a future state in which human beings are destined to exist, than Mr Gibbon represents them to have known; yet still we are very sensible, and very well pleased to admit, that "life and immortality were brought to light through the gospel."

The doctrine of a future life, as it was preached by the first Christians, was established on a more solid basis than that on which it had been before maintained; it was freed from every absurdity, and so much improved, that its influence, which, as explained by heathen poets and philosophers, must be confessed to have been in many instances doubtful, now became favourable only to the interests of piety and virtue, and that in no ordinary degree. It undoubtedly contributed to the successful propagation of Christianity; for it was calculated to attract and to please the speculating philosopher, as well as the simple unenlightened votary of the vulgar superstition. The views which it exhibited were distinct; and all was plausible and rational, being demonstrated by the fullest evidence. But the happiness which it promised was of a less sensual nature than the enjoyments which the heathens expected in Elysium; and it would therefore appear less alluring to those who were not capable of entertaining refined ideas, or who preferred the gratifications of the senses in the present life to every other species of good. If the first Christians rejoiced in the hope of beholding all the votaries of Pagan idolatry afflicted with the torments of hell in a future state, and boasted of these hopes with inhuman exultation, they in all probability irritated rather than alarmed those whom they sought to convert from that superstition. The heathens, assailed with such denunciations, might be moved to regard with indignant scorn the preacher who pretended that the beings whom they venerated as gods, heroes, and wise men, were condemned to a state of unspeakable and endless torment. Every feeling of the heart would revolt at the idea of a parent, a child, a husband, a wife, a friend, a lover, or a mistress, but lately lost and still lamented, being consigned to eternal torments for actions and opinions which they had deemed highly agreeable to superior powers.

With respect, then, to the influence of this secondary cause in promoting the propagation of Christianity, we may conclude that the circumstances of the heathen world were less favourable to that influence than Mr Gibbon pretends; that the means by which he represents the primitive Christians to have improved its efficacy, were some of them not employed, and others rather likely to weaken than to strengthen it; and that therefore more is attributed to the operation of this cause than it could possibly produce.

Third cause.

The third cause, the miraculous powers of the primitive church, is with good reason represented as having conduced to the conviction of infidels. Mr Gibbon's reasonings under this head are, that numerous miraculous works of the most extraordinary kind were ostentatiously performed by the first Christians; that, however, from the difficulty of fixing the period at which miraculous powers ceased to be communicated to the Christian church, and from some other circumstances, there is reason to suspect, as is darkly insinuated, that they were merely the pretences of imposture; and that the heathens having been happily prepared to receive them as real by the many wonders nearly of a similar nature to which they were accustomed in their former superstition, the miracles which the first Christians employed to give a sanction to their doctrines contributed in the most effectual manner to the propagation of Christianity.

In reply to what is here advanced, it may be suggested, that the miracles recorded in the New Testament as having been performed by the first Christians when engaged in propagating their religion, are established as true, upon the most indubitable evidence which human testimony can give to any facts. Mr Hume, who was too fond of employing his ingenuity in undermining truths generally received, has endeavoured to prove that no human testimony, however strong and unexceptionable, can afford sufficient evidence of the reality of a miracle; but his reasonings on this head, which once excited doubt and wonder, have since been completely refuted; and mankind still continue to acknowledge, that though we are all liable to mistakes, and exposed to imposition, yet human testimony may afford the most convincing evidence of the most extraordinary and even supernatural facts. We cannot be expected to enter, in this place, into a particular examination of the miracles ascribed to the primitive age of the church. An inquiry into these will occupy a prominent place under the appropriate head of THEOLOGY, to which the reader is accordingly referred. We may, however, consider it as an undeniable and a generally acknowledged fact, that those miracles were real, and that they contributed, in a very eminent manner, to the propagation of Christianity. But it is evident that genuine miracles are not to be ranked among the natural and *secondary* causes.

It was long the current opinion, even among Protestants, that a miraculous power continued for several centuries to reside in the Christian church. When Dr Middleton controverted this opinion in his Free Inquiry, he encountered the most vehement and acrimonious opposition; and many of the clergy, with Archbishop Secker at their head, thought themselves warranted in representing this lingering power as an article of faith. But the progress of reason, though slow, is commonly certain; and the late bishop of Lincoln, Dr Kaye, ventured to express himself in the following terms:—"My conclusion then is, that the power of working miracles was not extended beyond the disciples, upon whom the apostles conferred it by the imposition of their hands."[1]

The heathens were no strangers to pretended miracles and prophecies, and other seeming interpositions of superior beings disturbing the ordinary course of nature and of human affairs; but the miracles to which they were familiarized had been so often detected to be tricks of imposture or pretences of mad enthusiasm, that, instead of being prepared to witness or to receive accounts of new miracles with easy credulity, they must have been in general disposed to view them with jealousy and suspicion.[2] Besides, the miracles to which they had been accustomed, and those performed by the apostles and the first preachers of Christianity, were directly contradictory, and there-

[1] Kaye's Ecclesiastical History of the Second and Third Centuries, illustrated from the Writings of Tertullian, p. 98. Cambridge, 1826, 8vo.

[2] See Mr Weston's Enquiry into the Rejection of the Christian Miracles by the Heathens. Cambridge, 1746, 8vo.

fore the one could receive no assistance from the other. Yet notwithstanding what has been advanced above, we must acknowledge, that as disagreements with respect to the principles and institutions of their religion very early arose among Christians, so they likewise sought to extend its influence, at a very early period, by the use of pious frauds, which appear to have sometimes served the immediate purposes for which they were employed, though eventually they proved highly injurious to the cause of Christianity itself.

We conclude, then, that Christianity was indebted to the influence of miracles in a considerable degree for its propagation, but that the real miracles of our Saviour and his apostles were not among the *secondary* causes of its success; that the heathens who were to be converted were not very happily prepared for receiving the miracles of the gospel with blind credulity; that, as it is possible to discern between sufficient and insufficient evidence, so it is not more difficult to distinguish between true and false miracles; and, lastly, that false miracles were soon employed by Christians as engines to support and propagate their religion, and perhaps not unsuccessfully, but were, upon the whole, more injurious than serviceable to the cause which they were called in to maintain.

Fourth cause.

The fourth of this series of secondary causes, which the author supposes to have been adequate to the propagation of Christianity, is the virtue of the primitive Christians, which he is willing to attribute to other and less generous motives, rather than to the pure influence of the doctrines and precepts of their religion.

The first converts to Christianity were most of them originally persons of the lowest and most worthless characters. The wise, the mighty, and those who were distinguished by specious virtues, were in general perfectly satisfied with their actual circumstances and future prospects. People whose minds were naturally weak, unenlightened, or oppressed with the sense of atrocious guilt, and who were infamous, or outcasts from society, were eager to grasp at the hopes which the gospel held out to them. When, after enlisting under the banner of Christ, they began to consider themselves as "born again to newness of life;" remorse and fear, which easily prevail over weak minds; selfish hopes of regaining their reputation, and attaining to the honours and happiness of those mansions which Jesus was said to have gone to prepare; and a desire to raise the honour and extend the influence of the society of which they were become members; all operated powerfully, so as to enable them to display both active and passive virtue in an extraordinary degree. Their virtues did not flow from the purest and noblest source, yet they attracted the notice and moved the admiration of mankind. Of many who admired, some were eager to imitate, and, in order to this, thought it necessary to adopt the same principles of action. Their virtues, too, were rather of that species which excite wonder, because uncommon, and not of essential utility in the ordinary intercourse of society, than of those which are indispensably necessary to the existence of social order, and contribute to the ease and convenience of life. Such virtues were well calculated to engage the imitation of those who had failed egregiously in the practice of the more social virtues. Thus they practised extraordinary but useless and unsocial virtues, from no very generous motives; and those virtues drew upon them the eyes of the world, and induced numbers to embrace their faith.

We must, however, declare, that this is plainly an uncandid account of the virtues of the primitive Christians, and of the motives from which they originated. The social virtues are strongly recommended in the gospel. No degree of mortification or self-denial, or seclusion from the ordinary business and amusements of social life, was required of the early converts to Christianity, except what was indispensably necessary to wean them from the irregular habits in which they had before indulged, and which had rendered them nuisances in society, and to form them to new habits equally necessary to their happiness and their usefulness in life. We allow that they practised virtues which in other circumstances would, however splendid, have been unnecessary; but, in the difficult circumstances in which the first Christians were placed, the virtues which they practised were in the highest degree social. The most prominent feature in their character was their continuing to entertain sentiments of generous benevolence, and to discharge scrupulously all the social duties, towards those who exercised neither charity nor humanity, and frequently not even bare integrity and justice, in their conduct towards them.

It cannot be said with truth that such a proportion of the primitive Christians were people whose characters had been infamous, and their circumstances desperate, as that the character of the religion which they embraced should suffer from this circumstance. Nor were they only the weak and illiterate whom the apostles and their immediate successors converted by their preaching. The criminal, to be sure, rejoiced to hear that he might obtain absolution of his crimes; the mourner was willing to receive comfort; and minds of refined and generous feelings were deeply affected with that goodness which had induced the Son of God to submit to the punishment due to sinners: but the simplicity, the rationality, and the beauty of the Christian system, likewise prevailed in numerous instances over the pride and prejudices of the great and the wise, and in instances sufficiently numerous to vindicate the Christian church from the aspersions by which it has been represented as being in the first period of its existence merely a body of criminals and idiots.

The principles, too, from which the virtues of the first Christians originated, were not peculiarly mean and selfish: on the contrary, they seem to have been uncommonly sublime and disinterested. Remorse in the guilty mind is a natural and reasonable sentiment; and the desire of happiness in every human breast is equally so. It is uncandid, therefore, to cavil against the first Christians for being, like the rest of mankind, influenced by these sentiments. And when we behold them overlooking temporary possessions and enjoyments, extending their views to futurity, and "living by faith;" when we observe them "doing good to those who hated them, blessing those who cursed them, and praying for those by whom they were despitefully used and persecuted;" we cannot deny that their virtues were of the most generous and disinterested kind.

We allow, then, that the virtues of the first Christians must have contributed to the propagation of their religion; but it is with pain that we observe the historian studiously labouring to misrepresent the principles from which those virtues arose; and not only the principles themselves, but also the importance of the actions and conduct which naturally sprung from them.

Fifth cause.

The fifth cause was the mode of church government adopted by the first Christians, by which they were knit together in one society, and preferred the church and its interests to their country and civil concerns. We do not deny that the mutual attachment of the primitive Christians contributed to spread the influence of their religion; and the order which they maintained, by being animated with this spirit of brotherly love, and with an ardent zeal for the glory of God, must no doubt have produced those happy effects among them which order and regularity produce on every occasion when they are strictly observed.

But whether the form of church government, which was gradually established in the Christian church, was actually the happiest that could possibly have been adopted; or whether, by establishing a distinct society, with separate interests, within the Roman empire, it contributed to the dissolution of that mighty fabric; we cannot here pretend to inquire. These are subjects of discussion with respect to which we may with more propriety endeavour to satisfy our readers under another head.

From the whole, then, of this review of what Mr Gibbon has so speciously advanced concerning the influence of these five secondary causes in the propagation of the gospel, we think ourselves warranted to conclude, that the zeal of the first Christians was not, as he represents it, intolerant; that the doctrine of the immortality of the human soul was somewhat better understood in the heathen world, particularly among the Greeks and Romans, and the Jews, than he represents it to have been, and had an influence somewhat happier than that which he ascribes to it; that the additional circumstances by which, he informs us, the first preachers of Christianity improved the effects of this doctrine, were far from being calculated to allure converts; that the heathens, therefore, were not quite so well prepared for an eager reception of this doctrine as he would persuade us that they were, and, of consequence, could not be influenced by it in so considerable a degree in their conversion; that real and unquestionable miracles, performed by our Saviour, and the first race of Christians, contributed signally to the propagation of Christianity, but are not to be ranked among the secondary causes of its diffusion; that weakness and blind zeal did at times employ pretended miracles for the same purpose not altogether ineffectually; that though these despicable and wicked means might be in some instances successful, yet they were, upon the whole, much more injurious than beneficial; that the virtues of the primitive Christians arose from the most generous and noble motives, and were in their nature and tendency highly favourable to social order, and to the comfort of mankind in the social state; and, lastly, that the order and regularity of church government, which were gradually established among the first Christians, contributed greatly to maintain the dignity and spread the influence of their religion, but tended in no degree to disjoin them from their fellow-subjects, or to render them inimical to the welfare of the state of which they were members. Upon the whole, therefore, we do not see that these secondary causes were equal to the effects which have been ascribed to them; and it seems undeniable that others of a superior kind must have co-operated in the diffusion of Christianity.[1]

CHRISTIANS, those who profess the religion of Jesus Christ. The name Christians, as we read in the Acts of the Apostles, was first given at Antioch, in the year 42, to those who believed in Jesus Christ. Till that time they were called *disciples*.

The first Christians distinguished themselves in the most remarkable manner by their conduct and their virtues. The faithful, whom the preaching of St Peter had converted, hearkened attentively to the exhortations of the apostles, who failed not carefully to instruct them, as persons who were entering upon an entirely new course of life. They went every day to the temple with one heart and one mind, and continued in prayers; doing nothing different from the other Jews, because the time had not yet come to separate from them. But they made a still greater progress in virtue; for they sold all that they possessed, and distributed their goods in proportion to the wants of their brethren. They "ate their meat with gladness and singleness of heart, praising God, and having favour with all the people."

The Jews were the first and the most inveterate enemies of the Christians, whom they put to death as often as they had it in their power; and when they revolted against the Romans in the time of the emperor Hadrian, Barcochebas, the head of that revolt, employed against the Christians the most barbarous punishments, in order to compel them to blaspheme and renounce Jesus Christ. We find indeed that, even in the third century, they endeavoured to get into their hands Christian women, in order to scourge and stone them in their synagogues. They cursed the Christians solemnly three times a day in their synagogues, and their rabbin would not suffer them to converse with Christians upon any occasion. Nor were they contented merely to hate and detest them. They dispatched emissaries all over the world in order to defame the Christians, and to spread all sorts of calumnies against them; they accused them of many things absurd or detestable, and, among these, of worshipping the sun and the head of an ass; they reproached them with idleness, and with being a useless unprofitable race; they charged them with treason, and with endeavouring to erect a new monarchy in opposition to that of Rome; they affirmed, that, in celebrating their mysteries, they used to kill a child and eat its flesh; and they accused them of the most shocking incests, and of beastly intemperance in their feasts of charity. But the lives and behaviour of the first Christians were sufficient to refute all that was said against them, and evidently demonstrated that these accusations were mere calumnies and the effect of inveterate malice.

Pliny the Younger, who was governor of Pontus and Bithynia between the years 103 and 105, gives a particular account of the Christians of that province, in a letter which he wrote to the emperor Trajan, of which the following is an extract: "I take the liberty to give you an account of every difficulty which arises to me. I have never been present at the examination of the Christians; for which reason I know not what questions have been put to them, nor in what manner they have been punished. My behaviour towards those who have been accused to me has been this. I have interrogated them in order to know whether they were really Christians. When they have confessed it, I have repeated the same question two or three times, threatening them with death if they did not renounce this religion. Those who have persisted in their confession, have been, by my order, led to punishment. I have even met with some Roman citizens guilty of this phrenzy, whom, in regard to their quality, I have set apart from the rest, in order to send them to Rome. These persons declare, that their whole crime, if they are guilty, consists in this, that, on certain days, they assemble before sunrise, to sing alternately the praises of Christ, as of a God, and to oblige themselves, by the performance of their religious rites, not to be guilty of theft or adultery, to observe inviolably their word, and to be true to their trust. This deposition has obliged me to endeavour to in-

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[1] See Lord Hailes's Inquiry into the Secondary Causes which Mr Gibbon has assigned for the rapid Growth of Christianity. Edinb. 1786, 4to.

form myself still further of this matter, by putting to the torture two of their women servants, whom they call *deaconesses;* but I could learn nothing more from them than that the superstition of these people is as ridiculous as their attachment to it is astonishing."

There is still extant a justification, or rather panegyric, of the Christians, pronounced by the mouth of a heathen prince. It is a letter of the emperor Antoninus, written in the year 152, in answer to a charge by the states of Asia, which had accused the Christians of being the cause of some earthquakes which had happened in that part of the world. The emperor advises them to "take care, lest, in torturing and punishing those whom they accused of Atheism (meaning the Christians), they should render them more obstinate, instead of prevailing upon them to change their opinion; since their religion taught them to suffer with pleasure for the sake of God." As to the earthquakes which had happened, he put them in mind, that "they themselves are always discouraged, and sink under such misfortunes; whereas the Christians never discovered more cheerfulness and confidence in God than upon such occasions." He tells them, that "they pay no regard to religion, and neglect the worship of the Eternal; and, because the Christians honour and adore Him, therefore they are jealous of them, and persecute them even to death." He concludes with these words: "Many of the governors of provinces have formerly written to my father concerning them; and his answer always was, that they should not be molested or disturbed, provided they quietly submitted to the authority of the government. Many persons have likewise consulted me upon this affair, and I have returned the same answer to them all; namely, that if any one accuses a Christian merely on account of his religion, the accused person shall be acquitted, and the accuser himself punished." This ordinance, according to Eusebius, was publicly displayed at Ephesus, in an assembly of the states.

It is not a difficult matter to discover the causes of the many persecutions to which the Christians were exposed during the first three centuries. The purity of the Christian morality, being in direct contrast with the corruption of the heathens, was doubtless one of the most powerful motives of the public aversion; and to this may be added the many calumnies unjustly spread abroad concerning them by their enemies, particularly the Jews; a circumstance which occasioned so strong a prejudice against them, that the Pagans condemned them without inquiring into their doctrine, or permitting them to defend themselves. Besides, their worshipping Jesus Christ as God was contrary to one of the most ancient laws of the Roman empire, which expressly forbade the acknowledging of any God who had not been approved as such by the senate.

But notwithstanding the violent opposition made to the establishment of the Christian religion, it gained ground daily, and very soon made a surprising progress in the Roman empire. In the third century, there were Christians in the camp, in the senate, in the palace, in short, everywhere but in the temples and the theatres; they filled the towns, the country, the islands; men and women of all ages and conditions, and even those of the first dignities, embraced the faith; insomuch that the Pagans complained that the revenues of their temples were ruined. So numerous were they in the empire, that, as Tertullian expresses it, were they to have retired into another country they would have left the Romans to inhabit a solitude.

CHRISTIANSAND, a fortified seaport-town of Norway, capital of a stift of the same name, on a fiord of the Skagerrack, in Lat. 58. 8. N., Long. 8. 4. E. Pop. (1845) 8548. The town, for the most part of wood, is regularly built, and the streets are wide. The cathedral is a fine building of gray stone, and after those of Drontheim and Stavangar it is the finest in Norway. The principal branch of industry is shipbuilding; and a considerable trade is carried on in lobsters and timber. The harbour is one of the best in Norway.

CHRISTIANSTAD, a fortified town of Sweden, capital of the province of the same name, on the Helge river, where it forms a small lake, about 8 miles from its mouth in the Baltic. The town, though regularly built, consists principally of wooden structures. Chief manufactures, linen and woollen goods and gloves. Pop. 4500. At the mouth of the river is Ahus, the port of Christianstad, by means of which it carries on some trade in pitch, tar, alum, potash, and timber.

CHRISTINA, queen of Sweden, only daughter of Gustavus Adolphus, was born in 1626, and succeeded to the crown in 1632, when only six years of age. The solid and masculine education which she received from her father and guardians gave her, as she has expressed in her memoirs, an invincible antipathy to the employments and conversation of women; and she had all the awkwardness of a man in performing the little duties which generally fall to the share of her sex. In her youth she was fond of violent exercises; and her amusements generally consisted in feats of strength and agility. She also showed considerable ability and taste for abstract speculations; and made herself familiar with languages and the sciences, particularly with that of legislation. She derived her knowledge of ancient history from original sources: Polybius, Thucydides, and Tacitus, were her favourite authors. Independent of her acknowledged genius and ability, her position as the sovereign of a powerful kingdom made almost all the princes in Europe aspire to her hand. Amongst these were the prince of Denmark, the elector Palatine, the elector of Brandenburg, the king of Spain, the king of the Romans, Don John of Austria, Stanislaus king of Poland, John Casimir his brother, and Charles Gustavus duke of Deux Ponts, of the Bavarian Palatinate family, son of the great Gustavus's sister, and consequently her first cousin. To this nobleman, as well as to all his rivals, she constantly refused her hand, at the same time that she caused him to be appointed her successor by the states. Political interests, religious differences, and conflicting tastes, furnished Christina with pretences for rejecting all her suitors; but her real motives were love of independence, and a strong aversion, even from her infancy, to the marriage yoke. "Do not force me to marry," said she to the states, "for if I should have a son it is not more probable that he should be an Augustus than a Nero."

One of the most complicated affairs which occupied her attention was the peace of Westphalia, in which many conflicting interests were to be reconciled, and many claims to be decided. It was concluded in the month of October 1648. The success of the Swedish arms rendered Christina the arbitress of this treaty, at least in regard to the affairs of Sweden, to which the peace confirmed the possession of many important countries. No public event of importance took place during the rest of Christina's reign; for there were neither wars abroad nor troubles at home. Her reign was distinguished by an active encouragement of learning and genius. She drew to her court all the distinguished men of her time, including Grotius, Pascal, Bochart, Descartes, Gassendi, Saumase, Naude, Vossius, Heinsius, Meibom, Scudéry, Ménage, Lucas, Holstentius, Lambecius, Bayle, and many others. The arts never fail to immortalize the prince who protects them; and almost all these illustrious persons have rendered their patroness illustrious, either in poems, letters, or literary productions of some other kind.

Though Christina at first was fond of royal power and splendour, yet she soon began to feel embarrassed and restrained; and the same love of independence which had determined her against marriage at last made her weary of the

Christmas Day.

crown. Accordingly, as it grew more and more irksome to her, she resolved to abdicate; and, in 1652, communicated her resolution to the senate. The senate zealously remonstrated against it, and was joined by the people, nay, even by Charles Gustavus himself, who was to succeed her. She yielded to their importunities, and continued to sacrifice her own pleasure to the will of the public till the year 1654, when she carried her design into execution. Besides abdicating her crown, she also abjured her religion; an act which deeply wounded her Protestant subjects. No prince ever showed so much joy on being elevated to the throne as Christina did in quitting hers. When she came to a little brook which separates Sweden from Denmark, she got out of her carriage, and leaping on the other side, cried out in a transport of joy, "At last I am free, and out of Sweden, whither, I hope, I shall never return." She dismissed her women, and laying aside the habit of her sex, "I would become a man," said she; "yet I do not love men because they are men, but because they are not women." She made her abjuration at Brussels, where she saw the great Condé, who, after his defection, made that city his asylum. "Cousin," said she, "who would have thought, ten years ago, that we should have met at this distance from our respective countries?" During her residence in France she excited universal disgust by her open contempt and violation of the customs of the country. She treated the ladies of the court with the greatest rudeness, and when they came to embrace her, she exclaimed (alluding to her male attire), "What a strange eagerness these women have to kiss me! Is it because I look like a man?"

The murder of Monaldeschi, her master of the horse, on account of the betrayal of some secret, has left a deep stain on her character, notwithstanding the apologies that have been offered by Leibnitz and others. It is too much in keeping with expressions constantly used by Christina in her letters in regard to those with whom she was offended; for she scarcely ever signified her displeasure without threatening the life of the offender. "If you fail in your duty," said she to her secretary, whom she sent to Stockholm after her abdication, "not all the power of the king of Sweden shall save your life, though you should take shelter in his arms." With a musician who had quitted her service for that of the Duke of Savoy she was so enraged as to resort to a threat of murder. "He lives only for me; and if he does not sing for me he shall not sing long for anybody else."

The horror and indignation with which she was regarded in France, induced her to retire again to Rome, whence, on the death of Gustavus, in 1660, she went to Sweden; but meeting everywhere with hostility and coldness from the people, she quickly retraced her steps. Once more having quarrelled with the pope, she set out for her former dominions, but proceeded no further than Hamburgh, whence she again returned to Rome, and died in 1689.

Upon the whole, her character presents a strange combination of faults and foibles, pushed to the most extravagant excess. She says of herself, "that she was mistrustful, ambitious, passionate, haughty, impatient, contemptuous, satirical, incredulous, undevout, of an ardent and violent temper, and extremely amorous;" a disposition, however, to which, at least according to her own account, her pride and her virtue were always superior. See SWEDEN.

CHRISTMAS DAY, a festival of the Christian Church, observed on the 25th of December, in memory of the nativity of Jesus Christ. The day, however, now kept as Christmas cannot be that of the nativity of our Lord, for the reason assigned long ago by Shaw and others, viz., that in December, which is the height of the rainy season in Judæa, neither flocks nor shepherds could have been at night in the fields of Bethlehem, which we are told was the case at the nativity of Christ. As to the antiquity of this festival, the first traces we find of it are in the second century, about the time of the Emperor Commodus. The decretal epistles indeed carry it a little higher, and state that Telesphorus, who lived in the reign of Antoninus Pius, ordered divine service to be celebrated, and an angelical hymn to be sung, the night before the nativity of our Saviour. We have a melancholy proof that it was observed before the times of Constantine; for whilst the persecution raged under Diocletian, who then kept his court at Nicomedia, that prince, among his many acts of cruelty, finding multitudes of Christians assembled together to celebrate Christ's nativity, commanded the church doors where they were met to be shut, and fire to be put to it, which in a short time reduced the church and all within it to ashes.

In all civilized countries the annual recurrence of Christmas was celebrated with festivities of various kinds. In none however was it more joyfully welcomed than in England, where even still all the "old honour" has not altogether fled. In that country it was the custom on Christmas eve, after the usual devotions were over, to light large candles and throw on the hearth a huge log, called the Yule Log or Christmas Block. This latter practice is still observed to a considerable extent in England, especially in the northern counties. At court, and in the houses of the wealthy, an officer, named the *Lord of Misrule*, was appointed to superintend the revels; and even in Scotland a similar functionary used to be appointed under the title of the *Abbot of Unreason*, till the year 1555, when the office was abolished by act of parliament. The reign of the Lord of Misrule began on All-Hallow Eve and lasted till Candlemas day. The favourite pastimes over which he presided were gaming, music, conjuring, dipping for nuts and apples, dancing, fool plough, hot cockles, blind-man's buff, &c. All these recreations were regarded with the utmost horror by the Puritans, who cursed them with a wrath that was at best fanatical. The favourite dishes for breakfast and supper at this season were the boar's head with an apple or orange in the mouth, and set off with rosemary, plum pudding, and mince pies. The latter dish was regarded with peculiar aversion by the Puritans, and it was therefore a point of orthodoxy to partake of it. The houses and churches were decked with evergreens, especially with misletoe, to which a traditionary sacredness has attached since the days of the Druids.

Christophers.

CHRISTOPHERS, ST, or ST KITTS, one of the British West India Islands, 46 miles W.N.W. of Antigua, Lat. 17. 20. N., Long. 62. 40. W. It is about 20 miles in length from N.W. to S.E., with an average breadth of 4 miles, but narrowing towards its S.E. extremity. It takes its name from Columbus, by whom it was discovered in 1493, at which time it was densely peopled by Caribs. In 1623 a party of English under one Warner first settled on the island, and soon afterwards a party of French arrived under M. D'Esnambue. The English lived for some time on friendly terms with the natives; but having unwarrantably seized on some of their lands, and being apprehensive that the Caribs would retaliate, they treacherously surprised them during the night, murdered above one hundred, and expelled the rest, reserving the most handsome of the young women. The colony, however, after this inhuman outrage, was far from flourishing, and the two leaders were compelled to return to their respective countries for recruits. Warner returned with about 400, and a plentiful supply of necessaries. The greater part of D'Esnambue's recruits perished at sea, and the remainder reached the island in a wretched condition. A treaty was now signed, fixing the territory of each party, the upper part, Capis-terre, being allotted to the French, and the lower part, Basse-terre, to the English. The island was afterwards seized by the Spaniards; but these invaders departed in a short time, and the tranquillity of the settlement was restored. In the numerous wars between the

two mother countries, St Christophers suffered severely, and was repeatedly laid waste by the French. So completely was this done in 1705, that the parliament of England was obliged to distribute L.100,000 amongst the unhappy sufferers. At the peace of Utrecht the island was wholly ceded to Britain, and the French possessions were sold for the benefit of the English government. In the year 1782 it was taken possession of by a French armament, but again restored in the year following. St Christophers is computed to contain 43,726 acres of land, about one-half of which is under cultivation. This island has a beautiful and picturesque appearance. In the interior are several mountains, one of which, Mount Misery, an extinct volcano, towers to an elevation of 3711 feet above the level of the sea. The barrenness of these rugged, bleak, and precipitous eminences is amply compensated by the luxuriant vegetation of the plains, which have been cultivated to the very utmost. The soil is rich, and yields abundant crops of sugar, the staple product of the island. The sugar exported in 1850 amounted to 4708 hhds., and in 1851 (a very favourable year) to 7270. In 1852 a long-prevailing drought caused a partial failure of the crop, and considerably affected the revenue. Revenue (1851) L.17,902, (1852) L.13,265; expenditure (1851) L.14,672, (1852) L.13,090; imports (1851) L.112,748, (1852) L.76,680; exports (1851) L.126,610, (1852) L.91,741. Pop. (1812) 23,177. In 1851 the number of pupils attending the Church schools was 796, the Wesleyan schools 850, and the Moravian schools 885. The climate is healthy, but violent hurricanes occasionally occur. The island is governed by a lieutenant-governor, and sends 10 members to the house of assembly of the Leeward Islands at Antigua.

Basse-terre, the capital town, is situated at the S.W. end of the island, and at the mouth of a river which disembogues its waters into a bay called Basse-terre road. It possesses many good houses, and a large and handsome square, and carries on a considerable trade. Its harbour is defended by several batteries. Pop. 6500.

CHROMATIC, a kind of music which proceeds by several semitones in succession. The word is derived from the Greek χρωμα, which signifies *colour*. For this denomination several causes have been assigned, of which none appears certain, and all are equally unsatisfactory. Instead, therefore, of fixing upon any, we shall offer a conjecture of our own, namely, that as χρωμα not only signifies a *colour*, but also a shade of a colour by which it melts into another, or what the French call *nuance*, so the word in this sense is highly applicable to semitones, which being the smallest interval allowed in the diatonic scale, most easily run into one another. In order to learn the reasons assigned by the ancients for this denomination, and their various divisions of the chromatic species, the reader may consult the same article in Rousseau's Musical Dictionary. At present this species consists in giving such a procedure to the fundamental bass, that the parts in the harmony, or at least some of them, may proceed by semitones, as well in rising as in descending, which is most frequently found in the minor mode, from the alterations to which the sixth and seventh notes are subjected, by the nature of the mode itself.

The successive semitones used in the *chromatic* species are rarely of the same kind, but alternately major and minor, that is to say, chromatic and diatonic; for the interval of a minor tone contains a minor or chromatic semitone, and another which is major or diatonic, a measure which temperament renders common to all tones; so that we cannot proceed by two minor semitones which are conjunctive in succession without entering into the enharmonic species, but two major semitones twice follow each other in the chromatic order of the scale.

The most certain procedure of the fundamental bass to generate the chromatic elements in ascent, is alternately to descend by thirds and rise by fourths, whilst all the chords carry the third major. If the fundamental bass proceeds from dominant to dominant by perfect cadences avoided, it produces the chromatic in descending. To produce both at once, the perfect and broken cadences are interwoven, but at the same time avoided.

At every note in the chromatic species, the tone must be changed; that succession ought to be regulated and limited, for fear of deviation. For this purpose it will be proper to recollect that the space most suitable to chromatic movements is between the extremes of the dominant and the tonic in ascending, and between the tonic and the dominant in descending. In the major mode one may also chromatically descend from the dominant upon the second note. This transition is very common in Italy; and, notwithstanding its beauty, begins to be a little too common amongst us.

The chromatic species is admirably fitted to express grief and affliction; and these sounds boldly struck in ascending are powerfully effective. Their influence is no less magical in descending; it is then that the ear seems to be pierced with real groans. Attended with its proper harmony, this species appears proper to express everything; but its completion, by concealing the melody, sacrifices a part of its expression; and for this disadvantage, arising from the fulness of the harmony, it can only be compensated by the nature and genius of the movement. We may add that, in proportion to the energy of this species, the composer ought to use it with greater caution and parsimony, like those elegant viands which, when profusely administered, immediately surfeit us with their abundance, as much as they delight us when enjoyed with temperance and moderation. See Music.

CHROMATICS.

The gradual progress of scientific investigation has continued to add, from year to year, a multitude of new discoveries to our knowledge of experimental and physical optics; and no department of this subject has received additions so diversified and so important as those which relate to the phenomena of colours, which have been displayed, with a thousand brilliant and unexpected transformations, under circumstances that in former times could never have been suspected of exhibiting anything resembling them. The successive experiments and calculations of Dr Thomas Young (1801), Dr Wollaston (1802), Mr Malus (1810), Mr Arago, Mr Biot, Dr Brewster,[1] Dr Seebeck, and Mr Fresnel, have all contributed very essentially to the extension and illustration of this interesting branch of science. But, notwithstanding all that has hitherto been done, it appears to be utterly impracticable, in the present state of our knowledge, to obtain a satisfactory explanation of all the phenomena of optics, consi-

[1] Now Sir David Brewster.

dered as mechanical operations, upon any hypothesis respecting the nature of light that has hitherto been advanced. It will, therefore, be desirable to consider the facts which have been discovered, with as little reference as possible to any general theory; at the same time, it will be absolutely necessary, as a temporary expedient, to borrow from the undulatory system Dr Young's law of the interference of light, as affording the only practicable mode of connecting an immense variety of facts with each other, and of enabling the memory to retain them; and this adoption will be the more unexceptionable, as many of the most strenuous advocates for the projectile theory have been disposed, especially since the experiments of Mr Arago and Mr Fresnel, to admit the truth of the results of all the calculations in which this law has been employed. The details of its application to particular cases, together with an examination of the phenomena of polarisation and of oblique refraction, will occupy the principal part of this article; but it will also be necessary to premise an account of the few cases of the exhibition of colours which appear to be independent of its operation.

Sect. I.—*Of the Separation of Colours by Refraction.*

The separation of white light into different colours, as its component parts, by refraction, though firmly established as an optical fact by Newton, had been in general somewhat negligently examined as to its details, until Dr Wollaston pointed out the inaccuracy of the common subdivision of the colours of the prismatic spectrum into seven different species. There is little reason to doubt that white light consists of an infinite number of rays, varying gradually among each other, without any marked distinctions, and continued, on the one hand, into the dark chemical rays, and, on the other, into the rays of invisible heat; and that all these varieties are separable from each other by refraction, and preserve always a distinct and constant refrangibility. The species of homogeneous light, however, distinguishable from each other by the eye, are only five,—red, yellow, green, blue, and violet; which are uniform in their appearance, and well-defined in their limits, whenever a perfect spectrum is correctly exhibited, whether obtained by interposing a prism between the eye and a small, or rather narrow bright object, or between a lens and the image of such an object formed in its focus; while, in the common method of admitting a beam of the sun's light through a prism, without either employing a lens, or previously limiting the angular extent of the beam, it is obvious that there must be a double source of the mixture of colours; and hence has arisen the Newtonian division of the spectrum into seven parts, which were somewhat fancifully compared, with respect to their extent, to the intervals of the minor diatonic scale in music; although it has been shown by Dr Blair, and still more fully by Dr Brewster, that their proportions are liable to very great variations, according to the nature of the refracting substances employed.

Dr Brewster has remarked, that as, according to the fundamental law of refraction, a prism with a large angle must occasion a dispersion of the several colours somewhat greater than two smaller prisms of the same substance, having together an equal mean refractive power; so also the dispersion of the most refrangible or violet rays amongst themselves will be always somewhat greater in a prism with a larger angle, than in two smaller prisms having an equal mean dispersive power. Hence the green and blue will be less removed from the red towards the violet by the single prism, the refraction of the green remaining in defect, when compared with the mean of the whole. So that, if the two prisms be employed to correct the mean dispersion of the single one, and the extreme rays of the spectrum be brought to a perfect coincidence, the refraction of the green by these prisms being comparatively in excess, the green rays will be found on the side towards which their refraction tends to carry them; and the two extreme portions of red and violet will be left together, forming a crimson, on the side towards which the refraction of the larger prism is directed. It is obvious also that if, instead of the two smaller prisms, a single one of an equal angle, but of twice the dispersive power, were substituted, the joint effect would be nearly the same. Dr Brewster has, however, observed, that in almost all such combinations of different substances, the green is on the side towards which the refraction of the larger prism is directed; so that the original proportion of the space occupied by the different rays in the spectrum must be different for different substances. Dr Brewster has found that the violet is the most dispersed by oil of cassia and by sulphur, and least by sulphuric acid and by water; the distribution afforded by these substances appearing to vary from two parts of red, three green, four blue, and three violet, to about four red, three green, three blue, and two violet; while the yellow is always confined to a narrow line.

The immediate effects of the combinations of the primitive colours on the sense of sight afford an illustration of some of the physiological characters of sensation in general. It is well known that a mixture of red and green light produces a simple sensation, perfectly identical with that which belongs to the minute portion of yellow light originally found in the spectrum; and that a mixture of green and violet makes a perfect blue. The blue colour of the flame of spirit of wine, for example, is derived entirely from a mixture of green and violet rays; while the blue light of the lower part of the flame of a candle is shown by the prism to consist of five different portions, belonging to different parts of the spectrum, nearly resembling those which would be distinguished if we looked through a prism at a small portion of a transparent plate of a certain minute thickness. It is obvious, therefore, that the eye has no immediate power of analysing such light; and if we seek for the simplest arrangement, which would enable it to receive and discriminate the impressions of the different parts of the specimen, we may suppose three distinct sensations only to be excited by the rays of the three principal pure colours falling on any given point of the retina, the red, the green, and the violet; while the rays occupying the intermediate spaces are capable of producing mixed sensations, the yellow those which belong to the red and green, and the blue those which belong to the green and violet; the mixed excitement producing in this case, as well as in that of mixed light, a simple idea only: although it must be observed that no homogeneous light can extend its action so far as to excite at once the sensations of the fibres belonging to the red and the violet; so that every crimson must necessarily be a compound colour. A mixture of red and blue light exhibits an effect which appears unintelligible upon the supposition that a compound light ought to produce a colour intermediate between those of its constituent parts; but this difficulty will vanish, if we assume that the blue of the spectrum contains a greater proportion of violet than of green; so that the green is neutralized into a white by a mixture with the red and part of the violet, and the remaining violet gives its character to the whole, either alone, or with a mixture of red, according to the proportions employed.

When we look through a prism at a luminous object of considerable extent, surrounded by a dark space, the spectra belonging to the several parts of the object are mixed with each other, so as to produce a light perfectly

white, except towards the ends of the object, where the extreme parts project beyond each other. At the red end of the spectrum the whole of the red belonging to the extreme point retains its place unaltered, and the green and blue become a greenish yellow, nearly uniform in its appearance, throughout the space which belongs to them, while the place of the violet is scarcely distinguishable from the neighbouring white light; but at the opposite end the violet retains its place and appearance, and the remainder of the length of the spectrum becomes of a green, inclining more or less to blue, and continuing to be very distinctly visible throughout the extent of the simple spectrum, the place of the red included; so that the illuminating power of the red end of the spectrum must be incomparably greater than that of the violet end; as may also be inferred by a direct comparison of the distinctness of objects viewed in these different lights. The portion of light totally reflected at the internal surface of a dense medium, on account of the obliquity of its incidence, is bounded by a fringe or bow resembling the red end of the luminous object viewed through a prism; and the transmitted portion is bounded by the violet and blue fringe; but it requires some caution, in observing these colours, to avoid the optical deception which causes the neighbouring space to appear of the complementary colour, especially when the eye is turned towards it immediately after having received the impression of the colours actually exhibited.

Sect. II.—*Of the Colours of Halos and Parhelia.*

The immediate effect of the different refrangibility of light in the production of colours is sometimes spontaneously exhibited, in the atmospherical phenomena of halos and parhelia, or paraselenes, attending the sun or moon; the edge nearest to the luminary being generally reddish, and the remoter parts more or less green and blue, although without any well-marked separation of the different tints. These appearances had been long ago referred by Mariotte to the refraction of the prismatic crystals of snow floating in the atmosphere, and descending through it in all possible positions, but more especially in a vertical or horizontal direction, on account of the effect of gravity, combined with that of the resistance of the air; and sometimes perhaps, from their connection with other crystals, making angles of 60° with either of these positions. This theory, however simple and satisfactory, had been very unaccountably neglected for more than a century, and even superseded by the awkward and unsupported conjectures of Huygens respecting the existence of spherical or cylindrical particles of hail, including opaque nodules, related to them in a certain constant ratio; or by the equally inadmissible calculation of Newton, which assigns a partial maximum to the density of the light simply refracted through a spherical drop of water when the deviation is about 26°; and it is only a few years since that the doctrine of Mariotte was revived and extended by Dr Young, and approved by Mr Cavendish and Mr Arago.

In some of the highest northern latitudes these appearances of halos and parhelia are almost constant; and in warmer countries they are confined to the light clouds which occupy the higher and colder regions of the atmosphere. The halos are broad circles, with their interior margin tolerably well defined, and about the distance of 22° and 46° from the sun or moon, but less distinctly terminated externally. Now the angle of 22° exactly corresponds to the deviation produced by a prism of ice, with a refracting angle of 60°, when it becomes a minimum from the equality of the angles of incidence and emergence; and in other positions of the prism the deviation increases very slowly, till it becomes a few degrees greater. Hence the breadth of the circles of each colour being considerable, the colours must fall principally on each other, and become very indistinctly separated. The external circle may be referred to the effect of two such refractions in succession. Mr Cavendish seems to have thought the angle somewhat too great to be derived from this source; and he suggested that it might depend on a single refraction by the rectangular terminations of the crystals; but it does not appear that such terminations are very commonly observable; and it may easily be shown that the greatest intensity of the light of a halo formed by two refractions must be at more than twice the distance of the edge of the inner halo, derived from one only.

These halos are commonly accompanied by a white horizontal circle passing through the sun, derived from the reflection of the vertical faces of the crystals, which are scattered equally throughout all possible azimuths. There are also generally coloured parhelia on each side, depending on the refraction of these vertical prisms; they are commonly a little without the halos, because the deviation of the light passing obliquely through these crystals is somewhat greater than that of the light transmitted by the crystals which have their axes perpendicular to the plane of incidence and refraction. For a similar reason, the light passing through the crystals horizontally in various azimuths is variously modified, so as to produce the appearance of inverted arches, touching the halos at their highest points, and sometimes expanding in the form of a pair of wings, with a point of contrary flexure on each side.

The anthelia seem to be referrible to two refractions and an intermediate reflection within the same crystal, causing a deviation of about $120 + 22 = 142°$; and sometimes with two intermediate reflections, producing an angle of $60 + 22 = 82°$ only. It is not, however, very easy to assign a reason for the appearance of an anthelion exactly opposite to the sun, which is said to have been sometimes seen in the horizontal circle; but it has been delineated with the accompaniment of an oblique cross, and of other unusual appearances, which must have been derived from extraordinary forms of the compound crystals of snow existing at the time of the observation in the atmosphere.

Sect. III.—*Of the Colours of the Rainbow.*

The general nature of the primary rainbow was cursorily explained by De Dominis; but Descartes first applied the true law of refraction, which had recently before been discovered, to the determination of the angular magnitude both of this and of the secondary rainbow; although no sufficient reason could be assigned for the appearance of colours in either of them, until Newton ascertained the different refrangibilities of the different kinds of rays; but as soon as this discovery was established, the method of fluxions at once enabled him to determine precisely the limit at which the broad expanse of light belonging to each colour must necessarily terminate in an edge of greater brilliancy; the bright edges of the different colours projecting gradually beyond each other, so as to form a spectrum somewhat mixed, but still approaching to the common appearance of a spectrum obtained by the refraction of a prism; and in fact the angular distances of the exterior termination of the primary rainbow and of the interior of the secondary, from the sun, are found to agree very accurately with the calculation of the extreme deviations of the red rays reflected once and twice respectively within the spherical drops of rain; although

the whole breadth of the coloured appearances is liable to variations dependent on the magnitude of the drops, and belonging to the phenomena of supernumerary rainbows, to be described hereafter.

The light reflected from very small portions of water appears to be incapable of producing a regular rainbow. Thus we scarcely ever see a rainbow in a cloud, unless it has united its drops, so that they begin to descend in the form of rain. Dr Smith has observed this circumstance, and has attributed it to a tendency of the bright edge of the expanse of light to lose its intensity, by being gradually dissipated into the neighbouring dark space; a tendency which he would probably have been much at a loss to explain from any of the received doctrines of optics, but which bears some analogy to the effects more commonly observed in beams of light admitted into dark spaces, and sometimes designated by the term diffraction.

Sect. IV.—*Of Periodical Colours in general.*

By far the greater part of the phenomena of colours, except their separation by simple refraction, are referrible to the description of periodical or recurrent colours; being characterized by an alternation which is generally repeated, where the observation is sufficiently extensive, several times in succession, while the circumstances on which they depend are varied uniformly and by slow degrees. The number of these alternations, when light perfectly homogeneous is employed, appears to be continued without any discoverable limit, although it is always smaller, for any given change of circumstances, when the least refrangible or red light is employed, than when the observation is made on the most refrangible or violet; so that mixed or white light always produces a combination of alternations arranged according to a series of different intervals, which are at first more or less distinct, but by degrees are so mixed with each other as again to be lost in the general effect of white light. In all these cases the appearances may be reduced to calculation by means of the general law of the interference of two portions of light, with its appropriate modifications and corrections.

A. *The law is, that when two equal portions of light, in circumstances exactly similar, have been separated and coincide again in nearly the same direction, they will either cooperate or destroy each other, according as the difference of the times occupied in their separate paths is an even or an odd multiple of a certain half interval, which is different for the different colours, but constant for the same kind of light.*

B. *In the application of this law to different mediums, the velocity must be supposed to be inversely as the refractive density.*

C. *In reflections at the surface of a rarer medium, and of some metals, in all very oblique reflections, in diffraction, and in some extraordinary refractions, a half interval appears to be lost.*

D. *It is said that, according to some late observations of Mr Arago, two portions of light, polarised in transverse directions, do not interfere with each other.*

E. *The principal intervals in air are, for the*

Extreme Red...........	·0000266 = $\frac{1}{37640}$
Yellow....................	·0000235 = $\frac{1}{42550}$
Green.....................	·0000211 = $\frac{1}{47460}$
Blue.......................	·0000189 = $\frac{1}{52910}$
Extreme Violet.........	·0000167 = $\frac{1}{59750}$
Mean, or White.........	·0000225 = $\frac{1}{44440}$ *inch.*

Sect. V.—*Of the Colours of Thin Plates.*

The colours exhibited by very thin plates of transparent or semitransparent substances have been well known to optical philosophers, from the time that they were first noticed by Boyle, and more particularly examined by Hooke and Newton. They may be readily observed by pressing together any two clean pieces of common plate-glass, which have always sufficient convexities and concavities to exhibit them, touching each other in some points, and leaving elsewhere a thin plate of air between them; or, still more conveniently, by selecting from the plano-convex lenses, kept by the opticians, such as have their flatter sides very slightly convex, and are consequently calculated to throw the spaces of equal thickness, and the colours dependent on them, into the form of rings. The colours are most distinct when they are formed in the light reflected from the two surfaces in contact, especially when care is taken to exclude the foreign light reflected by the surfaces not concerned in their production; and in this case they begin from a central dark spot, immediately surrounded by a bright light, and then by rings more distinctly coloured, while the colours, exhibited in light transmitted through the glasses, begin from a bright spot in the centre, surrounded by a dark ring, being always exactly complementary to the colours seen by reflection, to which they are also, as Mr Arago has demonstrated, either exactly or very nearly equal in intensity, although they have generally been supposed to be much less vivid, on account of the diminution of their effect on the eye by their mixture with the whole of the beam of light which affords them. But if we employ for the observation two flattish pieces of glass, held in such a position as to transmit the light received from one part, and to reflect an image of another part, of an object equally illuminated throughout its extent, the two series of colours will destroy each other, and the whole appearance of rings will vanish. When, on the contrary, the illumination of the object varies materially, the rings will re-appear in one or other of their forms, according to the different intensities of the lights received from its different parts; so that, as Mr Arago has ingeniously suggested, this test might be employed to answer the purpose of a photometer, for ascertaining the equality of the lights of two distant objects.

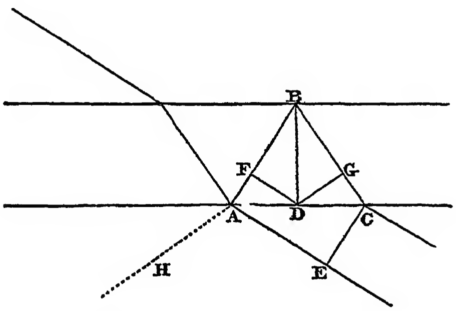
If any thin plate affording colours be inclined to the direction of the light passing through it, the appearance of the colours will be changed either precisely or very nearly in the same manner as if the thickness were reduced in the ratio of the radius to the cosine of the inclination within the plate; at least, if this proportion is not perfectly accurate, the deviations from it, in the experiments of Newton, are manifestly within the limits of the unavoidable errors of observation.

We are indebted to Mr Arago for the important fact, that the colours observed in transmitted light are distinguished by a polarisation opposite or transverse to that which is appropriate to transmitted light in general, and possessing the ordinary character of the polarisation produced by partial reflection. It is in light thus reflected that we must seek for one of the two portions which are to be combined according to the laws of interference, in the case of the colours seen by transmission, and for both in the case of reflection. The light transmitted simply through the plate will be followed by a portion which has been reflected back from the second surface to the first, and forwards again from the first to the second; and the difference of the times occupied in these different paths will obviously be proportional to the thickness of the plate, and also, according to the modification (B) of the law, to its refractive density; so that the number of alterations of any given colour between the central spots of the rings and any given point will be as the thickness of the plate at that point; and the numbers for different colours will

Chromatics.

be inversely as the magnitudes of the appropriate intervals; the plate appearing light when illuminated by a homogeneous colour, only where the thickness corresponds to any exact multiple of the interval, and dark at the intermediate points; and this proportion is found to agree perfectly with experiment. The two reflections within the plate being always of the same kind, will either not require any correction on account of their nature (C), or will altogether add a whole interval to the length of the path; an alteration which makes no change in the appearances.

When the incidence is oblique, the actual length of the two passages of the reflected ray across the plate AB, BC, is as twice the secant of the angle of refraction ABD, and its advance upon the surface AC, as twice the tangent; and this advance, reduced to the direction of the transmitted ray AE without the plate, must be subtracted from the retardation within the plate; the reduction being in the proportion of the radius to the sine of the angle of incidence ACE, for which, if we substitute that of the radius to the sine of the angle of refraction ADF or CDG, we



shall have the deduction required to be made from the length of the path within the plate, since the velocities vary directly as these sines; and by this deduction the secants AB, BC, will be reduced to the cosines BF, BG: so that the true retardation will always be proportional to the cosine of refraction.

The same demonstration is applicable to the difference of the paths of the two portions of light reflected once only, from the upper and lower surfaces of the plates respectively, supposing A, the point of emergence of the transmitted ray, to become the point of incidence of a new reflected ray HA. Hence it might be expected that all the phenomena of colours should be the same as in the case of transmitted light; and this really appears to happen when the observation is made on a plate of air contained between a transparent substance and a polished surface of gold or silver; or on a plate of a refractive density intermediate between the densities of the neighbouring substances, as in the instance of a thin coat of smoke or of an oxide, adhering to any polished metallic surface, which is at first of a yellowish white, and, as it becomes thicker, changes to a yellow and an orange colour; but in more common cases there is a loss of half an interval in one of the two reflections only, so that the thicknesses affording a perfect coincidence for any species of colour, are always intermediate between the thicknesses affording the same colour by transmission; and hence the tints of the two series of rings are always complementary to each other, the series seen by reflection always beginning from a dark central spot, when they are exhibited by any detached transparent substance, as a soap bubble, a thin film of glass or of talc, or by a plate of air contained between two plates of glass, or between a plate of glass and a piece of polished steel.

There is a peculiarity in the surface of silver and gold, and perhaps of some other metals, that, besides the regular reflection at an angle equal to that of incidence, a considerable quantity of light is dispersed irregularly; and this light, as Mr Arago has observed, is polarised in a direction transverse to that of the usual polarisation by reflection; there is also in the irregular reflection no loss of a half interval; so that it exhibits, with a piece of glass, a series of rings resembling those which are produced by polished steel, except that their dimensions are not varied exactly in the same proportion by the obliquity of the incidence, because the light which forms them is not required to pass towards the metal in an angle exactly equal to that which it makes upon its return after reflection; and there will probably be considerable irregularities in the interval of retardation, according to the mode of performing the experiment; although in general the irregular dispersion or diffraction from the glass is too weak to afford colours easily observable, when the position of the plate differs considerably from that in which the light is regularly reflected. If a portion of polarised light is incapable of interfering with another portion polarised in a transverse direction, these rings ought to disappear when the angle of incidence on the plate of glass is about 55°, since in this case the light reflected by it is completely polarised in the plane of incidence: and this disappearance seems actually to have been observed in some of Mr Arago's experiments, though in others, where the metallic surface was less highly polished, the polarisation of the dispersed light may have been less complete, and the rings may still have been visible at this angle. (*Mémoires d'Arcueil*, vol. iii. p. 354, 359.)

Sect. VI.—*Of the Colours of Double Plates.*

When light is transmitted in succession through two plates, differing but little in thickness, they exhibit an appearance of colour similar to that which would be produced by a single plate equal in thickness to their difference; and this appearance is wholly independent of the distance of the plates from each other. It was first noticed by Mr Nicholson in the glasses employed for the sights of sextants, and is attributed by Dr Young to "the rays twice reflected in the second only." In some circumstances, however, the light returning from the second glass to the first, and again reflected by it, may co-operate in the effect, the interval of retardation being the same in both cases. Mr Knox has more lately described some very striking appearances of colours, obtained in this way, by the combination of two pairs of lenses, each exhibiting their appropriate rings when viewed separately, and affording together a third series of rings of larger dimensions when the two former are unequal in magnitude, and of straight bands when they are equal. It is in fact easily demonstrable, that in order that the thicknesses of the plates of air, contained between two unequal pairs of lenses, may be equal, the distances from the centres of contact must be in a constant proportion; and it is well known that all the points from which the lines drawn to two given points are in a constant proportion, will be found in the circumference of a circle, the diameter of which is a third proportional to the difference and sum of the segments of the given distance of the points: so that the colours, depending on this difference, instead of beginning as usual from a white central spot, will begin from a white ring, and will be arranged in concentric rings on each side of it, precisely in the same order as when they form concentric rings round an actual point of contact; and when the curvatures of the two pairs of lenses are equal, the diameter of the circle becoming infinite, it will obviously be converted into a right line.

Dr Brewster has observed a series of similar phenomena

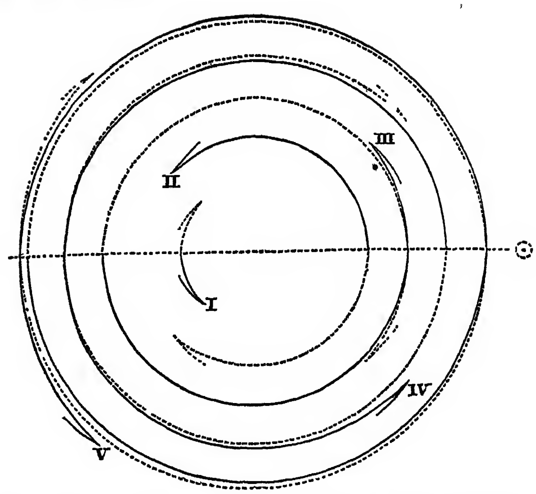
produced by two plates, of equal thickness, but forming a small angle with each other, so as to be differently inclined to the light passing through them. The effect of the inclination being to reduce the virtual thickness of the plate in the ratio of the cosine, and the difference of the cosines of equi-different arcs being simply as the sine of their half sum, it is evident that the colours must correspond to a thickness which varies nearly as the sine of the angle of incidence, considered with regard to a plane bisecting the angle formed by the plates; and this result agrees correctly with Dr Brewster's experiments.

Sect. VII.—*Of the Colours of Supernumerary Rainbows and Glories.*

Within the common primary rainbow, and without the secondary, we sometimes observe a partial repetition of colours, more or less distinctly marked, and extending occasionally to several alternations; the repetitions occupying somewhat narrower spaces, as they are more remote from the ordinary bows. These appearances seem to have been first described by Mariotte; they have been since noticed by Langwith, Daval, and Dicquemare; and the term supernumerary rainbows has been very properly applied to them. The coloured circles called glories may generally be seen surrounding the shadows of our heads when we have an opportunity of standing on a high hill, and observing them in a cloud below us; they are also sometimes accompanied by a large white circle, which, in an observation of Ulloa, was 67° in diameter; and such a circle may frequently be distinguished when the sun shines on a mass of vapour rising from a warm bath, of nearly the same dimensions, or sometimes a little smaller. The whole of these phenomena may be explained, from the interference of some of the portions of light regularly reflected within the minute drops of water, with other portions, incident at a different angle, but, after an equal number of reflections, coinciding ultimately with them in direction; supposing only the clouds in question to afford a number of these drops, varying but little from each other in diameter. We find, by the well-known mode of calculating the greatest deviation, that each order of reflections exhibits a zone from 30° to 10° in breadth, through which a double light is diffused by each drop; and, besides this, when there have been more than three reflections, the portions belonging to the opposite sides cross each other in one or more points, and surround the drop, or rather the observer, if we consider the effect of the refraction of a multitude of drops situated in all directions. Supposing the index of refraction for the extreme rays 1·336, and its logarithm ·1258000, the results will be these:—

After	Extreme Deviation.	Final Deviation.
1 reflection	41° 40′	13° 52′
2	51 41	69 12
3	40 39	27 44
4	45 2	55 20
5	50 0	41 36
6	34 14	41 28

We may obtain a more distinct idea of these duplicatures if we represent them in a diagram, showing the angular extent of the diffusion of light derived from each order of reflections, and distinguishing by different kinds of lines the portions belonging to the opposite halves of the drops; and it will be obvious, from the inspection of this figure, that the appearances in question have only been observed within some of the duplicatures of the orders to which they belong, between the angles of extreme and of final deviation. The tertiary and quaternary bows (III. IV.) are evidently too near the luminary to be visible; the



quinary (V.) ought to be seen in the space between the primary and secondary; but it is probably much too faint to be visible under any circumstances. The duplicature belonging to the primary rainbow exhibits two portions, for which we may calculate the interval of retardation in parts of the radius of the drop, supposing the velocity to be that which is appropriate to the air, by taking twice the difference of the cosines of incidence on the drop, and multiplying twice that of the cosine of refraction by the index 1·336; the difference of these differences giving the interval for the two portions, of which the direction has been found to coincide by a previous calculation.

Distance from the Edge.	Angle of Reflection.	Difference of the Paths.
0°	40° 2′	·0000
1	42 59 / 36 23	·0014
2	44 2 / 34 32	·0040
3	44 45 / 33 3	·0074
4	45 20 / 31 45	·0113
5	45 46 / 30 34	·0160
6	46 9 / 29 26	·0210
8	46 45 / 27 20	·0327
10	47 12 / 25 24	·0461
12	47 32 / 23 33	·0612

Hence it may be inferred, that, supposing the extreme red to re-appear at the distance of 2° from the primitive external termination of the rainbow, the radius of the drop must be $\frac{\cdot 0000266}{\cdot 004} = \cdot 00665$, or $\frac{1}{150}$ of an inch; the fourth alternation of the red being at the distance of 5°, where the interval is ·016. The magnitude of the interval, at an equal distance from the edge, varies but little with the refractive density: thus, for violet light, the index of refraction being probably about 1·346, and its logarithm ·1290000, the greatest deviation will be found 40° 14′; and for a deviation 2° less, the angles of refraction must be 43° 30′ and 33° 37′, and the interval will be little different from ·00400.

The supernumerary bands of the secondary bow, formed by the same drops, will be a little broader than these, since it appears, from a similar calculation, that the rays inter-

fering with each other, at the distance of a degree from the edge, will exhibit an interval of ·0011 of the radius only, instead of ·0014.

The supernumerary colours of the third and fourth bows will be equally imperceptible with the bows themselves; but the portions of light, four times reflected, will cross each other in the point opposite to the sun, where their coincidence will be perfect, and at other neighbouring points will afford an interval nearly proportional to the distance from that point. We shall find that the intervals for different deviations, supposed to be measured in air, are these:—

Deviation.	Angle of Reflection.	Interval in parts of the Radius.
180°	24° 49′	·000
185	25 31	·096
175	24 7	
190	26 14	·195
170	23 25	

Hence, supposing the first bright or greenish ring to appear at the distance of 5° from the observer's head, the radius of the drops must be about $\frac{\cdot 0000225}{\cdot 096} = \cdot 000234$, or $\frac{1}{4370}$ of an inch.

It might be questioned whether the light, five times reflected, could retain sufficient force to produce any sensible effects by these interferences; but since it exhibits no appearance of colour between the primary and secondary rainbows, it must necessarily be extremely faint. The interval which it affords, by the comparison of its two portions, agrees sufficiently well with that which is derived from four reflections, to contribute in some measure to the production of an alternation of light and shade; but the separate colours would be rather weakened than strengthened by the mixture: thus, at the deviation of 5°, the interval is found to become ·076 instead of ·096; and at 10°, ·155 instead of ·195; and this difference is too considerable to allow us to expect any material increase of brilliancy from the addition of the fifth reflection, however great its intensity might be.

Supposing, now, a cloud to consist of spherules of which the radius is ·000234, we may inquire at what distance from the outer edge of the primary rainbow the first additional red of the supernumerary colours ought to be found: the interval being in parts of the radius $\frac{\cdot 0000266}{\cdot 000234} = 116$; and we may infer from the table, by taking the successive differences, that this distance will be about 18°; so that the semidiameter of this red ring will be 42 — 18 = 24°; and the termination of the primitive band of red, supposing it to extend to one fourth of a complete interval only, will be where the difference is ·029, or at $7\frac{1}{2}$°; but for the violet the quarter of the interval will be, in parts of the radius, $\frac{\cdot 0000042}{\cdot 000234} = \cdot 0183$, which answers to a distance from the edge of about $5\frac{1}{2}$°; and this distance, measured from the edge of the violet, which is somewhat less than 2° within that of the red, will extend nearly to the same point as the red space; so that we shall have a circle about 70° in diameter, at the circumference of which all the colours will be united, and which will consequently be white. This magnitude agrees tolerably well with the direct observations of the phenomenon; and if we wish to make the agreement more complete, we have only to suppose the drops a little smaller, and the coloured glories, which they are capable of affording, a little larger. It has already been remarked, that the non-appearance of the ordinary rainbow, in this case, must be referred to the operation of something like diffraction; although it is obvious that its form, under such circumstances, would necessarily be somewhat modified by the diffusion of the colours through a greater space than that which they ordinarily occupy.

Sect. VIII.—*Of the Colours of Striated Substances.*

It was observed by Boyle that small scratches of any kind on the surfaces of polished substances exhibited, when viewed in the sunshine, a variety of changeable colours; and the observation may easily be repeated with any piece of metal not too highly polished, and placed in a strong but limited light. Dr Young ascertained by experiment that the colours afforded by some regular lines drawn on glass always corresponded to an interval, varying as the sine of the angle of deviation from the position in which an image of the luminous object was exhibited by the regular reflection of the surface; and it is easily shown, that if we suppose two portions of light to be reflected from the opposite edges of the furrow, the difference of their paths must vary in that proportion. Dr Young had conjectured that the colours of the integuments of some of the coleopterous insects might be derived from furrows of this nature; but the conjecture has not been verified by observation. Dr Brewster has, however, very unexpectedly discovered that some similar inequalities are the cause of the colours exhibited by mother of pearl; and he has confirmed the observation by showing that impressions of the surface of this substance taken in black wax, in a hard cement, or in fusible metal, will often exhibit a similar appearance. Where the form of the surface of the mother of pearl is the most regular, it reflects, in an oblique light, a white image of a luminous object, like that which any other polished substance affords; but on one side of this image only, and at some little distance from it, we may observe the first order of recurrent colours, beginning from violet, and occasioned in all probability by the reflections from one side only of an infinite number of parallel striæ, formed by the terminations of a minute lamellated structure, nearly but not perfectly perpendicular to the general surface; one side only of each of the little furrows being situated in such a direction as to reflect an image of the luminous object to the eye, and at such a distance that the whole may constitute a regular series of equal intervals. By transmitted light, this substance generally appears of a red or a green colour, changing more or less according to the obliquity, and apparently belonging to some of the higher orders of recurrent colours.

Dr Young has observed a series of these colours, produced by the parallel lines of some of Coventry's glass micrometers, drawn at the distance of $\frac{1}{500}$ of an inch from each other, in which the first bright space, or the confine between the green and the red, corresponded to the interval of $\frac{1}{43000}$ of an inch, or ·0000232 (*Medical Literature*, p. 559); and this result agrees very accurately with the general theory, the interval for the yellow, derived from Newton's measurements, being ·0000235; but in general these lines exhibit colours much more widely extended, each separate line consisting in reality of two or more scratches at a minute distance from each other.

There is a remarkable peculiarity in the appearance both of these colours, and of those which are exhibited by substances naturally striated, as by mother of pearl, agate, and some other semitransparent stones; they lose the mixed character of periodical colours, and resemble much more the ordinary prismatic spectrum, with intervals completely dark interposed. This circumstance may be satisfactorily deduced from the general law, if we consider that each interference depends not only on two por-

tions separated by a simple interval, but also on a number of other neighbouring portions, separated by other intervals which are its multiples; so that unless the difference of the two paths agrees very exactly with the interval appropriate to each ray, the excess or defect being multiplied in the repetitions, the colour will disappear; consequently each of the stripes, which in other cases divide the space in which they appear almost equally between light and darkness, when homogeneous light is employed, becomes here a narrow line; and their succession affords a spectrum exhibiting very little mixture of the neighbouring colours with each other, and nearly resembling that which is afforded by the simple dispersion of the prism; except that, as in all other phenomena of periodical colours, the blue and violet portions are much more contracted than in the common spectrum.

Sect. IX.—*Of the Colours of Mirrors, and of thick Plates.*

In all the species of periodical colours which have been described, the two portions of light concerned have both been regularly reflected from different surfaces. The methodical division of the subject now leads us to the consideration of the colours exhibited in light separately reflected from the same surface. These may be denominated in general the colours of mirrors; and they will include as a variety those which are called by Newton the colours of thick plates.

The general character of these colours is, that they are observed in light reflected by small particles, or irregularly dissipated by a single surface, first in the passage of the beam of light towards the mirror, and then in its return; the difference of the length of their paths affording, as usual, the interval of retardation. Thus, in Dr Herschel's experiment of scattering a fine powder in a beam of light reflected perpendicularly by a concave mirror, and received on a screen in its return, it may easily be shown that the colours will be precisely such as would be exhibited by light transmitted through a thin plate of air, everywhere half as thick as the plate limited by two spherical surfaces in contact; the centre of the one surface being the particle of powder, and that of the other its image formed by the mirror. For in the direction of the principal ray, which is perpendicular to the mirror, the paths of the light will be of equal length, whether the dissipation takes place before or after the reflection; and in other parts the whole length of the path of the light passing from any local point to its conjugate focus being the same, according to the definition of a conjugate focus in the Huygenian theory, from whatever point of the mirror it may be reflected, the light first dissipated will have advanced, after its reflection, as far as the circumference of a circle, of which the conjugate focus is the centre, at the same instant that the portion coming directly from the powder, after a previous reflection, will reach the circumference of the circle of which the particle of powder is the centre; so that the distance between these two circles must be the difference of the paths of the two portions, and the colours the same as would be exhibited by a plate of air of half the thickness, since such a plate is twice traversed by the retarded light.

A similar appearance of colours had been obtained, by earlier experimenters, from the interposition of a screen of gauze, or of a semitransparent substance, in the path of the beam falling on the mirror. But the colours of thick plates, observed by Newton, are modified by the nature of the transparent substance employed, and by the obliquity of the refracted light. The dissipation here takes place at the anterior surface of a concave mirror of glass, and the reflection at the posterior, which is coated with quicksilver: and if these two portions proceed, each with a slight divergence, from a perforation in a screen situated near the centre of curvature of the mirror, they will co-operate perfectly with each other in the circumference of a circle described on the screen, of which the diameter is the distance of the perforation from its image; since all the light passing, in any given section of the mirror, with the same obliquity through the glass as the beam itself passes in the principal section, must be collected into a focal point situated in some part of this circle, and will arrive at this point at the same time, whatever its situation in the section may have been; the obliquity of the incident light being the same in every part of the section, because the point of divergence is at the same distance from the mirror as the centre of curvature. For the other parts of the dissipated light, passing with different obliquities, the interval will be determined by the difference between the lengths of the paths of the two portions of light arriving at the given point, the one by regular refraction, after being first dissipated and then reflected; the other by dissipation, after being first regularly refracted and reflected. And this interval agrees precisely with the law which Newton has deduced from his experiments, but the analogy which he infers from it, between these colours and those of thin plates, is in fact very far from amounting to identity; since, if they belonged to the ordinary colours of thin plates, there is no reason why the series should begin anew from a certain arbitrary thickness, differing in every different experiment, which affords a white of the first order.

Sect. X.—*Of the Colours of deflected Light.*

We are next to examine the case of light only once reflected, and interfering with a portion of the same beam which has pursued its course without interruption; a case which would scarcely have required a separate consideration, but from the difficulty of including it in a general definition with any others; although it is comprehended in the Newtonian description of the colours of inflected light: but since the light is in this case turned away from the substance near which it passes, it may more properly be termed deflected, especially as the greater number of the appearances mentioned by Newton as depending on inflection, belong more properly to diffraction, and the term inflection might consequently be misunderstood as relating to them.

When a beam of light is received in a dark room, and suffered to fall upon the edges of two extremely sharp knives or razors, meeting each other in a very acute angle, the shadows of the knives, received on a screen at some distance, will be found to be bordered by several fringes of colours; and the angle will be bisected by a dark line. The distances from the shadows at which these fringes appear agree in general with the supposition of their depending on the interference of the light reflected from the edges of the respective knives, with the uninterrupted light of the beam passing between them; but the coincidence of these portions ought to be perfect in the immediate neighbourhood of the point in which the shadows meet, and the two last bright fringes ought to unite there in an angle of light. This, however, does not happen, on account of the modification of the general law (C), which makes it necessary to allow half an interval for the effect of a very oblique reflection; and for the same reason, the space immediately next to the shadow is always dark instead of being light. If the knives are at all blunt, the reflection from one to the other, where they meet, causes the bisecting dark line to disappear; but this source of error may be avoided by causing one of them to advance a little before the plane of the other.

Mr Fresnel has repeated these experiments with all possible care, and has ascertained that the points in which the fringes of any one colour are found, at different distances from their origin, belong always to a hyperbola, as they ought to do according to the calculation founded on the general law of interference; a fact which had before been inferred from other measurements, but which had not been so distinctly proved by direct experiments. Newton himself, indeed, was so far from believing that these fringes are rectilinear, as Mr Fresnel supposes, that he expressly mentions their curvature, and infers from it that they are not derived from "the same light" in all their parts; imagining, perhaps, that each fringe was of the nature of a caustic line, formed by reflection or refraction, in which the light is everywhere more condensed than in the collateral spaces, but which is by no means necessarily straight. Mr Fresnel has also shown that all the fringes are found exactly at such distances from the true shadow, as would be inferred from the supposition of the loss of half an interval by reflection; while some of the experiments of Newton appeared to indicate a deviation from this law. It has been asserted that fringes of the same kind have been observed at the edges of a detached beam of light, reflected into a dark space by a narrow plane and polished surface; and in this case it would be difficult to point out in what manner the supposed oblique reflection could be produced, or how a diffraction of any kind could cause the light to be redoubled back upon itself; but the experiment does not appear to have been hitherto performed with sufficient attention to all possible sources of error.

SECT. XI.—*Of the Colours of diffracted Light; including those of Fibres and of Coronæ.*

The light reflected from each of the knife edges, in experiments like those of Newton, not only produces colours by its interference with the light proceeding uninterruptedly between them, but also with another portion, diverging from the edge of the opposite knife, and spreading into its shadow. This tendency of light to diffuse itself was first described by Grimaldi, under the appropriate name diffraction; but many of the phenomena in which it is concerned having been attributed by Newton to other causes, he appears almost to have overlooked its existence.

The general law of interference is very directly applicable to all phenomena of this kind; the fringes exhibited are broader in the same proportion as the distance between the edges is narrower; and they always depend on the difference of the distance from the edges as the interval of retardation. It is, however, necessary to suppose the same modification to take place in diffraction as in oblique reflection, half an interval being lost in both cases; since the light which deviates the least from a rectilinear direction, and which is derived from the near approach of the two paths to equality, is always white. But it is remarkable, that when the obliquity becomes a very little greater, the diffracted light seems to change its character in this respect; for the colours occupy the same spaces as would have belonged to them if they had begun from a dark centre, one of the portions only having lost a half interval in comparison with the other; and of this circumstance no explanation has yet been attempted.

The diffraction producing these fringes may easily be detected within the eye itself, by holding any object near it in such a position as to intercept nearly all the light of a candle except a narrow line at the edge: this line will then appear to be accompanied by other lines parallel to it, separated from it by a dark space, and becoming wider when the object is brought nearer to the eye. These fringes must be referred to the light diffracted on one side round the object, so as to be spread on the unenlightened part of the retina, and reflected on the other from the margin of the pupil; for if we employ an object narrower than the pupil, so as to observe them on both sides of it, their magnitude will be altered by any change in the aperture of the pupil, occasioned by admitting light to the opposite eye, or otherwise. In such cases as this, where one of the points of divergence is much nearer to the point of interference than the other, the interval increases more rapidly than the distance from the primitive direction; and the first fringes are much broader than those which succeed them; the mode of their formation approaching to that of the fringes seen in deflected light, commonly called the exterior fringes of the shadow; while the interior fringes belong more immediately to the present subject, that of the colours of diffracted light.

When the distance of the points of divergence is more nearly equal, the one being collateral to the other, the breadth of the successive fringes is also more uniform. Such is the appearance of the colours exhibited by a number of equal fibres held between the eye and a distant luminous object; their origin being identical with those of the fringes produced in the shadows of the knives, except that the diffracted rays come from the remoter side of the fibres, and follow the reflected rays instead of preceding them. These colours may easily be observed by looking at a candle through a lock of fine wool, and still more distinctly by substituting for the wool some of the seeds of the lycopodium, strewed on a piece of glass; and they become very large if we employ a few of the particles of the blood, or the dust of the lycoperdon, or puff ball. Dr Young has made this appearance the foundation of a mode of measuring the fineness of wool, which he has recommended for agricultural purposes, though it seems hitherto to have been found much too delicate to be employed by "the hard hands of peasants" with any advantage. The instrument which he has invented for this examination is called the eriometer, and its scale is calculated to express, in semidiameters of a circle, formed round a central aperture in a card or a plate of brass, and marked by minute perforations, the distance at which the lock of wool must be held, in order that the first bright ring of colours, or the limit of the green and the red surrounding it, may coincide with the circle of points; and the actual measure, expressed by a unit of this scale, is found to agree very nearly with the thirty thousandth of an inch. Thus the particles of water which have been found capable of exhibiting a glory 5° from the shadow of the observer, being about $\frac{1}{2185}$ of an inch in diameter, they would correspond to number fourteen of this scale; and the cotangent of the angle subtended by the semidiameter of the bright circle being fourteen, the angle itself will be about 4°; consequently, if we looked at the sun through such a cloud, he would appear to be surrounded by a bright circle of colours, 8° in diameter, green within and red without, and attended by other colours, more or less distinctly marked, according to the degree of uniformity of the magnitude of the drops. These circles are called coronæ: their dimensions vary considerably, but they have seldom been observed quite so large as these drops would make them; and more commonly they seem to depend on drops about a thousandth of an inch in diameter, although it is not easy to ascertain the precise parts of the rings from which the measures have been taken by different observers.

In the shadow of a larger substance, formed in a beam of light admitted into a dark room, these colours are still perceptible, beginning from a white line in the middle; but here both the portions on which they depend are diffracted into the shadow, and beyond its limits they are lost in the stronger light that passes on each side of

it. Their appearance is somewhat modified when the shadow is formed by a body terminating in an angle; for the breadth of the fringes being inversely as the breadth of the object which forms them, it is obvious that this breadth must increase towards the point of the shadow, like the distance of the fringes formed in the shadows of Newton's knives: and the fringes seen within the angle must necessarily assume the character of hyperbolas; nor will this form be materially altered when the angle becomes a right one, as in the crested fringes noticed by Grimaldi, although the steps of the calculation for determining their magnitude are in this case a little more complicated.

We find, in an elegant experiment of Mr Biot, on the fringes produced by diffraction, a singular confirmation of the truth of the theory which derives these colours from the difference of the times occupied in the passage of the different portions of light to the point of interference; although this celebrated author does not seem to have been aware of the nature of the inference which may so naturally be drawn from it. He found that the densities of the substances, from the margin of which the diffracted light originated, had no influence whatever on the appearances produced by them; but when they were formed in the light diffracted from substances placed at one end of a long tube, and observed on a piece of glass fixed at the other end, they became contracted, upon filling the tube with water, in the proportion of four to three; as was to be expected from the diminished velocity which must be attributed, according to the modification of the general law (B), to the passage of the light through a denser medium.

Sect. XII.—*Of the Colours of Mixed Plates.*

The colours of mixed plates depend partly on diffraction, and partly either on reflection or on direct transmission; but their essential character consists in the different nature of the two mediums through which the light passes after its separation.

When a minute quantity of moisture is interposed between two lenses, it readily divides itself into a great number of smaller portions, scarcely distinguishable by the eye; and the light transmitted through the lenses exhibits rings of colours much larger than those which are ordinarily observed, and depending on the interval afforded by the difference of the velocities in the different mediums, according to the inverse proportion of the refractive densities. If they are viewed in a direct and unconfined light, the rings belong to the series commonly seen by transmission, beginning from a light central spot; both portions passing in this case simply through the separate mediums, and arriving at the eye after some slight diffraction only, which affects both of them in an equal degree; but if a distant dark object is situated immediately behind the lenses, and they are illuminated by a light incident a little obliquely, their character is changed, and they resemble the colours commonly seen by reflection, one of the portions of light being necessarily reflected, as in the case of the colours of deflected light; so that, when the dark object is situated behind one half of the glasses only, we observe the halves of two sets of rings, of opposite characters, exhibiting everywhere tints complementary to each other. The diameters of the rings vary according to the refractive density of the liquid employed, diminishing as that density increases, and becoming much larger when two liquids, incapable of mixing with each other, and differing but little in refractive density, as oil and water, are employed instead of air and a single liquid.

The magnitude of the interval may also depend on that of a minute transparent solid substance, immersed in a liquid, instead of being limited by the distance of the two lenses; thus the dust of the lycoperdon, mixed with water, gives it a purplish hue when seen by indirect, and a greenish by direct light; and when salt is added to the water, or oil is substituted for it, the difference of the velocities being lessened, the colours exhibited rise in the series, as if the plate were made thinner.

Mr Arago has very ingeniously applied the principle of the production of these colours to the construction of an instrument for measuring the refractive densities of different elastic fluids, and of air in different states of humidity; the fluids being contained in two contiguous tubes of a given length, through which the two portions of light are made to pass, previously to their re-union, and to the formation of the bands of colours; and it may easily be conceived, that the delicacy of such a test must be great enough for every determination that can be required, either for the correction of astronomical observations, or for the illustration of the optical properties of chemical compounds.

Sect. XIII.—*Of the Laws of the Polarisation of Light.*

The colours first observed by Mr Arago in doubly refracting crystals, and since more particularly analysed by Mr Biot, afford by far the most striking and interesting examples of the colours of mixed plates. In order to understand the laws of these phenomena, it is necessary to be previously acquainted with the affections of polarised light, which were first accurately investigated by Malus, and with the theory of extraordinary refraction, derived by Huygens, with equal elegance and precision, from his peculiar hypothesis respecting the nature of the transmission of light.

1. Mr Malus discovered, that at a certain angle of incidence, the light partially reflected by a transparent substance receives a peculiar modification, with respect to the plane of reflection, which is called *polarisation in that plane.*

2. Dr Brewster observed, that the *angle of complete* polarisation is such, that the mean direction of the transmitted light is perpendicular to that of the reflected portion; the tangent of the angle of incidence being equal to the index of the refractive density of the medium.

3. A ray of polarised light is again subdivided, in the usual proportion, by a second refraction in the plane of polarisation; but when it is refracted in a *plane perpendicular* to the plane of polarisation, by a surface properly inclined, *there is no partial reflection;* and in intermediate positions, the intensity of the reflection is nearly as the *square of the cosine* of the angular distance of the two planes.

4. A portion of the *transmitted* light is polarised in a *direction perpendicular* to that of the plane of refraction; so that none of this portion is reflected by a second surface parallel to the first; and when there are several parallel surfaces in succession, the whole of the transmitted light becomes at last so polarised, that none of it is partially reflected.

5. The same transverse polarisation will happen in a *greater number* of transmissions, when the *angle differs* from that of complete polarisation; and in the same manner a second partial reflection, by a surface parallel to the first, will produce a more complete polarisation, when the first is imperfect.

6. A perfect polarisation in any new plane, by a partial reflection at the appropriate angle, completely *supersedes* the former polarisation; but a reflection or refraction void of any polarising effect, which may be called a *neutral* reflection or refraction, changes the direction of the plane of polarisation, according to Mr Biot's experiments, into that

of the image of the former plane, supposed to be formed by the action of the given surface.

7. The light *ordinarily refracted* by a doubling crystal in the plane of the principal section of the crystal, passing through its axis, is *polarised in that direction;* the light *extraordinarily* refracted, in the *transverse direction.*

8. Light *previously polarised* is transmitted by the ordinary refraction when its plane of polarisation coincides with the principal section, and by the extraordinary when it is perpendicular to it. In intermediate directions, the quantity of light transmitted by each refraction is, according to Malus, as the square of the cosine and sine of the angle formed by the planes passing through the paths of the ray, and a line parallel to the axis in each crystal, supposing the species of refraction to be exchanged.

9. The rays of light ordinarily transmitted by doubling crystals appear in general to *retain their previous polarisation,* like rays transmitted through simple substances; but the extraordinary refraction polarises them, according to Biot, like a neutral reflection at a surface coinciding with the principal section; the new plane of polarisation taking the place of the image of the former.

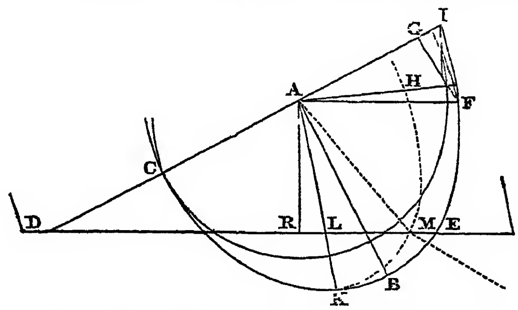
10. Reflections at *metallic surfaces* are generally neutral with respect to polarisation; but in oblique planes they seem, according to some experiments of Malus, to mix or depolarise the light subjected to them.

Sect. XIV.—*Of the Laws of Extraordinary Refraction.*

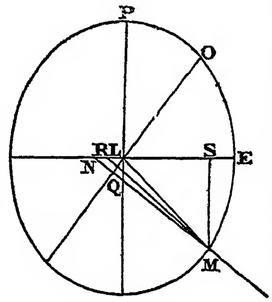
The extraordinary refraction of regular doubling crystals may be correctly determined in all circumstances, by means of the Huygenian supposition of an undulation diverging in the form of a spheroid from every point of the medium, the velocity in any given direction being always proportional to the corresponding diameter, so that the successive spheroidal surfaces remain always similar to each other. The relations of the angles of incidence and refraction may be calculated by finding the point in which any of the spheroids, supposed to represent the forms of the elementary undulations, at a given instant, is touched by a plane passing through that point of the surface at which the original beam of light would have arrived, at the same instant, through the external medium; it may also be deduced, somewhat more simply, from the determination of the velocity with which an expanding spheroidal undulation must extend itself on any given surface; a velocity which immediately gives us the direction of the ray in the surrounding medium; and the relation thus obtained will also obviously hold good with respect to a ray returning in the opposite direction. (*Quarterly Review*, No. xxi.)

In common refractions, if we compare the space described by an undulation or any given surface with the radius, the velocities appropriate to the different mediums will be represented by the sines of the respective angles; but the velocity with which a spheroidal undulation advances on any surface is evidently determined by the increment, or the fluxion, of the perpendicular to the circumference of the section of the spheroid formed by that surface; and calling this perpendicular y, the velocity may be considered as proportional to its increment y': but the velocity of the surrounding medium is to that with which the axis x increases, as r to 1, r being the index of the ordinary refractive density of the crystal, compared with that of the surrounding medium, since the velocity in the direction of the axis is the same as that which belongs to the ordinary refractive density; consequently, the increment of the path of the undulation in the surrounding medium will be expressed by rx', and s, the sine of refraction or incidence without the crystal, will be to the radius as rx' to y', and will be expressed by $\frac{rx}{y'}$, or by $r\frac{dx}{dy}$, the evanescent increments of any quantities being always in the ratio of their fluxions: and the plane of refraction or incidence, without the crystal, will always be perpendicular to the tangent of the section formed by the refracting surface. The determination of the relation of the angles is therefore reduced to the calculation of the value of y and of its fluxion.

Supposing, then, the ratio of the greatest and least refractive densities of the crystal or of the equatorial dia-



meter of the spheroid 2AB to the axis 2AC to be that of n to 1, n being greater than unity, and the tangent of the angle ADE, formed by the axis with the refracting surface DE, being called p; the magnitude of the semidiameter AF, parallel to the surface, may be found by comparing the secants of the angles FAG, HAG, subtended at the centre by the corresponding ordinates of the ellipsis and the inscribed circle: for their tangents FG, HG, being represented by p and $\frac{p}{n}$, the secants will be



$\sqrt{(1+p^2)}$, and $\sqrt{\left(1+\frac{pp}{nn}\right)}$; and the semidiameter of the circle AH being x, that of the ellipsis, AF, will be $n\sqrt{\frac{1+pp}{nn+pp}}\,x$. But the tangent of the angle GIF, made by the tangent of the ellipsis with the axis, is to that of the angle made by the corresponding tangent of the circle, GIH or GHA, that is, $\frac{n}{p}$, as n to 1; consequently $\frac{nn}{p}$ will be the tangent of the angle made with the axis by the elliptic tangent IF or by the conjugate diameter AK; and if we substitute $\frac{nn}{p}$ for p, we shall find the length of this diameter $AK=\sqrt{\frac{n^4+p^2}{nn+pp}}\,x$, which is to that of the former AF in the ratio of $n\frac{\sqrt{(n^4+p^2)}}{\sqrt{(1+pp)}}$ to 1. Hence, for the lesser semiaxis of the section formed by the given surface EL, calling AL the distance of its centre from that of the spheroid z, we have the mean proportional between the segments of the diameter $\sqrt{([AK+AL]\cdot[AK-AL])}=\sqrt{(AK^2-AL^2)}=\sqrt{\left(\frac{n^4+p^2}{nn+pp}x^2z^2\right)}$, which must be reduced in the ratio of the conjugate diameters AK and AF, so that it becomes

$$n\sqrt{\left(\frac{1+pp}{nn+pp}x^2-\frac{1+pp}{n^4+p^2}z^2\right)}=\text{EL}.$$

But from the known similarity of the parallel sections of a spheroid, the axes will be to each other as the semidiameter $\text{AF}=n\sqrt{\frac{1+pp}{nn+pp}}x$ is to nx the equatorial semidiameter, a ratio which may be called that of 1 to m, m being $=\sqrt{\frac{nn+pp}{1+pp}}$; so that the lesser axis EL being $=n\sqrt{\left(\frac{xx}{mm}-\frac{1+pp}{n^4+p^2}z^2\right)}$, the greater LP will be

$$n\sqrt{\left(x^2-\frac{1+pp}{n^4+p^2}m^2z^2\right)}.$$

Now, if q be the cotangent of the angle MNE, formed by the plane of the ray's motion in the external medium, with the lesser axis of the section, or the tangent of the angle ELO formed by the conjugate semidiameter LO with the same axis, this semidiameter may be found by substituting q for p, m for n, and the value of the semiaxis of the section for x, in the expression for AF, the semidiameter parallel to the refracting surface, and it becomes $m\sqrt{\frac{1+qq}{mm+qq}}\text{EL}=n\sqrt{\frac{1+qq}{mm+qq}}\left(\frac{xx}{mm}-\frac{1+pp}{n^4+p^2}z^2\right)=\text{LO}$. Hence, since all parallelograms described about an ellipsis are equal, dividing the product of the semiaxes EL·LP by this semidiameter, we shall have the required perpendicular $y=\text{MQ}=\frac{\text{EL}\cdot\text{LP}}{\text{LO}}=\frac{\text{LP}}{m}\sqrt{\frac{mm+qq}{1+qq}}=\frac{n}{m}\sqrt{\frac{mm+qq}{1+qq}}\sqrt{\left(x^2-\frac{1+pp}{n^4+p^2}m^2z^2\right)}$. Now, in order to find the fluxion of this quantity, increasing as the spheroid increases, while the place of the centre of radiation remains unaltered, we must make z constant while x varies, and we shall have

$$dy=\frac{n}{m}\sqrt{\frac{mm+qq}{1+qq}}x\mathrm{d}x:\sqrt{\left(x^2-\frac{1+pp}{n^4+p^2}m^2z^2\right)},$$

which must be equal to $\frac{r\mathrm{d}x}{s}$; consequently,

$\sqrt{\left(x^2-\frac{1+pp}{n^4+p^2}mz^2\right)}=\frac{ns}{mr}\sqrt{\frac{mm+qq}{1+qq}}x$; and the lesser semiaxis of the section EL, which was found $=\frac{n}{m}\sqrt{\left(x^2-\frac{1+pp}{n^4+p^2}m^2x^2\right)}$, becomes $\frac{nns}{mmr}\sqrt{\frac{mm+qq}{1+qq}}-x$, whence the semidiameter LM at the point of incidence, which may be called w, and which is analogous to the conjugate diameter AK in the former section, will be

$$\sqrt{\frac{m^4+q^2}{mm+qq}}\cdot\frac{nns}{mmr}\sqrt{\frac{mm+qq}{1+qq}}x=\frac{nns}{mmr}\sqrt{\frac{m^4+q^2}{1+qq}}x.$$

Hence it is obvious that this semidiameter, in any one plane of incidence, will be in a constant proportion to the sines, as Huygens himself demonstrated; so that, supposing x to be constant, and z to vary, the semidiameter w may be considered as an ordinate in the elliptic section passing through the point of incidence M and the diameter AK conjugate to the refracting surface, which is also the path of a ray falling perpendicularly on that surface from without; and the tangent of the angle ELM formed by this semidiameter with the lesser axis of the given section, will be $\frac{mm}{q}$, which determines the intersection of this oblique plane with the refracting surface.

But in order to find the angle made with the refracting surface in a plane perpendicular to it, we must compute LR, the distance of the centre of the refracting section from the point nearest to the centre of the spheroid; and the tangents of the inclinations of the diameters to the axis being p and $\frac{nn}{p}$, that of their mutual inclination will be $\frac{nn+pp}{p(1-nn)}$, since $\tan.(a+b)=\frac{\tan.a+\tan.b}{1-\tan.a\tan.b}$; and the sine of the same angle being expressed by $\frac{\tan.a+\tan.b}{\sec.a\sec.b}$, it becomes here $\frac{nn+pp}{\sqrt{(1+p^2)}\sqrt{(n^4+p^2)}}=\sin.\text{FAK}=\sin.\text{ALR}$, which we may call $\mathfrak{r}$, and the cosine $\frac{1-\tan.a\tan.b}{\sec.a\sec.b}=\frac{p(1-nn)}{\sqrt{(1+p^2)}\sqrt{(n^4+p^2)}}=t$: and the required distance LR will be tz, and the distance of the centre of the spheroid from the refracting surface $\text{AR}=\mathfrak{r}z$. But MS, the perpendicular falling from the point of incidence on the lesser axis of the section formed by the surface, being called u, the tangent of the angle MLS subtended by it at the centre being $\frac{mm}{q}$, and its sine consequently $\frac{mm}{\sqrt{(m^4+q^2)}}$, we have $u=\frac{mmw}{\sqrt{(m^4+q^2)}}=n^2\frac{sx}{r\sqrt{(1+q)}}$; and the distance of this perpendicular from the centre, $\text{LS}=v=\frac{qw}{\sqrt{(m^4+q^2)}}$; or if we call the sine of ordinary refraction $\frac{s}{r}=\varrho$, and the sine of the inclination of the plane of the ray's motion to the lesser axis $\frac{1}{\sqrt{(1+qq)}}=k$, and its cosine $\frac{q}{\sqrt{(1+qq)}}=h$, we have $u=n^2\varrho kx$, and $v=\frac{nn}{mm}\varrho hx$. Hence the cotangent of the angle ERM, formed by the line nearest to the ray in the section with the lesser axis, will be $\frac{v+tz}{u}$ if the value of s be considered as positive, when the ray is inclined on the refracting surface towards the axis of the crystal; for in this case the sign of t being negative, tz or LR will be subtracted from v or LS; and the reverse when s is negative. We have also for the hypotenuse RM, or the distance of the point of incidence from the point nearest to the centre of the spheroid, $\sqrt{(u^2+[v+tz]^2)}$; consequently the tangent of RAM, the angle of incidence or refraction within the crystal, will be $\frac{\sqrt{(u^2+[v+tz]^2)}}{\mathfrak{r}z}$. Now, since it has been shown that $\sqrt{(x^2-\frac{1+pp}{n^4+p^2}m^2z^2)}=\frac{ns}{mr}\sqrt{\frac{mm+qq}{1+qq}}x$, we have $z^2=\frac{n^4+p^2}{mm(1+pp)}\left(1-\frac{nnss}{mmrr}\cdot\frac{mm+qq}{1+qq}\right)x^2$, and the cotangent of the inclination of the plane of refraction ERM, or

$$\frac{v+tz}{u}=\frac{q}{mm}+\frac{tz}{u}, \text{ becomes}$$

$$\frac{q}{mm}+\frac{p(1-nn)}{m(1+pp)}\sqrt{\left(1-\frac{nn}{mm}[m^2k^2+h^2]\varrho^2\right)}\cdot\frac{1}{nn\varrho k};$$

and since $\mathfrak{r}^2z^2=(m^2-n^2\varrho^2[m^2k^2+h^2])x^2$, the tangent of the angle of incidence or refraction within the crystal, which is $=\sqrt{\left(\frac{uu}{\mathfrak{r}\mathfrak{r}zz}+\frac{vv}{\mathfrak{r}\mathfrak{r}zz}+\frac{2t}{\mathfrak{r}}\cdot\frac{v}{\mathfrak{r}z}+\frac{tt}{\mathfrak{r}\mathfrak{r}}\right)}$ will be represented by $\sqrt{\left(\frac{n^4m^4k^2+n^4h^2}{m^4(m^2-n^2\varrho^2[m^2k^2+h^2])}\varrho^2\right.}$

$$+\frac{2p(1-nn)\,nnk\varrho}{\sqrt{(nn+pp)}\,mm\sqrt{(m^2-n^2\varrho^2[m^2k^2+h^2])}}$$

$+\left[\dfrac{p(1-nn)}{nn+pp}\right]^2\Big)$. The value of the perpendicular to the surface, AR or τz, is also of importance, as immediately indicating, by its proportion to the axis x, the velocity of the undulation in the direction of the depth, which is therefore represented by $\sqrt{(m^2-n^2\varrho^2[m^2k^2+h^2])}$.

These expressions become somewhat simpler in many cases of common occurrence. Thus, when the axis is parallel to the surface, $p=0$, $m=n$, and $t=0$, consequently the tangent of refraction is $\dfrac{\varrho}{n}\sqrt{\dfrac{n^4k^2+h^2}{1-(nnkk+hh)\varrho\varrho}}$, and the perpendicular velocity $n\sqrt{(1-[n^2k^2+h^2]\varrho^2)}$. When the axis is perpendicular to the surface, p is infinite, $m=1$, and t is again $=0$; and the tangent of the angle of refraction is $\dfrac{nn\varrho}{\sqrt{(1-nn\varrho\varrho)}}$, the perpendicular velocity being $\sqrt{(1-n^2\varrho^2)}$.

The retardation, produced by the passage of light through such a plate, being equal to the time occupied within the plate, diminished by a time proportional to the product of the tangent of the angle of refraction and the sine of the angle of incidence (see Sect. V.), it will be expressed, in the case of a plate parallel to the axis, by

$$\frac{r}{n\sqrt{(1-[nnkk+hh])\varrho\varrho}}-s\varrho\frac{n^4k^2+h^2}{\sqrt{1-(nnkk+hh)\varrho\varrho}};$$

and when the axis is perpendicular, to the plate, by

$$\frac{r}{\sqrt{(1-nn\varrho\varrho)}}-\frac{snn\varrho}{\sqrt{(1-nn\varrho\varrho)}}=\frac{r(1-nn\varrho\varrho)}{\sqrt{(1-nn\varrho\varrho)}}$$

$=r\sqrt{(1-nn\varrho\varrho)}$. The effect of any small change in the form of the spheroid, on the retardation, may be found from the fluxions of these quantities, supposing n to vary; which, when properly reduced, making $n=1$, will be $-r\dfrac{1-hh\varrho\varrho}{\sqrt{(1-\varrho\varrho)}}\,dn$, and $-\dfrac{r\varrho\varrho}{\sqrt{(1-\varrho\varrho)}}\,dn$ respectively.

The values of r and n, for the principal substances, exhibiting the extraordinary refraction, which have been examined, are these:

Iceland crystal...	$r=$ 1·657	$n=$ 1·1140	$=$ 10 : 9
Arragonite.........	1·693	1·1030	$=$ 11 : 10
Ice..................	1·310	·9989	$=$ 890 : 891
Quartz.............	1·558	·99444	$=$ 179 : 180
Sulphate of lime..	1·525	·99432	$=$ 175 : 176
Sulphate of barita	1·635	·99295	$=$ 142 : 143

In mica, according to Mr Biot, and in arragonite, according to Dr Brewster, there are two axes of crystallization; and the refraction of such substances may probably be represented, by supposing all the circular sections of a spheroid to become ellipses, so that the undulation may assume the shape of an almond.

Sect. XV.—*Of the Colours of doubly refracting Substances.*

In the case of doubly refracting substances, the first difficulty is, not to explain why the colours of double lights are sometimes produced, but why they are not more universally observable; since it might naturally be expected, as a consequence of the general law of interference, that two portions of the same beam, passing through a moderately thin plate of such a substance, in paths differing but little from each other, and coinciding again in direction, should, in all common cases, exhibit colours nearly similar to those of ordinary thin plates. It would, however, be difficult to conjecture whether they ought to resemble the colours seen by transmission or by reflection; and the fact is, that both these series of colours are at once produced by the substances in question; but they are so mixed that, without a particular arrangement, they always neutralise each other; and their formation appears to be also limited to certain peculiar conditions of polarisation, consistent with Mr Arago's observation on the non-interference of two portions of light polarised in transverse directions. Several of the cases, indeed, in which they are exhibited remain still involved in some degree of obscurity; but it is easy to analyse the most important of the phenomena, and to reduce them, with great precision, to the general laws of periodical colours.

Mr Malus has demonstrated, by satisfactory experiments, that a beam of light, admitted into a doubly refracting crystal, is as much divided by partial reflection at the second surface as by transmission at the first; the directions and the relative intensities of the two portions being precisely the same as those of the two portions of a ray similarly polarised, and returning to the second surface from without in an equal angle; so that, after a farther transmission at the first surface, all the portions become again parallel. When the ray is in the direction of the principal section, there is no separation, each of the pencils proceeding undivided, as they would do if they passed through a second crystal parallel to the first; and the separation becomes most complete when the plane of incidence makes an angle of about 45° with the principal section; each of the portions o and e, into which the ray is divided upon its admission, affording then two reflections, oO and oE, eO and eE, of nearly equal intensity. The times occupied by the portions oO, eE, will differ most from each other, while oE and eO will describe their paths in equal times of intermediate length; but of these, eO only will commonly interfere with oO, which has a similar polarisation in the plane of incidence, and oE with eE, both being polarised in a transverse direction; so that we have two series of colours, depending on an equal interval, except so far as they are distinguished by the inversion of one of the portions belonging to the extraordinary reflection, which renders the series of colours exhibited by them similar to that of the colours of common thin plates seen by reflection, while the ordinary reflection exhibits colours analogous to those of thin plates seen by transmission.

Mr Biot's usual mode of exhibiting these colours is to place a thin plate of sulphate of lime, or of any other crystal, on a black substance, to allow it to reflect the white light of the clouds at an angle of incidence of about 55°, and to receive this light on a black glass, at an equal angle of incidence, in a plane transverse to the former, so that the plate may be viewed by reflection in the black glass. In this arrangement, the light reflected from the upper surface of the plate, being polarised in the first plane of reflection is not reflected by the black glass, and consequently is incapable of rendering the colours less easily perceptible by admixture with them; the beams oO and eO, returning by the ordinary reflection, are also similarly polarised, and will be transmitted or absorbed by the glass; but the beams oE and eE, being polarised in a transverse direction, will be partially reflected by it, and will exhibit a very brilliant colour, depending on their mutual interference. If, on the contrary, the black glass be turned round the ray, so that the second plane of incidence may

coincide with the first, the ordinary rays only will be partially reflected by it, and the complementary colour will be exhibited by the union of the portions oO, eO; but this colour will be less distinct, on account of its mixture with the white light reflected by the first surface.

Appearances of a similar nature may also be observed in the transmitted light, each of the refractions exhibiting the colour complementary to that which it affords by reflection, as happens in the ordinary colours of thin plates; and we must seek for the portions of light which afford them in the successive partial reflections at the two surfaces of the plate, as in the case of the ordinary colours; the light simply transmitted by the separate refractions not exhibiting the ordinary effects of interference, for want of a similarity of polarisation. The obliquity of the incident light produces similar effects on both series.

Under some circumstances of the reflection of rays near the perpendicular, Mr Biot observes that the plate assumes the colour which is usually exhibited by a plate of twice the thickness viewed a little more obliquely; and in such cases it is probable that the polarisation of the beams oO and eE has been so modified as to afford a partial interference; and if this is not the true explanation, it will not be difficult to suppose the interval to be doubled in some other manner by a repeated reflection.

The effect of a plate of a double thickness is also produced by two equal and parallel plates, through which the light passes in succession, provided that their axes of crystallization be parallel, and that they be of such a thickness as to exhibit in conjunction a colour more easily observable than those which they afford separately; a condition which is more generally applicable to the case in which the axes are transverse to each other, and one of the thicknesses is to be subtracted from the other; since in this situation the two portions of light must always interchange their refractions, and that which has moved the more slowly in its passage through one of the plates, will move the more rapidly in the other. This result is very accurately confirmed by experiment, and certainly affords a very striking illustration of the truth of the law of interference.

When we wish to examine the effects of the different obliquities of the incident light, it is most convenient to employ a beam previously polarised, which renders the separation of the different portions by a subsequent reflection or refraction more easily practicable; and for these purposes we may either make use of plates of black glass, placed in proper situations, or polarising piles, consisting of a number of oblique thin plates, which produce the effect on the light transmitted through them, with less diminution of its intensity than would take place in a single partial reflection. In some cases, also, the light may be analysed, by causing it to pass through a piece of Iceland crystal; or through a thin plate of agate, which Dr Brewster has found to transmit only such light as is polarised in a particular plane.

The measurements of the thickness of plates of doubly refracting substances agree in general very accurately with the various tints exhibited by them in various situations with respect to the axis, and with various obliquities of the incident light, according to the theory of periodical colours; and the agreement is always sufficiently perfect to convince us of the dependence of the phenomena on the law of interference, even if it should happen to require some unknown modification in particular cases. In the first place, when the incidence is perpendicular, the thickness of the plates is precisely such as would be inferred from the theory, at least as nearly as the theory is founded on observations sufficiently accurate, although this thickness is often many hundred times as great as that of the thin plates with which it is to be compared; thus the greatest disproportion of the ordinary and extraordinary refraction of rock crystal, according to Malus's experiments, is that of 159 to 160; so that the difference of the times occupied by light in passing through this substance is to the interval, in virtue of which a similar plate exhibits the common colours, as 1 to 320, and to the interval in a plate of crown glass as 1 to 318; while the experiments of Mr Biot make the observed proportion that of 1 to 360; the difference being no greater than would arise from an error of less than a thousandth part of the whole, in the determination of one of the refractive densities.

The effect of the obliquity of the incident light, on the colours exhibited by plates of rock crystal, agrees also perfectly with the theory. The difference of the times required for the ordinary and extraordinary refractions, which is always comparatively small, will vary as the fluxion of the retardation when the obliquity varies; and the sine of ordinary refraction being ϱ, the interval will be expressed by $-r\dfrac{1-hh\varrho\varrho}{\sqrt{(1-\varrho\varrho)}}\,dn$ when the axis is parallel to the surface of the plate, and by $-r\dfrac{\varrho\varrho}{\sqrt{(1-\varrho\varrho)}}\,dn$ when it is perpendicular. Taking, for example, an experiment of Mr Biot, on a plate in which the axis was nearly perpendicular, the mean angle of refraction being 21° 38·5′, the tint was a reddish white of the seventh order, answering to the reflection from a plate of glass ·0000496 of an inch thick, in the experiments of Newton, while the colour exhibited, in a perpendicular light, by a plate of the same crystal, in which the axis was parallel to the surface, would have been expressed by the thickness ·000332. In these two cases, the values of the fluxion become $-r\,dn$ and $-·14633r\,dn$; and reducing the interval ·000332 in this proportion, we find ·0000486 for the thickness of a plate of glass which ought to exhibit the tint corresponding to the oblique incidence; the difference from the experiment being only one millionth of an inch, which would scarcely make a sensible alteration in the colour observed. When the thickness of such a plate is more considerable, or when the eccentricity of the extraordinary refraction is greater, the colours differ, with the incidence, in different parts of the plate; and they are generally disposed in rings concentric with the axis. These rings have been particularly described by Dr Brewster, as observed in the topaz; they are always interrupted by a dark cross, occasioned by the want of light, properly polarised to afford them, in the two transverse directions.

Mr Biot has made a great number of experiments on the colours of the plates of sulphate of lime, in the form denominated Muscovy talc. They exhibit a general agreement with the results of the calculation, particularly with respect to the constancy of the tint, in all moderate obliquities, when the inclination of the axis to the plane of incidence is 45°; but in other cases the agreement is somewhat less perfect, and the difference is too great to be attributed altogether to accident. The most probable reason for this irregularity, under circumstances so nearly similar to those which accord with the theory in the case of rock crystal, is the want of a perfect identity of the two refractions, in the direction of the supposed axis; or, in the language employed by Mr Biot with respect to mica, the existence of a double axis of extraordinary refraction: and it is the more credible that such a slight irregularity may have existed in the sulphate of lime without having been observed, as Dr Brewster has detected a similar property in the arragonite, though both Malus and Biot had examined this substance very carefully without being aware of it. The calculation of the extraordinary re-

fraction, in such a case, would afford but little additional difficulty, if its characters were well determined; the form in which the undulations must be supposed to diverge might properly be termed an *amygdaloid*, and the velocities with which the sections formed by the given surface would extend themselves might be deduced from the properties of the ellipsis, nearly in the same manner as they have been determined for the spheroid. The difference of the results of the calculation from the spheroid, and of Mr Biot's experiments, or rather of the empirical formula derived from them, may be seen in the subjoined table; the first part of which, deduced from the theory, is applicable to all substances affording a regular extraordinary refraction, when the axis is either perpendicular or parallel to the surface of the plate. The first column of decimals shows the equivalent variation of thickness where the axis is perpendicular to the plate, being equal to $\frac{\varrho\varrho}{\sqrt{(1-\varrho\varrho)}}$, the product of the sine and tangent of refraction; the second represents the variation for an ordinary thin plate, being proportionable to the cosine $\sqrt{(1-\varrho\varrho)}$; and the subsequent columns are found by adding to the numbers of the second column those of the first, multiplied by k^2, the square of the sine of the inclination of the plane of incidence to the axis, since

$$\frac{1-hh\varrho\varrho}{\sqrt{(1-\varrho\varrho)}}=\sqrt{(1-\varrho\varrho)}+\frac{kk}{\sqrt{(1-\varrho\varrho)}}.$$

Angle of Refraction.	Perpendicular Plate.	Parallel Plate. Inclination of the Plane of Incidence to the principal Section.				
		0°	22½°	45°	77½°	90°
00°	·0000	1·0000	1·000	1·000	1·000	1·000
20	·1245	·9397	·958	1·002	1·046	1·064
40	·5394	·7660	·845	1·036	1·245	1·305
60	1·5000	·5000	·720	1·250	1·780	2·000
80	5·5851	·1736	·992	2·966	4·940	5·759
Biot. 20°		·969	·975	·995	1·023	1·038
40		898	·920	1·000	1·112	1·175
60		·848	·882	1·097	1·396	1·588
80		1·196	·921	1·440	2·338	3·562

There are also some circumstances in the experiments of Mr Biot on plates of rock crystal cut perpendicularly to the axis, which cannot be sufficiently explained on any hypothesis, without some further investigation. These plates seem to transmit the beam of light subjected to the experiment, without materially altering its polarisation, and then to produce different colours, according to the situation of the substance subsequently employed for analysing the light; so that Mr Biot supposes the rays of light to be turned more or less by the crystal, round an axis situated in the direction of their motion; and he has observed some similar effects in oil of turpentine, and in some other fluids. But it is highly probable that all these phenomena will ultimately be referred to some simpler operation of the general law of interference.

Dr Seebeck and Dr Brewster have discovered appearances of colours, like those of doubly refracting substances, in a number of bodies which can scarcely be supposed to possess any crystalline structure. They are particularly conspicuous in large cubes of glass which have been somewhat suddenly cooled, so that their internal structure has been rendered unequal with regard to tension. The outside of a round mass thus suddenly cooled, being too large for the parts within it, must necessarily be held by them in a state of compression with respect to the direction of the circumference, while they are extended in their turn by its resistance; although in the direction of the diameter the whole will generally be in a state of tension; so that the refractive density may naturally be expected to be somewhat different in different directions, which constitutes the essential character of oblique refraction; and when the proportions of the external parts to the internal are modified by the existence of angles, or other deviations from a spherical form, the arrangement of the tensions must be altered accordingly; and there is no doubt that all the apparently capricious variations of the rings and bands of colours which are observed, might, by a careful and minute examination, be reduced to the natural consequences of these inequalities of density, so far at least as the laws of the extraordinary refraction alone are concerned, although the separation of the light into two portions might still remain unexplained. Effects of the same kind are produced by the temporary operation of partial changes of temperature, producing partial compression and extension of the internal structure of the substance; and even a mechanical force, if sufficiently powerful, when applied externally in a single direction, has been shown, by the same observers, to produce a double refraction; although the difference of the densities thus induced is much too minute to be perceived in any other way than by means of these colours, which are in general so much the more easily seen, as the cause which excites them is the feebler.

Dr Brewster has also shown that the total reflection of light within a denser medium, and the brilliant reflection at the surfaces of some of the metals, are capable of exhibiting some of the appearances of colour; as if the light concerned were divided into two portions, the one partially reflected in the first instance, the other beginning to be refracted, and caused to return by the continued operation of the same power. In the case of silver and gold, it has already been observed that there appear to be two kinds of reflection, occasioning opposite polarities; and these may possibly be concerned in the production of this phenomenon. The original interval appears to be extremely minute, but it is capable of being increased by a repetition of similar reflections, as well as by obliquity of incidence. Mr Biot has also found that such surfaces, combined with plates of doubly refracting substances, either increase or diminish the equivalent thickness, according to the direction of the polarisation which they occasion. In these, and in a variety of similar investigations, a rich harvest is opened, to be reaped by the enlightened labours of future observers; and the more difficulty we find in fully explaining the facts, upon the general principles hitherto established, the more reason there is to hope for an extension of the bounds of our knowledge of the optical properties of matter, and of all the laws of nature connected with them, when the examination of these apparent anomalies shall have been still more diligently pursued.

Sect. XVI.—*Of the Nature of Light and Colours.*

Notwithstanding the acknowledged impossibility of fully explaining all the phenomena of light and colours by any imaginable hypothesis respecting their nature, it is yet practicable to illustrate them very essentially, by a comparison with the known effects of certain mechanical causes, which are observed to act in circumstances somewhat analogous; and, as far as a theory will enable us to connect with each other a variety of facts, it is perfectly justifiable to employ it hypothetically, as a temporary expedient for assisting the memory and the judgment, until all doubts are removed respecting its actual foundation in truth and nature. Whether, therefore, light may consist merely in the projection of detached particles with a certain velocity, as some of the most celebrated philosophers of modern times assert; or whether in the undulations of a

certain ethereal medium, as Hooke and Huygens maintained; or whether, as Sir Isaac Newton believed, both of these causes are concerned in the phenomena; without positively admitting or rejecting any opinion as demonstrably true or false, it is our duty to inquire what assistance can be given to our conception and recollection, by the adoption of any comparison which may be pointedly applicable even to some insulated facts only. It has, however, been thought desirable to separate this investigation as much as possible from the relation of the facts, in order to avoid confounding the results of observation with the deductions from mere hypothesis; an error which has been committed by some of the latest and most meritorious authors in this department. It may be objected to some of the preceding sections, that this forbearance has not been exercised with respect to the general law of interference and its modifications; but it would have been impossible to give any correct statement of the facts in question, without determining whether the appearances depend upon one or both of the portions of light supposed to be concerned.

Art. 1. (Sect. I.) The separation of colours is explained, in the hypothesis of emission, by the supposition of an elective attraction, different in intensity for the different rays of the spectrum; but for this difference no ulterior cause is assigned. Any original difference of velocity is contrary to direct experiment; and even the alterations of relative velocity, which must inevitably be occasioned by a variety of astronomical causes, have not been detected by the most accurate observations, instituted for the express purpose of discovering them; so that it has been suggested that there may possibly be a multitude of rays of the same colour, moving with various velocities, and only affecting the sense when they have the velocity appropriate to that colour in the eye. The name of elective attraction is indeed little more than a mode of expressing the fact, without referring it to any simpler mechanical cause; and in chemical elective attractions the substances concerned are under very different circumstances with respect to contact, and with respect to the probable influence of the form and bulk of their integral particles; at the same time it seems impossible to show any absurdity in the supposition of the existence of such an elective attraction with regard to the different kinds of light. On the other hand, if we consider colours as depending on a succession of equal undulations, of different magnitudes as the colours are different, we may discover an analogy, somewhat more approaching to a mechanical explanation, in the motions of waves on the surface of a liquid; the largest waves moving with the greatest rapidity, although the approximate calculation, derived from the most approved theory, leads us to the same expressions for the velocity as are applicable to the transmission of an impulse through an elastic fluid. The fact is, that a larger wave moves more rapidly than a smaller, because the pressure is not precisely limited to a perpendicular direction, as the simplest calculation supposes, but operates also more or less in an oblique direction, principally within a certain angular limit; so that the utmost depth at which any difference of pressure can affect the liquid as a motive force, is that at which this angle may be imagined to comprehend virtually the exact breadth of a wave; and since the velocity depends on the depth of the fluid affected at once by the pressure, the breadth becomes in this manner an element of the determination. Thus also the larger undulations, constituting red light, are found to move more rapidly than those of the violet, which are supposed to be smaller; and there are many ways in which the difference may be supposed to be occasioned, although not depending exactly on the same cause as in the case of the waves on the surface of a liquid. It is well known that sounds of all kinds move with an equal velocity through the air, and all colours arrive through the supposed elastic ether in the same time from the remotest planets; but a refractive medium, however transparent, is not to be considered as perfectly homogeneous; in many instances, two mediums, of different qualities, seem to pervade every part of a crystal, which is completely uniform in its appearance; and it seems to be necessary, in every case, to suppose the particles of material bodies scattered at considerable distances through a medium which passes freely through their interstices; so that we may conceive the undulations of light to be transmitted partly through the particles themselves, and partly through the intervening spaces, the two portions meeting continually after a certain very minute difference in the length of their paths; we may then suppose the portion transmitted through the interstices to be weakened by the irregularity of its passage, which will affect the smaller undulations more than the larger; and when these portions are combined with the portions more slowly transmitted through the particles themselves, these last will bear a greater proportion to the former in the violet than in the red light, and will have more influence on the ultimate velocity, which will therefore be smaller for the violet than for the red. This explanation may perhaps be far from the best that the hypothesis in question might afford; but it will serve as an illustration of a possible mode, in which the phenomenon may be referred to the established laws of mechanics, without the continual introduction of new principles and properties.

Art. 2. (Sect. IV. A.) Most of the ordinary phenomena of optics are capable of a sufficiently satisfactory explanation, on either of the hypotheses respecting the nature of light and colours; but the laws of interference, which have been shown to be so extensively applicable to the diversified appearances of periodical colours, point very directly to the theory of undulation; so directly, indeed, that their establishment has been considered by many persons on the Continent as almost paramount to the establishment of that theory. It might not, however, be absolutely impossible to invent some suppositions respecting the effects of light, which might partially reconcile these laws to the theory of emission. Thus, if we suppose, with Newton, the projected corpuscles of light to excite sensation by means of the vibrations of the fibres of the retina and of the nerves, we may imagine that such vibrations must be most easily produced by a series of particles following each other at equal distances, each colour having its appropriate distance in any given medium; it will then be demonstrable that any second series of similar particles interfering with them, in such a manner as to bisect their intervals, will destroy their effect in exciting a vibratory motion, each succeeding particle meeting the fibre at the instant of its return from the excursion occasioned by the stroke of the preceding, and thus annihilating the motive effect of that stroke. But the illustration ends here; for it seems impossible to adapt it to the greater number of the alternations which occur, during the passage of a ray, through a given space, in a denser medium; since it is an indispensable condition of the projectile theory, that the velocity of light should be increased upon its entrance into a medium of greater refractive density. The Newtonian theory, of fits of easy reflection and easy transmission, is still more limited in its application, since it attributes to one portion of light those effects which have been strictly demonstrated to depend on the presence of two.

In the undulatory theory, the analogy between the laws of interference, and the phenomena of the tides, and the effects of the combination of musical sounds, is direct and

striking. The existence of an undulation of an elastic medium depends on the recurrence of opposite motions, alternately direct and retrograde, at certain equal distances, in the same manner as a series of waves consists in a number of alternate elevations and depressions, and the succession of the tides in a number of periods of high and low water. The spring and neap tides, derived from the combination of the simple solar and lunar tides, afford a magnificent example of the interference of two immense waves with each other; the spring tide being the joint result of the combination, when they coincide in time and place, and the neap when they succeed each other at the distance of half an interval, so as to leave the effect of their difference only sensible. The tides of the port of Batsha, described and explained by Halley and Newton, exhibit a different modification of the same opposition of undulations; the ordinary periods of high and low water being altogether superseded, on account of the different lengths of the two channels by which the tides arrive affording exactly the half interval which causes the disappearance of the alternation. It may also be very easily observed, by merely throwing two equal stones into a piece of stagnant water, that the circles of waves which they occasion obliterate each other, and leave the surface of the water smooth, in certain lines of a hyperbolic form, while, in other neighbouring parts, the surface exhibits the agitation belonging to both series united. The beating of two musical sounds, nearly in unison with each other, appears also to be an effect exactly resembling the succession of spring and neap tides, which may be considered as the beatings of two undulations related to each other in frequency as 29 to 30; and the combination of these sounds is still more identical with that which this theory attributes to light, since the elementary motions of the particles of the luminiferous medium are supposed to be principally confined to the line of direction of the undulation, while the most sensible effects of the waves depend immediately on their ascent and descent, in a direction perpendicular to that of their progressive motion.

Art. 3. (Sect. IV. B.) The diminution of the velocity of light upon its entrance into a denser medium, in the direct proportion of the refractive density, is one of the fundamental principles of the undulatory theory, and is perfectly inadmissible on the supposition of projected corpuscles. But it must be remembered that the demonstration of the actual existence of this proportion is somewhat indirect, being only derived from the necessity of admitting it in the application of the laws of interference to the observed phenomena; and we have no means of obtaining an immediate measure of the velocity of light in different mediums.

Art. 4. (Sect. IV. C.) The loss of the half interval may be explained, in particular cases, without difficulty, although, in other instances, the circumstances are too complicated to allow us to appreciate their effects. In the direct transmission of a ray of light through a plate of a transparent substance, we may compare the denser medium to a series of elastic balls, larger and heavier than another series in contact with them on each side. Now, it is well known that a series of elastic balls transmits any motion from one end to the other, while each ball remains at rest, after having communicated the motion to the next in order, so that the last only flies off, from having none beyond it to impel; and if the balls, instead of being only possessed of repulsive forces, were connected by elastic ligaments of equal powers, a motion in a contrary direction would be transmitted with equal ease; the last ball, being retained by the ligament, instead of flying off, would draw the last but one in the same direction, itself remaining at rest after this negative impulse; and the motion would be communicated backwards in the same manner throughout the series to the first ball; and then, for want of further resistance, this ball would not remain at rest after receiving the negative impulse, but would be drawn forwards by it, so as to strike the second, precisely in the same manner as at the beginning of the experiment; and this second positive impulse would proceed through the whole series like the first. Such is the nature of the longitudinal vibrations of elastic rods, first observed by Chladni; the cohesion of the substance supplying the place of the supposed elastic ligaments; and in the case of an elastic fluid, the pressure of the surrounding parts performs the same office, a negative impulse being always propagated through it with the same facility as a positive one. If, instead of a single series of balls, we now consider the effect of two series, the second consisting of larger balls than the first, the last ball of the smaller series will not remain at rest after striking the first of the larger, but will be reflected, so as to strike the last ball but one in a retrograde direction; and this retrograde impulse will be continued to the first ball, constituting a positive impulse with respect to the new direction in which it is propagated. But if the first series of balls be larger than the second, the last of the larger balls will not be deprived of all its motion by striking the first of the smaller, but will continue to move more slowly in its first direction; and the elastic ligaments will then be called into action, so as to carry back step by step to the first ball this remaining impulse, which will become negative with respect to the new direction of its transmission. And the same must happen in the case of two elastic mediums in contact, supposing them to be of equal elasticity, but of different densities; the direction of the elementary motions either coinciding with that of the general impulse, or being opposite to it in both mediums at once, when the reflection is produced by the arrival of the undulation at the surface of a denser medium, and being reversed when at the surface of a rarer; and it is obvious that such an inversion of any regular undulation is paramount to its retardation or advancement, to the extent of half of the interval which constitutes its whole breadth; every affection of such an undulation being precisely inverted at the distance of half the breadth of a complete alternation: and these effects will not materially differ, whether the impulse be supposed to arrive perpendicularly at the surface, or in an oblique direction.

Art. 5. (Sect. IV. D.; Sect. XIII.) The experiments of Mr Arago, which show that light does not interfere with light polarised in a transverse direction, lead us immediately to the consideration of the general phenomena of polarisation, which cannot be said to have been by any means explained on any hypothesis respecting the nature of light. It is certainly easier to conceive a detached particle, however minute, distinguished by its different sides, and having a particular axis turned in a particular direction, than to imagine how an undulation, resembling the motion of the air, which constitutes sound, can have any different properties with respect to the different planes which diverge from its path. But here the advantage of the projectile theory ends; for every attempt to reduce the phenomena of polarisation to mechanical laws, by the analogy of magnetism, has completely failed of enabling us to calculate the results of the actions of the forces supposed to be concerned, in any correct manner; to say nothing of the extreme complication of the properties which it would be necessary to attribute to the simplest and minutest substances, in order to justify the original hypothesis of a polarity existing in all the particles of light, and a directive attraction, that is, a combination of attraction and repulsion, in every reflecting or refracting sub-

stance. In the undulatory theory we may discover some distant analogies, sufficient to give us a conception of the possibility of reconciling the facts with the theory, and perhaps even of reducing those facts to some general laws derived from it; although it will be necessary, in this intricate part of the inquiry, to proceed analytically rather than synthetically, and to rest satisfied for the present, without bringing the analysis to a termination by any means explanatory of all the phenomena. Some of the supporters of this theory may perhaps be of opinion that its deficiencies are too strongly displayed by this attempt; but it is for them to find a more complete solution of the difficulties, if any such can be discovered.

In the case of a wave moving on the surface of a liquid, considering the motion of the particles at some little distance below the surface as concerned in the propagation of an undulation in a horizontal direction, we may observe that there is actually a lateral motion, throughout the liquid, in a plane of which the direction is determined by that of gravitation; but this happens because the liquid is more at liberty to extend itself on this side than on any other, the force of gravitation tending to bring it back with a pressure of which the operation is analogous to that of elasticity; and we cannot find a parallel for this force in the motions of an elastic medium. It is indeed very easy to deduce a motion, transverse to the general direction, from the combination of two undulations proceeding from two neighbouring points, and interfering with each other, when the difference of their paths amounts to half an interval; for the result of this combination will be a regular though a very minute vibration in a transverse direction, which will continue to take place throughout the line of the propagation of the joint motions, although certainly not with any force that would naturally be supposed capable of producing any perceptible effects. There must even be a difference in the motions of the particles in every simply diverging undulation, in different parts of the spherical surface to which they extend; for, supposing it to originate from a vibration in a given plane, the velocity of the motion constituting the undulation will be greatest in the direction of that plane, and will disappear in a direction perpendicular to it, or rather will there become transverse to the direction of the diverging radii; and in all other parts there must be a very minute tendency to a transverse motion, on account of the difference of the velocities of the collateral direct motions, and of the compressions and dilatations which they occasion. When, also, a limited undulation is admitted into a quiescent medium, it loses some of its force by diffraction on each side, where it is unsupported by the progress of the collateral parts; and if an undulation were admitted by a number of minute parallel linear apertures or slits, or reflected from an infinite number of small wires, parallel to each other, it would still retain the impression of the incipient tendency to diffraction in all its parts, producing a modification of the motion, in a direction transverse to that of the slits or wires. It is true that all these motions and modifications of motion would be minute beyond the power of imagination, even when compared with other motions, themselves extending to a space far too minute to be immediately perceived by the senses: and this consideration may perhaps lessen the probability of the theory as a physical explanation of the facts; but it would not destroy its utility as a mathematical representation of them, provided that such a representation could be rendered general, and reducible to calculation; and, even in a physical sense, if the alternative were unavoidable, it is easier to imagine the powers of perceiving minute changes to be all but infinite, than to admit the portentous complication of machinery, which must be heaped up, in order to afford a solution of the difficulties which beset the application of the doctrine of simple projection to all the phenomena of polarisation and of colours. It is not however possible at present to complete such a mathematical theory, even on imaginary grounds; although a few further analogies between polarisation and transverse motion force themselves on our observation.

In the theory of emission, the resemblance of the phenomena of polarisation to the selection of a certain number of particles, having their axes turned in a particular direction, supposing these axes, like those of the celestial bodies, to remain always parallel, will carry us to a certain extent, in estimating the quantity of light contained in each of the two pencils into which a beam is divided and subdivided; but it would soon appear that, after a few modifications, this parallelism could no longer be supposed to be preserved: we should also find it impossible to assign the nature and extent of any forces which might be capable of changing the former directions of the axes, and fixing them permanently in new ones. The distinction of a fixed, a movable, and a partial polarisation, which has been imagined by Mr Biot, must vanish altogether, upon considering that all the effects which he attributes to the partial polarisation are observable in experiments like those of Mr Knox, in which there is confessedly no polarisation at all.

If we assume as a mathematical postulate, in the undulatory theory, without attempting to demonstrate its physical foundation, that a transverse motion may be propagated in a direct line, we may derive from this assumption a tolerable illustration of the subdivision of polarised light by reflection in an oblique plane. Supposing polarisation to depend on a transverse motion in the given plane, when a ray completely polarised is subjected to simple reflection in a different plane, which is destitute of any polarising action, and may therefore be called a neutral reflection, the polar motion may be conceived to be reflected, as any other motion would be reflected, at a perfectly smooth surface, the new plane of the motion being always the image of the former plane; and the effect of refraction will be nearly of a similar nature. But when the surface exhibits a new polarising influence, and the beams of light are divided by it into two portions, the intensity of each may be calculated, by supposing the polar motion to be resolved instead of being reflected, the simple velocities of the two portions being as the cosines of the angles formed by the new planes of motion with the old, and the energies, which are the true measure of the intensity, as the squares of the sines. We are thus insensibly led to confound the intensity of the supposed polar motion with that of the reflected light itself; since it was observed by Malus, that the relative intensity of the two portions into which light is divided under such circumstances, is indicated by the proportion of the squares of the cosine and sine of the inclination of the planes of polarisation. The imaginary transverse motion might also necessarily be alternate, partly from the nature of a continuous medium, and partly from the observed fact, that there is no distinction between the polarisations, produced by causes precisely opposed to each other, in the same plane.

Why light should or should not be reflected at certain surfaces, when it has been previously polarised, cannot, even with the greatest latitude of hypothesis, be very satisfactorily explained; but it is remarkable that the transmission is never wholly destroyed, or even weakened in any considerable proportion. We might, indeed, assign a reason for the occurrence of a partial reflection or a total transmission in the constitution of the surface concerned, since every abrupt change of density must necessarily produce a partial reflection, while a gradual transition by insensible steps must transmit each impulse with undimi-

nished energy, and without any reflection of finite intensity, as in the well-known case of a collision supposed to be performed with the interposition of an infinite number of balls of all possible intermediate magnitudes. If, therefore, we could find any modification of light, which could cause it to be transmitted from one medium to another in a more or less abrupt manner, we should thus be able to discover a cause of a variation of the intensity of the partial reflection; and this seems to be the nearest approach that we can at present make to an explanation of the phenomenon, according to the undulatory theory.

Art. 6. (Sect. V.) The equal intensity of the colours of thin plates, seen by reflection and by transmission, is a fact which would not have been expected from the immediate application of the law of interference, and which seems, therefore, at first sight to militate against its general adoption. But this is only one of the many modifications of the law, which are the immediate consequences of its connection with the undulatory theory; and it may be demonstrated, from the analogy of a series of elastic bodies, that no material difference in the intensity of the two kinds of colours ought to be expected in such circumstances. The intensity of a ray of light must always be considered as proportional to the energy or impetus of the elementary motions of the particles concerned, which varies as the square of the velocity, and not simply as the velocity itself; for if the velocity were made the measure of intensity, there would be an actual gain of joint intensity whenever a ray is divided by partial reflection; since it follows from the laws of the motion of the centre of inertia, that when a smaller body strikes a larger, not the sum, but the difference of the separate momenta, will remain unchanged by the collision, while the sum of the energies remains constant in all circumstances; the square of a negative quantity being equal to that of the same quantity taken positively. Thus, supposing an elastic ball, 1, to strike another, of which the mass is r, with the velocity 1, the velocity of the transmitted impulse will be $\frac{2}{r+1}$, and that of the reflected, $\frac{2}{r+1}-1=-\frac{r-1}{r+1}$, the sum of the momenta in the opposite directions being $\frac{3r-1}{r+1}$, instead of 1, the original momentum; but the energies expressed by the products of the masses into the squares of the velocities will be $\frac{4r}{(r+1)^2}$, and $\left(\frac{r-1}{r+1}\right)^2$ respectively; and the sum of these is $\left(\frac{r+1}{r+1}\right)=1$. Now, when an impulse arrives at the last of a series of larger particles, and is reflected in an inverted form, if we substitute $\frac{1}{r}$ for r, the energies will be in the proportion of $\frac{4}{r}$, and $\left(\frac{1}{r}-1\right)^2$, or of $4r$ and $(1-r)^2$, which is the same as the former; so that, according to this analogy, the subdivision of the light at the second surface of a plate must be in the same proportion as at the first. We may call this proportion that of m^2 to n^2, m^2+n^2 being equal to 1; we have then n^2 for the energy of the first partial reflection, m^2n^2 for the second, and m^2n^4 for the third; for the first transmission, into the substance, m^2; for the second, out of it, m^4; for the third, after an intermediate reflection, m^4n^2; and for the fourth, after two reflections, m^4n^4; and the elementary velocities in either medium, compared among themselves, will be as the square roots of the respective energies. But it may be proved that, in all collisions of two moving bodies, each of the motions produces its effect on the velocities after impulse, independently of the other; so that the changes introduced, in consequence of the motion of one of the bodies concerned, are the same as it would have occasioned if the other had been at rest; and, consequently, if two undulations interfere in any manner, the joint velocities of the particles must always be expressed by the addition or subtraction of the separate velocities belonging to the respective undulations. When, therefore, the beam first partially reflected, of which the elementary velocity is expressed by n, interferes with the beam transmitted back, after reflection at the second surface, with the velocity m^2n, the joint velocity, in the case of the perfect agreement of the motions, will be $n+m^2n$, and in case of their disagreement, $n-m^2n$; the energies being $(n+m^2n)^2$ and $(n-m^2n)^2$; the difference, which is the true measure of the effect of the interference, being $4m^2n^2$, that is, four times the product of the respective velocities. But when the light simply transmitted at the second surface, with the velocity m^2, interferes with the light transmitted after two reflections, with the velocity m^2n^2, the quadruple product becomes $4m^4n^2$, only differing from the former in the ratio of m^2 to 1, which is that of the intensity of the light transmitted by the single surface to the intensity of the incident light, the difference being much too slight to be directly perceived by the eye; so that this result may be considered as agreeing perfectly with Mr Arago's observation.

We may also obtain, from the analogy with the effects of collision, an illustration of the intensity of the partial reflection in different circumstances; although it is not easy to say what ought to be the precise value of r in the comparison. If we imagined the two mediums to differ only in density, while their elasticity remained equal, which is the simplest supposition, the density must be conceived to vary as the square of the velocity appropriate to the medium; but the value of r thus determined makes the partial reflection in general much too intense, and it becomes necessary to suppose it weakened by the intervention of a stratum of intermediate density, such as there is every reason to attribute to the surfaces of material substances in general, from the considerations stated in the article COHESION. However this may be, we shall in general approach sufficiently near to a representation of the phenomenon, by taking the mass r in the simple proportion of the refractive density: thus, in the case of water, making $r=\frac{4}{3}$, we have for the energy of the first partial reflection $\left(\frac{r-1}{r+1}\right)^2 = \frac{1}{49} = \cdot 0204$, while the result of Bouguer's experiments is $\cdot 018$; and the agreement is as accurate as could have been expected, even if the whole calculation had not been an imaginary structure. In the case of glass, the difference is somewhat greater; and it is natural to expect a greater loss of light from a want of perfect polish in the surface; for, taking $r=\frac{3}{2}$, we have $n^2=\cdot 040$, and Bouguer found the reflection only $\cdot 025$. The surface of mercury reflected nearly $\cdot 60$; whence r should be about 8. Whether the index of the refractive density can be so great as this, we have no precise mode of determining; but there seems to be something in the nature of metallic reflection not wholly dependent on the density. Thus it may be observed, that potassium has a very brilliant appearance, though its specific gravity is very low; at the same time, its great combustibility might give it a much higher rank among refractive substances than could otherwise have been expected from its actual density.

Art. 7. (Sect. XIII.) Although the ingenuity of man

has not yet been able to devise any thing like a satisfactory reason for the reflection of a polarised ray in one case, and its transmission in another, yet several attempts have been made, with various success, to reconcile the different hypotheses of light with the other phenomena of oblique refraction. The illustrious M. Laplace has undertaken to reduce the laws of this refraction, according to the projectile system, from the general doctrines of motion; and he has sufficiently demonstrated that the path followed by the light is always such as to agree with the principle of the least action, supposing the law of the velocities previously established; or, in other words, that the sum of the products of the spaces described, into the respective velocities, is always the least possible. To this demonstration it has been objected, that notwithstanding the complication of its steps, it is in fact nothing more than the simple translation of the fundamental law of Huygens into another language; for it is assumed in this theory, upon obvious and intelligible grounds, that the path of light must always be such that the time may be equal with respect to two neighbouring collateral parts of the undulation, which is the well-known condition of a minimum of the whole time employed; and the time being always expressed by the space divided by the velocity, if we suppose the proportions of the velocities to be inverted, as in the two theories respecting light, the expression of the time in the one will be identical with that of the action in the other; consequently the conditions of the propagation of light, in the Huygenian doctrine, must always imply the observation of the law of least action in the opposite hypothesis; and this general proposition M Laplace has taken great pains to prove with respect to a particular instance, in which the Huygenian calculation had been found, notwithstanding Newton's doubts, to agree perfectly with the phenomena. It has also been observed, that the law of the least action is wholly inadmissible as a fundamental principle of motion; that it is completely unphilosophical to multiply unnecessarily the number of postulates or elementary laws; and that although in many cases the principle may be capable of being established as a derivative proposition, yet, in order to demonstrate it, we must assume that the velocity must be the same in all directions, between the same parallel or concentric surfaces, or at any rate must limit our reasoning by conditions incompatible with the nature of the actions, to be considered as the foundation of the laws of extraordinary refraction.

In this single point, the undulatory theory has every possible advantage over its rival. For the difference of the velocities in different directions, no force has been assigned as a cause, in the projectile system, at all more general than the individual directions of the rays with respect to the axis. But upon the hypothesis of undulations, it has been demonstrated, without any gratuitous supposition, that every lamellar or fibrous substance must transmit every diverging impulse in the form of a spheroidal surface, supposing only the elasticity to act more powerfully in one direction than another, as it naturally must do in such circumstances. (*Quarterly Review*, No. iv.) And when we consider the experiments of Dr Brewster and Dr Seebeck, which show that any compression or extension whatever, acting in a given direction on any transparent solid, is capable of occasioning those appearances of colour which prove the transmission of light by an ordinary and extraordinary refraction, we cannot help imagining that the cause of the elliptic refraction must be of a nature more simple than is consistent with the existence of a multiplicity of attractions, and repulsions, and polarising powers, acting in all manner of directions, with every possible variation of intensity, independently of any assignable variation of the circumstances of the light affected.

There is however another mode of considering the mechanism of elliptic refraction, which is somewhat less simple and elementary, but which affords us a further analogy to the phenomena of polarisation by reflection and transmission. If we suppose a doubling crystal to consist of a large number of very thin plates, united by a medium differing but little from them in refractive density, this pile will completely polarise the transmitted light, as Malus and Dr Brewster have shown, in a plane perpendicular to that of the incidence, even when the inclination of the surfaces is widely different from that which produces the most complete polarisation at once; and at the same time a part of the light, partially reflected by each plate, will be again reflected by the neighbouring surfaces into its original direction; nor will it be difficult to imagine that the quantity of light thus twice reflected may, from some unknown cause, be rendered ultimately equal to that of the light simply transmitted, which, according to the laws of polarisation, will never exceed half of the original beam. Now the lengths of the paths of these two portions will not only be different, but the difference will vary according to the direction; for while the light simply transmitted proceeds to describe its path, with the uniform velocity belonging to the mean of the two mediums, combined always in a constant proportion, the light twice reflected by each plate will be retarded most of all in the direction perpendicular to the plates, as in the case of the colours of common thin plates; and in oblique directions, the number of plates which it has to pass through in a given space being as the cosine of the angle of incidence, and the retardation in each plate being also as the same cosine, neglecting the difference between the angles of incidence and refraction, which is supposed to be inconsiderable, the whole retardation will be as the square of the cosine of the inclination to the axis, which is the well-known proportion of the difference of the diameters of a circle, and of an ellipsis approaching near in it. We thus obtain a general idea of the combination of two effects which do not appear to be related in any other point of view, a regular oblique refraction and a distinct polarisation; further than this, the comparison is by no means completely satisfactory; and the great difficulty of all, which is to assign a sufficient reason for the reflection or non-reflection of a polarised ray, will probably long remain, to mortify the vanity of an ambitious philosophy, completely unresolved by any theory. (T. Y.)

CHROMIUM, one of the metals. See CHEMISTRY.

CHRONIC, a term applied to diseases of long continuance, in contradistinction to those that speedily terminate, which are called acute.

CHRONICLE, an historical register of events in the order of time. Chronicle is nearly synonymous with annals.

CHRONICLES, the name given to two books of the Old Testament, standing thirteenth and fourteenth in our English collection, but variously placed in the lists of the Masorets, Talmudists, and Fathers. Eichhorn (*Einleitung* § 7) and De Wette (*Kurzgefasstes exegetisches Handbuch zum Neuen Testament*, Bd. i. 247), with many others in recent times, contend, from the mention of Zacharias, son of Barachias, in Matt. xxiii. 35. (whom they identify with Ze-

chariah, son of Jehoiada, in 2 Chron. xxiv. 19–22), that they must have stood last in the order of the canonical Scriptures, because thus alone could the two events there mentioned be pointed out as conspicuous landmarks, inclusive of all Old Testament martyrology. The difficulties, however, which beset the interpretation of both passages—the definitely marked chronology of the martyrdom in the Old Testament, with the obvious latitude required by the commination in the New—render this objection of comparatively little force. In Hebrew the Chronicles have the title of *Words of the Days* or *Journals*, and form, as their internal character sufficiently demonstrates, one book; but in the Alexandrine version they form two books under the name *Paraleipomena* or *things omitted*, a title which recognises them as standing in a merely supplementary relation to the previous histories. The name of *Chronicles* does not remount beyond the time of Jerome, and is obviously less correct than the Alexandrine designation.

The Book of Chronicles (for we shall speak of them as one) opens with a variety of lists, principally genealogical; but these are neither complete nor coextensive with the Jewish tribes, Dan and Zebulon being omitted, while peculiar prominence is given to Benjamin. After these it gives the history of David, entirely harmonizing with the earlier account of Samuel, but regarding it from a more purely theocratic point of view. From the establishment of the monarchy under David it narrates the increasing glory of the Jewish kingdom under Solomon, and traces its decline in that last and most vital of the two branches into which it was at his death divided, viz. the kingdom of Judah. This latter part of the history is continued after the fall of Israel, and with particular reference to the vicissitudes in the history of Jewish worship. The narrative is brought down till after the exile; and one of the genealogies (1 Chron. iii. 19–24, which, however, Eichhorn, Dahler, Jahn, and Keil, regard as a later addition) seems to be continued till the time of Alexander.

The comparatively late origin of the book of Chronicles is as strongly marked in the enfeebled Aramaic colouring which everywhere overspreads the diction as by the chronological notes which are to be found in the narrative. The same inference may be allowed from the special jealousy in behalf of sacerdotal institutions which the writer manifests, and which is evidently in keeping with the whole tone of the later prophetic denunciations. In regard to the authorship of the book, the invariable Jewish tradition is in favour of Ezra, and this is generally regarded as sufficiently borne out by the peculiarities of its style and idiom, and as directly shown in the obvious connection subsisting between the close of the narrative in the Chronicles and the opening of the book which bears his name. Several recent critics, however, partly on historical and partly on literary considerations, attribute it to some unknown author, who is in all probability to be found in the priesthood. The sources from which the materials have been derived are incidentally given in the record itself, and comprehend a great variety of books which have not been admitted into the canon. Some have denied that the author drew any information from the previous historical books; but this has been generally conceded, and it seems difficult otherwise to account for the marked similarity which obtains between them.

The most important subject of debate in regard to the book of the Chronicles, is that which affects the integrity of the text and the accuracy of the history. One or other of these is surrendered by either of two parties; those who uphold the historical accuracy of the record deny the immaculate integrity of the text; while those who uphold the integrity of the text, as a necessary consequence, impeach the historical accuracy of the record. A third party who, in a narrative so unmistakably one in style and spirit, seek by a process of delicate criticism to eliminate the spurious additions of later hands, have by the inconsistency of their results signalized the worthlessness and failure of the scheme. As these are questions of purely historical criticism, in which ethical considerations find no place, it is idle to appeal to the consentient voice of the synagogue and the church as furnishing any ground of decision in the case; and thus it is unnecessary here to give any details in regard to the exegetic history of the book. The textual corruption postulated on the one hand, and the historical inaccuracy postulated on the other, have varied greatly in amount at different epochs, and are always in striking disproportion. The former is gradually subsiding to a minimum of some six or seven instances—most of them arising immediately from the delicacies of Hebrew orthography and numeration—while under the pressure of the destructive criticism which has long prevailed abroad, the former has reached a maximum so largely aspersing the general character of the book that it were an easier task to estimate the small residuum of accuracy than the mass of error which it contains. To arrive at this latter result the fragmentary and disjointed character of the book is wholly overlooked, and every chasm is unhesitatingly reckoned an inaccuracy, every variation in statement from the earlier books a deviation from truth, every retrenchment an apologetic omission, and every addition an edifying gloss. (See De Wette's *Introduction to the Canonical Books of the Old Testament*, who on this side of the question may be said to have exhausted the subject). But this is not all; critics of this class have gone a step further, and regard the inaccuracy as systematic and designed. Applying the *cui bono* principle (who profits by the fraud?) they find the key to all the corrections, retrenchments, and additions in the growing influence and arrogance of the priesthood who sought to consolidate and aggrandize the power of their order by thus clumsily exaggerating their influence on the previous history of the nation. For this purpose they, or the writer who represents them, have endeavoured to throw a sacerdotal colouring over every transaction, concealing everything that would lower the orthodox or exalt the idolatrous kings in popular estimation, overstating the respective numbers of the tribes, and values of the offerings to the temple. Against this hypothesis it is enough to plead—independent of the monstrosity of the supposition which it necessarily involves, that the whole Jewish Levitical system was the work of time and chance and personal intrigue—the entire absence of that superficial accuracy which invariably marks all such disingenuous productions, and the ease with which the seeming contradictions, with the exception of a very few otherwise readily accounted for, can be reconciled. (See this ably shown in Dr Samuel Davidson's *Sacred Hermeneutics developed and applied.*) Besides this, the scope and style of the book admits of a higher and truer explanation. Psychologically it stands in immediate connection with the mission of the ecclesiastical reformer who was its author, and historically with the reforms which he was instrumental in executing; while as the last of the genealogical records it served at once to fix the line and prepare the way of the last and greatest priesthood. (R. W—N.)

CHRONOLOGY.

CHRONOLOGY, from χρονος, *time*, and λογος, *word* or *description*, is the science which treats of time. Its object is to arrange and exhibit the various events which have occurred in the history of the world in the order of their succession, and to ascertain the intervals of time between them.

The preservation of any record, however rude, of the lapse of time, implies some knowledge of the celestial motions, by which alone time can be accurately measured, and some advancement in the arts of civilized life, which could only be attained by the accumulated experience of many generations. Before the invention of letters, the memory of past transactions could not be preserved beyond a few years with any tolerable degree of accuracy. Events which greatly affected the physical condition of the human race, or were of a nature to make a deep impression on the minds of the rude inhabitants of the earth, might be vaguely transmitted through several ages by traditional narrative; but intervals of time, expressed by abstract numbers, and these too constantly varying, would soon escape from the memory. The invention of the art of writing afforded the means of substituting precise and permanent records for vague and evanescent tradition; but in the infancy of the world mankind had neither learned to estimate accurately the duration of time, nor to refer passing events to a fixed and determined epoch. Writing was practised many centuries before historians began to assign dates to the events they narrated.

For these reasons the history of the early ages of the world is involved in impenetrable obscurity, and chronology, comparatively speaking, is only of recent date. After political relations began to be established, the necessity of preserving a register of passing seasons and years would soon be felt, and the practice of recording important transactions must have grown up as a necessary consequence of social life. But of these early records, how small a portion has escaped the ravages of time and barbarism? The annals of the early Greeks and of the Etruscans are irretrievably lost. Of the chronicles which Manetho, high priest of Sebenne, professed to have reduced from the archives of the Egyptian temples; of the histories of Sanconiathon the Phœnician, of Berosus, Hecatæus, and others, only a few mutilated fragments have been transmitted to our times through the suspected relation of Josephus, Julius Africanus, Eusebius, Syncellus, and other chronologers. The Gauls destroyed the records of ancient Rome. The Romans, in their turn, extirpated the Druids of Gaul and Britain, and obliterated the last vestiges of their ancient traditions. An Arab chief burned the library of Alexandria, a Chinese emperor the histories of his own country, and a Spanish soldier the paintings and hieroglyphics of the palace of Montezuma.

In order to preserve an exact record of the succession of events, some conventional *epoch*, or fixed point of time, must be taken as the origin of the reckoning, and some standard period assumed with which the successive intervals may be compared. It is a trite remark, that the simplest ideas are generally the latest in representing themselves to the mind. Nothing seems more obvious than to measure the longer intervals of time by the tropical revolutions of the sun, and to number the years in regular succession. But this simple method was not adopted by historians in the earliest ages. In the Scripture history the lapse of time is frequently estimated by generations, or reigns of kings, and not by exact numbers of years. The historians of early Greece proceeded in a similar manner. Hellanicus regulated his narrative by the succession of the priestesses of Juno in the temple of Argos. Others reckoned by the ephori and kings of Sparta, or the archons of Athens. Ephorus, the disciple of Isocrates, who composed a chronological history of Greece, reckoned by generations. Eratosthenes and Apollodorus, who flourished about a hundred years after the death of Alexander the Great, first attempted to introduce precision into historical records, by substituting numbers of years for generations, reigns, or successions. (See Newton's *Chronology*, Introduction). Now, when time is measured by any of the above methods, it is obvious that we can only approximate to the intervals between successive events, from our knowledge of the average duration of human life, and of kings' reigns, in the present state of the world. Chronologers usually reckon three generations equivalent to a hundred years, and Sir Isaac Newton allows eighteen or twenty years to a reign or succession. In a great number of years this estimate is probably near the truth, but it affords very uncertain information with respect to short periods, and none whatever with regard to the duration of an individual reign. It is to those loose methods of marking the lapse of time that we must ascribe the great discrepancy that exists among the chronological accounts of the early ages of Greece and Rome.

Another great cause of uncertainty and confusion in chronology has arisen from the diversity of epochs assumed by historians, and the practice, which has been unhappily too prevalent, of shifting the origin of their eras from one epoch to another. Having little intercourse with each other, the different groups or communities into which mankind were divided in early times, instead of agreeing on a common epoch, began each to date the years from some event, important perhaps in reference to its individual history, but of which other tribes were probably entirely ignorant, or which at least they regarded with indifference. Hence in ancient history we have the Olympiad of Corœbus, the foundation of Rome, the era of Nabonassar &c.; and in more recent times the Christian era, the Hegira, the era of Yezdegird, &c. Some centuries after the introduction of Christianity, the various sects of Christians began to found their eras on events connected with the appearance of Christ, but without any regard to uniformity. Some reckoned from the epoch of his conception, or the annunciation; others from his birth, others again from his passion, others from his ascension; and hence there is very frequently the greatest difficulty in reconciling the dates given by the historians and annalists of the middle ages.

In reckoning years from any fixed epoch in constant succession, the numbers denoting the years necessarily undergo a constant and unlimited augmentation. But rude nations, and illiterate people in general, seldom attach any definite idea to large numbers. Hence it has been a practice, very extensively followed, to employ cycles or periods, containing a moderate number of years, and to distinguish and reckon the years by their number in the cycle. The Chinese, and some other nations of Asia, reckon not only the years, but also the months and days, by cycles of sixty. The Saros of the Chaldeans, the Olympiad of the Greeks, and the Roman Indiction, are instances of this mode of reckoning time. Several cycles were formerly known in Europe; but most of them were invented for the purpose of adjusting the solar and lunar divisions of time, and were

rather employed in the regulation of the calendar than as chronological eras. They are frequently, however, of very great use in fixing dates that have been otherwise imperfectly expressed, and consequently form important elements of chronology.

In the article Calendar, we have already treated of that part of Chronology which relates to the measurement of time, and explained with sufficient detail the principal methods that have been employed, or are still in use, for adjusting the lunar months to the solar year, as well as the intercalations necessary for regulating the civil year according to the celestial motions. In the present article it is our purpose to give an account of the different *Eras* and *Periods* that have been employed by historians, and by the different nations of the world, in recording the succession of time and events; to fix the epochs at which the eras respectively commenced; to ascertain the form and the initial day of the year made use of; and to establish their correspondence with the years of the Christian era. These elements will enable us to convert, by a simple arithmetical operation, any historical date, of which the chronological characters are given according to any era whatever, into the corresponding date in the common era of the Incarnation.

Julian Period.

Although the Julian period is not, properly speaking, a chronological era, yet, on account of its affording considerable facilities in the comparison of different eras with one another, and in marking without ambiguity the years before Christ, it is very generally employed by chronologers. It consists of 7980 Julian years. The number 7980 is formed by the continued multiplication of the three numbers 28, 19, and 15, that is, of the cycles of the sun, of the moon, and of the Indiction: hence, when the number of any year in the Julian period is divided by one of these three numbers, the remainder of the division will indicate the number of that year in the corresponding cycle. The first year of the Christian era had ten for its number in the cycle of the sun, two in the cycle of the moon, and four in the Indiction; but 4714 is the only number less than 7980 which, on being divided by 28, 19, and 15, gives the respective remainders 10, 2, and 4 (See Calendar). Hence the first year of the Christian era corresponded with the year 4714 of the Julian period. In order, therefore, to find the year of our era corresponding to any other year of the period, or the contrary, we have the following rule:

1. When the given year is anterior to the commencement of the Christian era, subtract the number of the year in the Julian period from 4714, and the remainder is the year before Christ: or subtract the year before Christ from 4714, and the remainder is the corresponding year in the Julian period.

2. When the given year is after Christ, subtract 4713 from the year of the period, and the remainder is the year of the Christian era; or add 4713 to the year of Christ, and the sum is the corresponding year of the Julian period.

Olympiads.

The Olympic games, so famous in Grecian history, were celebrated once every four years, between the new and full moon first following the summer solstice, on the banks of the river Alpheus, near the city of Pisa, in the Peloponnesus, and lasted five days. They are said to have been originally instituted by Hercules, at the funeral ceremonies of Pelops, 1354 years before the Christian era; but they seem to have been forgotten, or at least to have been discontinued, during several centuries. They were afterwards re-established by Iphitus, king of a canton of Elis, in concert with Lycurgus and Cleosthenes of Pisa, 844 years before Christ, and 470 years from the time of their original institution; but it was not till upwards of a hundred years after this time that they began to be used as a chronological epoch. It was then that the practice was adopted of designating the Olympiad, or period of four years, by the name of the victor in the contests of the stadium, and of inscribing his name in the gymnasium of Olympia. The first who received this honour was Corœbus. The games in which Corœbus was victor, and which form the principal epoch of Grecian history, were celebrated about the time of the summer solstice, 776 years before the common era of the Incarnation, in the 3938th of the Julian period, and twenty-three years, according to the account of Varro, before the foundation of Rome.

Form of the Olympic Year.—Before the introduction of the Metonic cycle, the ordinary Grecian year consisted of twelve lunar months, containing twenty-nine and thirty days alternately; and in order to reconcile this with the course of the sun, a thirteenth month was added, at first every second year, and subsequently three times in eight years. The additional or intercalary month contained thirty days, so that the *Octaeteris*, or period of eight years, consisted of ninety-nine months, containing in all 2922 days, which is exactly equal to eight Julian years. The years which contained the intercalary month were called *embolismic*, and formed the third, fifth, and eighth of the period. Hence the Olympiads contained forty-nine and fifty months alternately, the first four years of the Octaeteris containing one intercalary year, and the second two; and hence, also, the Olympic games were celebrated alternately on common and embolismic years. It has been shown in the article Calendar, that the Octaeteris fell short of the actual length of ninety-nine lunations by a day and a half nearly; at the end of two periods, therefore, the moon's age was three days less than it had been at the commencement, and in order to restore the coincidence between the civil month and the lunation, three days were added to the last year of each second Olympiad. But this correction introduced an error in respect of the sun, and caused the solar year to commence three days too late. This error was allowed to accumulate till the end of the fortieth Olympiad, when a full month of thirty days was omitted, by which means the solar and lunar years were adjusted, and the forty-first Olympiad commenced with the same day of the moon, and the same season of the year, as the first had done 160 years before. According to this arrangement the common years contained 354 days, and the embolismic 384; excepting however the concluding year of each second Octaeteris, which contained 387 days, and the last year of each fortieth Olympiad, which had 357 days.

In the fourth year of the eighty-sixth Olympiad, Meton published his celebrated cycle of nineteen years, which, after receiving a slight correction from Calippus, continued to be followed ever afterwards, so long as the practice of dating by Olympiads continued in use. Before the introduction of the Metonic cycle, the Olympic year began sometimes with the full moon which followed, sometimes with that which preceded, the summer solstice, on account that the year sometimes contained 384 days instead of 354; but subsequently to its adoption, the year always commenced with the eleventh day of the moon which followed the solstice. In order to avoid troublesome computations, which it would be necessary to recommence for every year, and of which the results differ from one another only by a few days, chronologers in general regard the first of July as the commencement of the Olympic year. Some authors, however, among whom are Eusebius, Jerome, and the historian Socrates, place its commencement at the first of September; but they seem to have confounded the Olym-

pic year with the civil year of the Greeks, or the era of the Seleucidæ.

It is material to observe, that as the Olympic years and periods begin with the first of July, the first six months of a year of our era correspond to one Olympic year, and the last six months to another. Thus, when it is said that the first year of the Incarnation corresponds to the first of the 195th Olympiad, we are to understand that it is only with respect to the last six months of that year that the correspondence takes place. The first six months belonged to the fourth year of the 194th Olympiad. In referring dates expressed by Olympiads to our era, or the contrary, we must therefore distinguish two cases.

1st, When the event in question happened between the first of January and the first of the following July, the sum of the Olympic year and of the year before Christ is always equal to 776. The year of the era, therefore, will be found by subtracting the number of the Olympic year from 776. For example, Varro refers the foundation of Rome to the 21st of April of the third year of the sixth Olympiad, and it is required to find the year before our era. Since five Olympic periods have elapsed, the third year of the sixth Olympiad is $5\times4+3=23$; therefore, subtracting 23 from 776, we have 753, which is the year before Christ to which the foundation of Rome is referred by Varro.

2d, When the event took place between the summer solstice and the first of January following, the sum of the Olympic year and of the year before Christ is equal to 777. The difference therefore between 777 and the year in one of the dates will give the year in the other date. Thus, the moon was eclipsed on the 27th of August, a little before midnight, in the year 413 before our era; and it is required to find the corresponding year in the Olympic era. Subtract 413 from 777, the remainder is 364; and 364 divided by four gives 91 without a remainder; consequently the eclipse happened in the fourth year of the ninety-first Olympiad, which is the date to which it is referred by Thucydides.

If the year is after Christ, and the event took place in one of the first six months of the Olympic year, that is to say, between July and January, we must subtract 776 from the number of the Olympic year to find the corresponding year of our era; but if it took place in one of the last six months of the Olympic year, or between January and July, we must deduct 777. The computation by Olympiads seldom occurs in historical records after the middle of the fifth century of our era.

The names of the months were different in the different Grecian states. The Attic months, which were the most usual, are as follows:

Hecatombæon.	Gamelion.
Metageitnion.	Anthesterion.
Boedromion.	Elaphebolion.
Pyanepsion.	Munychion.
Mœmacterion.	Thargelion.
Poseideon.	Seirophorion.

Era of the Foundation of Rome.

After the Olympiads, the era most frequently met with in ancient history is that of the foundation of Rome, which is the chronological epoch adopted by all the Roman historians. There are various opinions respecting the year in which this event took place; but the authorities most deserving of credit are the five following:

1st, Fabius Pictor, who places the epoch of the foundation of Rome in the latter half of the first year of the eighth Olympiad, which corresponds with the 3967th of the Julian period, and with the year 747 before Christ.

2d, Polybius, who places it in the second year of the seventh Olympiad, corresponding with 3964 of the Julian period, and 750 B. C.

3d, Cato, who places it in the first year of the seventh Olympiad, that is, in 3963 of the Julian period, and 751 B. C.

4th, Verrius Flaccus, who places it in the fourth year of the sixth Olympiad, that is, in the year 3962 of the Julian period, and 752 B. C.

5th, Terentius Varro, who places it in the third year of the sixth Olympiad, that is, in the year 3961 of the Julian period, and 753 B. C.

A knowledge of these different computations is frequently necessary, in order to reconcile the Roman historians with one another, and even with themselves. Livy in general adheres to the epoch of Cato, though he sometimes follows that of Fabius Pictor. Cicero follows the account of Varro, which is also in general adopted by Pliny. Dionysius of Halicarnassus follows Cato. Modern chronologers for the most part adopt the account of Varro, which is supported by a passage in Censorinus, where it is stated that the 991st year of Rome commenced with the festival of the Palilia, in the consulship of Ulpius and Pontianus. Now this consulship corresponded with the 238th year of our era; therefore, deducting 238 from 991, we have 753 to denote the year before Christ. The Palilia commenced on the 21st of April; all the accounts agree in regarding this date as the epoch of the foundation of Rome.

The Romans employed two sorts of years, the civil year, which was used in the transaction of public and private affairs, and the consular year, according to which the annals of their history have been composed. From the time of Numa the civil year always commenced with the calends of January; but by reason of the arbitrary manner in which, till the time of Julius Cæsar, their calendar was regulated by the pontiffs, the civil months did not retain a fixed place in the solar year, and the calends of January successively passed into the different seasons. Hence part of the Roman civil year corresponded to one Julian year, and part of it to another. Thus, when the 1st of January in the civil year corresponded with the Julian 1st of September, the first four months of the civil year belonged to one Julian year, and the last eight months to the Julian year following. With regard to the consular year (or year of the reign before the expulsion of the kings) the confusion and uncertainty are still greater. The epoch of the succession of a king regulated the commencement of the years of his reign, and the installation of the consuls the commencement of the consular year. The initial day of the consulate was never fixed, at least before the seventh century of Rome, but varied with the different accidents which in times of political commotion so frequently occurred to accelerate or retard the elections. Hence it happens that a consular year, generally speaking, comprehends a part not only of two Julian years, but also of two civil years. The consulate is the date employed by the Latin historians generally, and by many of the Greeks, down to the sixth century of our era.

In the era of Rome the commencement of the year is placed at the 21st of April; an event therefore which happened in the months of January, February, March, or during the first twenty days of April, in the year (for example) 500 of Rome, belongs to the civil year 501. Before the time of the Decemvirs, however, February was the last month of the year. Many authors confound the year of Rome with the civil year, supposing them both to begin on the 1st of January. Others again confound both the year of Rome and the civil year with the Julian year, which in fact became the civil year after the regulation of the calendar by Julius Cæsar. Through a like want of

attention, many writers also, particularly among the moderns, have confounded the Julian and Olympic years, by making an entire Julian year correspond to an entire Olympic year, as if both had commenced at the same epoch. Much attention to these particulars is required in the comparison of ancient dates.

The Christian Era.

The Christian or vulgar era, called also the era of the Incarnation, is now almost universally employed in Christian countries, and is even used by some eastern nations. Its epoch or commencement is the 1st of January in the fourth year of the 194th Olympiad, the 753d from the foundation of Rome, and the 4714th of the Julian period. It is usually supposed to begin with the year of the birth of Christ, but there are various opinions with regard to the year in which that event took place. The most probable is, that the birth of Christ happened five years and seven days before the initial day of the vulgar era. This method of dating the years was introduced into Italy in the sixth century, by Dennis or Dionysius the Little, a Roman abbot, and began to be used in France in the seventh, though it was not generally followed in that country before the reigns of Pepin and Charlemagne. In England it seems to have been introduced by St Augustin. Before its adoption the usual practice in Latin countries was to distinguish the years by their number in the cycle of Indiction.

In the Christian era the years are simply marked and distinguished by the cardinal numbers; those before Christ being distinguished by the characters B. C. (Before Christ), or A. C. (Ante Christum), and those after Christ by A. D. (Anno Domini.) This method of reckoning time is more commodious than those which employ cycles or periods of any length whatever; and, provided the commencement of the era had been placed at the creation of the world, or at some point of time prior to all historical records, it would have satisfied, in the simplest manner possible, all the conditions that are necessary for registering the succession of events. But when the commencement of the era is placed, as in the present case, at an intermediate period of history, some inconvenience is felt with regard to the dates of preceding events, on account of the interruption of the numerical order. Some ambiguity is also occasioned by the want of uniformity in the methods adopted by authors, of numbering the preceding years. In order to preserve uniformity in their computations, astronomers denote the year which preceded the first of our era by 0, and the year previous to that by 1 B. C.; but chronologers, in conformity with common notions, call the year preceding the era 1 B. C., the previous year 2 B. C., and so on. By reckoning in this manner, there is an interruption in the regular succession of the numbers; and in the years preceding the era, the leap years, instead of falling on the fourth, eighth, twelfth, &c., fall, or ought to fall, on the first, fifth, ninth, &c.

In the chronicles of the middle ages much uncertainty frequently arises respecting dates, on account of the different epochs that have been assumed for the commencement of the Christian year. Dennis, the author of the era, thinking it more natural to reckon from the conception, adopted the day of the *Annunciation*, or the 25th of March, which preceded the birth of Christ by nine months, as the commencement of the first year of the era. The epoch of Dennis therefore precedes that of the vulgar era by nine months and seven days. This manner of dating was followed in some of the Italian states, and continued to be used in Pisa even down to the year 1745. It was also adopted by some of the Popes in their Bulls; and there are proofs of its having been employed in France about the middle of the eleventh century. Some chroniclers, who adhere to the day of the annunciation as the commencement of the year, reckon from the 25th of March *following* our epoch, as the Florentines in the tenth century. Gregory of Tours, and some writers of the sixth and seventh centuries, make the year commence sometimes with the 1st of March, like the Romans before the time of Numa, and sometimes with the 1st of January. In France under the third race of kings it was usual to begin the year with Easter; and this practice continued at least till the middle of the sixteenth century, for an edict was passed by Charles IX. in the month of January 1563, ordaining that the commencement of the year should thenceforth be considered as taking place on the first of January. An instance is given, in *l'Art de Verifier les Dates*, of a date in which the year is reckoned from the 18th of March; but it is probable that this refers to the astronomical year, and that the 18th of March was taken for the day of the vernal equinox. In Germany, about the eleventh century, it was usual to commence the year at Christmas; and this practice also prevailed at Milan, Rome, and other Italian cities, in the thirteenth, fourteenth, and fifteenth centuries.

In England, the practice of placing the beginning of the year at Christmas was introduced in the seventh century, and traces of it are found to exist even in the thirteenth. Gervais of Canterbury, who lived in the beginning of the thirteenth century, mentions that almost all writers of his country had agreed in regarding Christmas day as the first of the year, because it forms as it were the term at which the sun finishes and recommences his annual course. In the twelfth century, however, the custom of beginning the civil year with the day of the Annunciation, or the 25th of March, began to prevail, and continued to be generally followed from that time till the reformation of the calendar in 1752. The *historical* year has always been reckoned by English authors to begin with the first of January. The liturgic year of the church of England commences with the first Sunday of Advent.

A knowledge of the different epochs which have been chosen for the commencement of the year in different countries is indispensably necessary to the right interpretation of the ancient chronicles and annals, in which the dates often appear contradictory, though correctly and precisely marked. We may cite an example or two. It is well known that the emperor Charlemagne was crowned at Rome on Christmas-day in the year 800, and that he died in the year 814, according to our present manner of reckoning; but in the annals of Metz and Moissac, the coronation of Charlemagne is stated to have taken place in the year 801, and his death in 813. Both these statements appear at first sight to be erroneous; but on attending to the different periods at which the year has been supposed to begin, they will both be easily reconciled with the known facts. In the first case the annalist supposes the year to begin with Christmas, and accordingly reckons the 25th of December and all the following days of that month to belong to 801, whereas in the common reckoning they would be referred to the year 800. In the second case the year has been supposed to begin with the 25th of March, or perhaps with Easter; consequently the first three months of the year 814, reckoning from the 1st of January, would be referred to the end of the year 813. As another example, the English revolution is popularly called the revolution of 1688. Had the year then begun, as it now does, with the 1st of January, it would have been the revolution of 1689, that event having taken place in February in the year 1689; but at that time the year was considered in England as beginning on the 25th of March. Another circumstance to which it is often necessary to pay attention in the comparison of dates, is the alteration of style which took place on the adoption of the

Gregorian Calendar. The old style still continues to be used by the Russians and Greeks; and in order to convert a date expressed in this manner into the new style, it is necessary to attend to the variation which takes place from century to century, in the interval between the commencement of the Julian and Gregorian years. From the reformation of the calendar in 1582 to the 29th of February 1700, the difference is ten days; from the 1st of March 1700 to the 29th of February 1800, it is eleven days; from the 1st of March 1800 to the 29th February 1900 the difference is twelve days; and after the 1st of March 1900, if the old style shall then continue to be in use, the difference will be thirteen days, till the 29th of February 2100, as has been explained at length in the article CALENDAR.

Era of the Creation of the World.

As the Greek and Roman methods of computing time were connected with certain Pagan rites and observances, which the Christians held in abhorrence, these began at an early period to imitate the Jews in reckoning their years from the creation of the world. The chronological elements on which both Jews and Christians founded their computations for determining the epoch of that event were derived from the Old Testament narrative, which, though sufficiently circumstantial to enable us to determine the lapse of time during the first two ages of the world with considerable precision, has been transmitted to us through three distinct channels, not only differing greatly in respect of chronology, but totally irreconcilable with each other. These are, first, the Hebrew text of the Scriptures; second, the Samaritan text; and, third, the Greek version of the Septuagint. Unfortunately no very conclusive reason can be given for preferring any one of these accounts to another. We have no concurrent testimony with which to compare them: it is not even known which of them was regarded as the most probable by the Jews themselves, when the books of the Old Testament were revised and transcribed by Ezra; and the ordinary rules of probability cannot be applied to a state of things in which the duration of human life extended to nearly a thousand years.

Between the creation and the flood ten patriarchs are enumerated, whose names, with the age of each at the birth of his eldest son, according to the three versions, are as follows:

	Hebrew.	Samaritan.	Septuagint.
Adam	130	130	230
Seth	105	105	205
Enos	90	90	190
Cainan	70	70	170
Mahalaleel	65	65	165
Jared	162	62	162
Enoch	65	65	165
Methusaleh	187	67	187
Lamech	182	53	188
Noah	500	500	500
Total	1556	1207	2162

Noah entered the ark when he was 600 years of age; by adding, therefore, a hundred to each of the above sums, we have for the interval between the creation of Adam and the flood,

	Years.
According to the Hebrew account	1656
According to the Samaritan	1307
According to the Septuagint	2262

Hence it appears that the Greek version assigns to this period a duration of 606 years above the Hebrew account, and 955 above the Samaritan, while the two latter differ from each other only by 349 years. On account of their nearer agreement, and also of their greater antiquity, critics generally give the preference to the Hebrew and Samaritan texts; and as it appears from a passage in St Jerome, that in his day some manuscripts of the Samaritan agreed with the Hebrew in respect of Methusaleh and Lamech (two out of the three cases in which it at present differs), chronologers usually adopt the Hebrew account. The Latin or vulgate translation, which was declared authentic by the Council of Trent, is in entire conformity with the Hebrew.

The second age of the world is reckoned from the deluge to the vocation of Abraham. It contains also ten patriarchs (the Septuagint reckons eleven), with respect to whose ages the three accounts differ still more widely than in the case of the antediluvian patriarchs. The following are their names, with the age of each at the birth of his eldest son:

	Hebrew.	Samaritan.	Septuagint.
Shem	100	100	100
Arphaxad	35	135	135
Cainan II.	—	—	130
Salah	30	130	130
Eber	34	134	134
Peleg	30	130	130
Reu	32	132	132
Serug	30	130	130
Nahor	29	79	179
Terah	70	70	70
Abraham	75	75	75
Total	465	1115	1345

From the above sums we must deduct the age of Shem when the deluge took place. This was ninety-eight years. The interval between the flood and the call of Abraham is consequently,

	Years.
According to the Hebrew account	367
According to the Samaritan	1017
According to the Greek	1243

In this case the Samaritan and Greek accounts differ greatly from the Hebrew. Their difference from each other is only 230 years; and if we reject Cainan II., whose name does not appear either in the Hebrew or Samaritan text, the difference is only 100 years, which may easily be supposed to have arisen from the errors of the copyists. The near agreement of the Samaritan and Greek accounts renders it probable that the Hebrew text is in error. As another reason for giving the preference to the Samaritan, it may also be mentioned, that according to the Hebrew account, the dispersion of the descendants of Noah, which took place in the time of Peleg, must have happened about a hundred years after the deluge; and it can hardly be conceived that in so short a space of time they should have increased to so great an extent, that, as it is mentioned, a single country could not contain them. According to the Samaritan text, the dispersion took place about 400 years after the deluge,—a space of time which allows of a considerable increase in the number of the inhabitants of the earth.

From this period the intervals of time between the principal events recorded in Scripture are seldom mentioned in the same circumstantial manner; and the chronologers who computed the succession of years had not only to contend with the discordant readings, but were often obliged to assign arbitrary values to the *generations*, or other vague terms by which the time is computed. From computations founded on such loose and uncertain data, it would be in vain to look for agreement; accordingly the results not only present great discrepancies, but

appear to be as numerous as the computations. Desvignoles, in the preface to his Chronology of Sacred History, asserts that he has collected upwards of two hundred different calculations, the shortest of which reckons only 3483 years between the creation of the world and the commencement of the vulgar era, and the longest 6984. The difference amounts to thirty-five centuries. In the following table we have inserted the results obtained by some of the most eminent of the computers. The reader who is desirous of more information on this subject may consult the first volume of the *Universal History*, or *L'Art de Verifier les Dates, avant J. C.* p. ix.

Table of the Years elapsed between Adam and the Birth of Christ, according to the computation of the principal Chronologers.

	Years.
Alphonso X. king of Castile, in the tables of Regiomontanus	6984
Suidas	6000
Nicephoras, patriarch of Constantinople	5700
Riccioli, according to the Septuagint	5634
Clement of Alexandria	5624
The Septuagint of John Ernest Grabe (computation followed by the Russians)	5508
Julius Africanus	5500
The Ethiopians	5499
Albumazar, an Arabian	5328
Eusebius, bishop of Cæsarea	5200
Authors of *L'Art de Verifier les Dates*	4963
Flavius Josephus the historian	4698
Riccioli, according to the Vulgate, 2d System	4184
Michael Mœstlin	4079
Riccioli, 3d System	4062
John Müller, or Regiomontanus	4053
Archbishop Usher, in Moreri	4004
The same, in Chevreau	4000
Kepler, Petau, and Decker	3984
Philip Landsberg	3972
Gerard Mercator and Peter Opmeer	3966
Longomontanus, in the *Astronomia Danica*	3964
John Lightfoot	3960
John Pic, count of Mirandola	3955
Venerable Bede, in Chevreau	3952
Joseph-Juste Scaliger	3950
The same, in Chevreau	3947
St Jerome	3941
Mercator, 2d calculation	3928
James Gordon, a Scotch Jesuit	3880
Some of the Talmudists	3784
The modern Jews	3760
Abridged Chronology of the Jews	3670
Louis Lippoman, a Venetian	3616

All that can be gathered from these conflicting statements amounts to this, that the true epoch of the creation of the world is utterly unknown. British chronologers in general prefer the computation of Archbishop Usher, who places the creation of the world, or rather of Adam, 4004 years before the vulgar era.

Jewish Year and Eras.

Before the departure of the Israelites from Egypt, their year commenced at the autumnal equinox; but in order to solemnize the memory of their deliverance, the month of *Nisan* or *Abib*, in which that event took place, and which falls about the time of the vernal equinox, was afterwards regarded as the beginning of the ecclesiastical or legal year. In civil affairs, and in the regulation of the jubilees and sabbatical years, the Jews still adhere to the ancient year, which begins with the month Tisri, about the time of the autumnal equinox.

The ancient Jewish year was lunisolar, that is to say, the months were regulated by the moon, and intercalations employed to preserve a correspondence between the same months and the same seasons of the year. This correspondence was implied in the ceremonials of their religion. The passover began at the middle of the month Nisan; and, besides the paschal lamb, required the offering of a sheaf of barley as the first fruits of the harvest. Pentecost, or the feast of weeks, which was celebrated fifty days after the passover, required the offering of two loaves as the first fruits of the wheat harvest; and the feast of tabernacles, which was always celebrated on the 15th of the month Tisri, was at the end of the harvest. Hence the passover could only be celebrated about the season when the barley was ready to be cut, Pentecost after the wheat was ripe, and the feast of tabernacles after the vintage and the ingathering of the olives. These regulations rendered it necessary that the three great festivals of the Jews should always occur at nearly the same seasons, and consequently, that some sort of intercalation should be employed for the adjustment of solar and lunar time. But the methods employed for this purpose seem to have been of the rudest kind,—founded on no astronomical calculation, and regulated by no fixed rule. The beginning or end of the month was determined only by sight. When a new moon became visible, a new month began. Experience taught them that it was needless to look out for a new moon before the 29th day of the month; if a new moon then appeared, the next day was the first of the following month; if not, they resumed their watch on the night following, and if the moon was not then visible, they concluded that it must have been obscured by clouds, and the following day was reckoned the first of the succeeding month. Twelve months formed the ordinary year, but every two or three years an intercalary month was added. The rule which they followed with regard to the intercalary month seems to have been this. When the 15th of Nisan, which was the first day of unleavened bread, and of the passover, would have occurred in the ordinary course before the vernal equinox, an intercalary month was inserted before Nisan, in consequence of which the passover, with the feasts depending on it, was thrown back a whole month. The intercalary month was called *ve-Adar*, or second Adar, from its immediately following Adar, the last of the twelve ordinary months.

While the year continued to be regulated in this uncertain and arbitrary manner, it is evident that uniformity could only be preserved by conventional arrangements entered into from year to year. Accordingly the Jews, after their dispersion, were constrained to have recourse to the astronomical rules and cycles of the more enlightened heathen, in order that their religious festivals might be observed on the same days in all the countries through which they were scattered. For this purpose they adopted a cycle of eighty-four years, which is mentioned by several of the ancient fathers of the church, and which the early Christians borrowed from them for the regulation of Easter. This cycle seems to be neither more nor less than the Calippic period of seventy-six years, with the addition of a Greek octaeteris, in order to disguise its true source, and give it an appearance of originality. In fact, the period of Calippus containing 27,759 days, and the octaeteris 2922 days (see CALENDAR), the sum, which is 30,681, is exactly the number of days in eighty-four Julian years. But the addition was very far from being an improvement on the work of Calippus; for instead of a difference of only five hours and fifty-three minutes between the places of the sun and moon, which was the

whole error of the Calippic period, this difference, in the period of eighty-four years, amounted to one day six hours and forty-one minutes. Buccherius places the commencement of this cycle in the year 162 B. C.; Prideaux in the year 291 B. C. According to the account of Prideaux, the fifth cycle must have commenced in the year 46 of our era; and it was in this year, according to St Prosperus, that the Christians began to employ the Jewish cycle of eighty-four years, which they followed, though not uniformly, for the regulation of Easter, till the time of the council of Nice.

Soon after the Nicene council, the Jews, in imitation of the Christians, abandoned the cycle of eighty-four years, and adopted that of Meton, by which their lunisolar year is regulated at the present day. This improvement was first proposed by Rabbi Samuel, rector of the Jewish school of Sora in Mesopotamia, and was finally accomplished in the year 360 of our era by Rabbi Hillel, who introduced that form of the year which the Jews at present follow, and which, they say, is to endure till the coming of the Messiah.

The following are the names of the Jewish months, with the number of days in each:

	Days.		Days.
1. Nisan, or Abib	30	7. Tisri	30
2. Jyar, or Zius	29	8. Marchesvan	29 or 30
3. Sivan	30	9. Chisleu	29 or 30
4. Thammuz	29	10. Thebet	29
5. Ab	30	11. Sebat	30
6. Elul	29	12. Adar	29
and, in intercalary years, Ve-Adar			30

When each of the two months Marchesvan and Chisleu has twenty-nine days, the year of twelve months contains only 353 days, and is called *defective;* when these months contain each thirty days, the year contains 355 days, and is called *perfect;* when the one contains twenty-nine days and the other thirty, the year is *common*, and contains 354 days. These two months are variable, because certain days of the week are regarded by the Jews as unlucky; on such days it is not lawful to celebrate the feasts; and as the passover begins on the same day of the week as that with which the year began, when the first day of the year would fall, in the regular course, on one of the unlucky days, the commencement of the year is postponed to the day following.

Till the fifteenth century the Jews usually followed the era of the Seleucidæ or of Contracts. Since that time they generally employ a mundane era, and date from the creation of the world, which, according to their computation, took place 3760 years and about three months before the commencement of our era. No rule can be given for determining with certainty the day on which any given Jewish year begins, without entering into the minutiæ of their irregular and complicated calendar.

Egyptian Year and Canicular Period.

The ancient year of the Egyptians appears to have been lunisolar, and to have continued so till the reign of Hyperion or Osiris. From that time they employed a solar year, which consisted of 365 days, or twelve months of thirty days each, with five complementary days added at the end of the last month. This was their religious year; and as its commencement anticipated that of the true solar year by one day every four years, it was adhered to long after they had discovered that the year consists of $365\frac{1}{4}$ days, from superstitious notions, in order that each of the seasons might in its turn be blessed by the enjoyment of the sacred festivals.

As the anticipation of a day every four years brought back the commencement of the vague year to the same place in the seasons in the space of 1461 years, it follows that 1461 Egyptian years are equal to 1460 Julian years. The period of 1461 Egyptian years is denominated in chronology the *Sothic* or *Canicular* period, because it commenced with the heliacal rising of the dog-star, called in Egypt Sothis; that is to say, it commenced at the time when that star begins to disengage itself from the rays of the sun, and to be visible just before sunrise. In the latitude of Lower Egypt the dog-star begins to rise heliacally about the 20th of July.

The vague year of the Egyptians began with the month of Thoth, or the 20th of July, in the year of our era 136, which year, therefore, was the first of a Sothic period. The same coincidence took place 1460 Julian years before that time, that is to say, in the year 1325 before Christ. The cycle which began 1325 B. C. is regarded by chronologers as the second which was used in Egypt. Hence, since $1325+1460=2785$, the first must have commenced in the year 2785 B. C. according to the Julian computation. In this first cycle we must place the principal events of Egyptian history, such as the invasion of the shepherds, the establishment of the Israelites in that kingdom, &c.

The names of the Egyptian months are,

1. Thoth.	7. Phamenoth.
2. Paophi.	8. Pharmuthi.
3. Athyr.	9. Pashon.
4. Cohiac.	10. Payni.
5. Tybi.	11. Epiphi.
6. Meshir.	12. Mesori.

Each month contained thirty days, and the year, as already stated, was completed by the addition of five supplementary or epagomenal days.

Era of Constantinople.

This era, which is still used in the Greek church, and was followed by the Russians till the time of Peter the Great, dates from the creation of the world. The incarnation falls in the year 5509, and corresponds, as in our era, with the fourth year of the 194th Olympiad. The civil year commences with the 1st of September; the ecclesiastical year sometimes with the 21st of March, sometimes with the 1st of April. It is not certain whether the year was considered at Constantinople as beginning with September previous to the separation of the Eastern and Western empires.

At the commencement of our era there had elapsed 5508 years and four months of the era of Constantinople. Hence the first eight months of the Christian year 1 coincide with the Constantinopolitan year 5509, while the last four months belong to the year 5510. In order, therefore, to find the year of Christ corresponding to any given year in the era of Constantinople, we have the following rule: If the event took place between the 1st of January and the end of August, subtract 5508 from the given year; but if it happened between the 1st of September and the end of the year, subtract 5509.

Era of Alexandria.

The chronological computation of Julius Africanus was adopted by the Christians of Alexandria, who accordingly reckoned 5500 years from the creation of Adam to the birth of Christ; but in reducing Alexandrian dates to the common era, it must be observed that Julius Africanus placed the epoch of the Incarnation three years earlier than it is placed in the usual reckoning, so that the initial day of the Christian era fell in the year 5503 of the Alexandrian era. This correspondence, however, continued only from the introduction of the era till the accession of Diocletian, when an alteration was made by dropping ten years in the Alexandrian account. Diocletian ascended the throne

of the Roman empire in the year of Christ 284. According to the Alexandrian computation, this was the year 5787 of the world, and 287 of the incarnation; but on this occasion ten years were omitted, and that year was thenceforth called the year 5777 of the world, and 277 of the Incarnation. There are, consequently, two distinct eras of Alexandria, the one being used before, and the other after the accession of Diocletian. It is not very well known for what reason the alteration was made; but it is conjectured that it was for the purpose of causing a new revolution of the cycle of nineteen years (which was introduced into the ecclesiastical computation about this time by Anatolius, bishop of Hierapolis) to commence with the first year of the reign of Diocletian. In fact, 5777 being divided by 19, leaves 1 for the year of the cycle. The Alexandrian era continued to be followed by the Copts in the fifteenth century, and is said to be still used in Abyssinia.

Dates expressed according to this era are reduced to the common era by subtracting 5502, till the Alexandrian year 5786 inclusive, and after that year by subtracting 5492; but if the date belongs to one of the four last months of the Christian year, we must subtract 5503 till the year 5786, and 5493 after that year.

Mundane Era of Antioch.

The chronological reckoning of Julius Africanus formed also the basis of the era of Antioch, which was adopted by the Christians of Syria, at the instance of Panodorus, an Egyptian monk, who flourished about the beginning of the fourth century. Panodorus struck off ten years from the account of Julius Africanus with regard to the years of the world, and he placed the Incarnation three years later, referring it to the fourth year of the 194th Olympiad, as in the common era. Hence the era of Antioch differed from the original era of Alexandria by ten years; but after the alteration of the latter at the accession of Diocletian, the two eras coincided. In reckoning from the Incarnation, however, there is a difference of seven years, that epoch being placed in the reformed era of Alexandria, seven years later than in the mundane era of Antioch or in the Christian era.

As the Syrian year began in autumn, the year of Christ corresponding to any year in the mundane era of Antioch is found by subtracting 5492 if the event falls between January and September; from September to January subtract 5493.

Era of Nabonassar.

This era is famous in astronomy, having been generally followed by Hipparchus and Ptolemy. It had been in use for some centuries among the Chaldean astronomers; for the ancient observations of eclipses, which were collected in Chaldea by Callisthenes, the general of Alexander, and transmitted by him into Greece to Aristotle, were for the greater part referred to the commencement of the reign of Nabonassar, founder of the kingdom of the Babylonians. The epoch from which it is reckoned is precisely determined by numerous celestial phenomena recorded by Ptolemy, and corresponds to Wednesday at mid-day, the 26th of February of the year 747 before Christ. The year consisted of twelve months of thirty days each, with five complementary days added at the end. No intercalation was used; and it is therefore in all respects the same as the ancient Egyptian year. From this circumstance the initial day of the year falls one day earlier every four years than the first of the Julian year; so that 1460 Julian years are equal to 1461 Babylonian years. On account of this difference in the length of the year, the conversion of dates according to the era of Nabonassar, into years before Christ, is attended with considerable trouble. The surest way is to follow a comparative table. Frequently the year cannot be fixed with certainty, unless we also know the month and the day.

The Greeks of Alexandria formerly employed the era of Nabonassar, with a year of 365 days; but soon after the reformation of the calendar by Julius Cæsar, they adopted, like the other Roman provincials, the Julian intercalation. At this time the first of Thoth had receded to the 29th of August. In the year 136 of our era, the first of Thoth, in the ancient Egyptian year, corresponded with the 20th of July, between which and the 29th of August there are forty days. The adoption of the Julian year must therefore have taken place about 160 years before the year 136 of our era (the difference between the Egyptian and Julian years being one day in four years), that is to say, about the year 25 B. C. In fact, the first of Thoth corresponded with the 29th of August in the Julian calendar, in the years 25, 24, 23, and 22 B. C.

Era of the Seleucidæ, or Macedonian Era.

The era of the Seleucidæ dates from the epoch of the first conquests of Seleucus Nicator in Syria, 311 years before Christ, in the year of Rome 442, and twelve years after the death of Alexander the Great. It was adopted not only in the monarchy of the Seleucidæ, but in general in all the Greek countries bordering on the Levant; was followed by the Jews till the fifteenth century; and is said to be used by some Arabians even at the present day. By the Jews it was called the *Era of Contracts;* by the writers of the books of Maccabees the *Era of Kings.* But notwithstanding its general prevalence in the East during a great number of centuries, the authors by whom it was followed differ much with regard to their manner of expressing dates, in consequence of the different epochs which they adopt for the commencement of the year. Among the Syrian Greeks the year began with the month Elul, which corresponds to our September. The Nestorians and Jacobites at the present day suppose it to begin with the following month, or October. The author of the first book of Maccabees makes the era commence with the month Nisan, or April; and the author of the second book with the first Tishrin, or October. Albategnius, a celebrated Arabian astronomer, dates from the 1st of October. Some of the Arabian writers, as Alfragan, date from the 1st of September. At Tyre the year was counted from the 19th of our October, at Gaza from the 28th of the same month, and at Damascus from the vernal equinox. These discrepancies with respect to the initial day of the year render it extremely difficult to determine the exact correspondence of Macedonian dates with those of other eras; and the difficulty is rendered still greater by the want of uniformity in respect of the length of the year. Some authors who follow the Macedonian era, use the Egyptian or vague year of 365 days; Albategnius adopts the Julian year of $365\frac{1}{4}$ days. For all these reasons, it frequently happens that the date cannot be fixed, unless some other chronological characters are given with it than merely the month and the year.

According to the computation most generally followed, the year 312 of the era of the Seleucidæ began on the 1st of September in the Julian year preceding the first of our era. Hence, to reduce a Macedonian date to the common era, subtract 311 years and four months.

The names of the Syrian and Macedonian months, and their correspondence with the Roman months, are as follows:

Syrian.	Macedonian.	English.
Elul.	Gorpiæus.	September.
Tishrin I.	Hyperberetæus.	October

Syrian.	Macedonian.	English.
Tishrin II.	Dius.	November.
Canun I.	Apellæus.	December.
Canun II.	Audynæus.	January.
Sabat.	Peritius.	February.
Adar.	Dystrus.	March.
Nisan.	Xanticus.	April.
Jiar.	Artemisius.	May.
Haziran.	Dæsius.	June.
Tamus.	Panæmus.	July.
Ab.	Lous.	August.

Era of Alexander.

Some of the Greek historians have assumed as a chronological epoch the death of Alexander the Great, which took place in the year 325 before Christ. The year is the same as in the preceding era. This era has not been much followed; but it requires to be noticed in order that it may not be confounded with the era of the Seleucidæ.

Era of Tyre.

The era of Tyre is reckoned from the 19th of October, or the beginning of the Macedonian month Hyperberetæus, in the year 126 before Christ. In order, therefore, to reduce it to the common era, subtract 125; and when the date is B. C., subtract it from 126. Dates expressed according to this era occur only on a few medals, and in the acts of certain councils.

Cæsarean Era of Antioch.

This era was established to commemorate the victory obtained by Julius Cæsar on the plains of Pharsalia, on the 9th of August in the year 48 B. C., and the 706th of Rome. The Syrians computed it from their month Tishrin I.; but the Greeks threw it back to the month Gorpiæus of the preceding year. Hence there is a difference of eleven months between the epochs assumed by the Syrians and Greeks. According to the computation of the Greeks, the 49th year of the Cæsarean era began in the autumn of the year preceding our history; and, according to the Syrians, the 49th year began in the autumn of the first year of the Incarnation. It is followed by Evagrius in his Ecclesiastical History.

Julian Era.

The Julian era commences with the 1st of January, forty-five years before Christ. It was designed to commemorate the reformation of the Roman calendar by Julius Cæsar.

Era of Spain.

The conquest of Spain by Augustus, which was completed in the thirty-ninth year before Christ, gave rise to another era, which began with the first day of the following year, and was long followed in Spain and Portugal, and generally in all the Roman provinces subdued by the Visigoths, both in Africa and the South of France. Several of the councils of Carthage, and also that of Arles, are dated according to this era. After the ninth century it became usual to join with it the year of the Incarnation in public acts. It was followed in Catalonia till the year 1180, in the kingdom of Arragon till 1350, in Valencia till 1358, and in Castile till 1393. In Portugal it is said to have been in use so late as the year 1415, or 1422, though it would seem, that after the establishment of the Portuguese monarchy, no other era was used in the public acts of that country than that of the Incarnation. As the era of Spain commenced with the 1st of January, and the months and days of the year are those of the Julian calendar, any date is reduced to the common era by subtracting thirty-eight from the number of the year.

Era of Actium.

This era was established to commemorate the battle of Actium, which was fought on the 3d of September, in the year 31 before Christ, and in the 15th of the Julian era. By the Romans the era of Actium was considered as commencing on the 1st of January of the 16th of the Julian era, and the 30th B. C. The Egyptians, who followed it till the time of Diocletian, dated its commencement from the beginning of their month Thoth, or the 29th of August; and the eastern Greeks from the 2d of September. By the latter it was also called the era of Antioch, and continued to be used till the ninth century. It must not be confounded with the Cæsarean era of Antioch, which began seventeen years earlier. Many of the medals struck by the city of Antioch in honour of Augustus are dated according to this era. Besides the era of Actium, there was also an Augustan era, which commenced four years later, or 27 B. C., the year in which Augustus prevailed on the senate and people of Rome to decree him the title of Augustus, and confirm him in the supreme power of the empire.

Era of Diocletian, or Era of Martyrs.

We have already remarked that the Alexandrians, at the accession of Diocletian to the throne of the Roman empire, made an alteration in their mundane era, by striking off ten years from their reckoning. The same event furnished them with an opportunity of establishing a new era, which is still followed by the Abyssinians and Copts. It commences with the 29th of August (the first day of the Egyptian year) of the year 284 of our era, which was the first of the reign of Diocletian. The denomination of *Era of Martyrs*, subsequently given to it in commemoration of the persecution raised by that prince against the Christians, would seem to imply that its commencement ought to be referred to the year 303 of our era; for it was in this year that Diocletian issued his famous edict; but the practice of dating from the accession of Diocletian has prevailed. In order to transfer a date from this era to that of the Incarnation, it is necessary to recollect the form of the Egyptian year. The ancient Egyptian year consisted of 365 days; but after the introduction of the Julian calendar, the astronomers of Alexandria adopted an intercalary year, and added six additional days instead of five to the end of the last month of every fourth year. In consequence of this regulation the year is exactly similar to the Julian year. The Egyptian intercalary year, however, does not correspond to the Julian leap year, but is the year immediately preceding; and the intercalation takes place at the end of the year, or on the 29th of August. Hence the first three years of the Egyptian intercalary period commence on the 29th of our August, and the fourth commences on the 30th of that month. Before the end of that year the Julian intercalation takes place, and the beginning of the following Egyptian year is restored to the 29th of August. Hence, to reduce a date according to this era to our own reckoning, it is necessary, for common years, to add 283 years and 240 days; but if the date belongs to the first three months of the year following the intercalation, or, which is the same thing, if it falls between the 30th of August and the end of the year of the third year of the Julian cycle, we must add 283 years and 241 days. We ought to remark, that the Ethiopians do not reckon the years from the beginning of the era in a consecutive series, but employ a period of 532 years, after the expiration of which they again commence with unity. This is the *Dionysian*, or Great Paschal Period, and is formed

by the multiplication of the numbers 28 and 19, that is, of the solar and lunar cycles, into each other.

The following are the Ethiopian or Abyssinian months, with the days on which they begin in the Julian calendar, or old style:—

Mascaram...29th August.	Magabit.....25th February.
Tikmith.....28th September.	Miazia......27th March.
Hadar.......28th October.	Gimbot......26th April.
Tacsam......27th November.	Sene..........26th May.
Tir...........27th December.	Hamle......25th June.
Yacatit......26th January.	Nahasse.....25th July.

The additional or epagomenal days begin on the 24th of August. In intercalary years the first seven months commence one day later. The Egyptian months, followed by the modern Copts, agree with the above in every respect excepting the names.

Indiction.

The cycle of indiction is a period of fifteen years, and was very generally followed in the Roman empire for some ages before the adoption of the Christian era. We are unacquainted with the circumstances and the exact time of its origin, but it was certainly not in use before the time of Constantine; and examples occur in the Theodosian code of its being employed in dating the years under the reign of Constance, who died 361 A. C. Three *indictions* may be distinguished; but they differ only in regard to the commencement of the year.

1. The *Constantinopolitan Indiction*, which, like the Grecian year, commenced with the month of September. This was followed in the Eastern empire, and in some instances also in France.

2. The *Imperial* or *Constantinian Indiction*, so called because its establishment is attributed to Constantine. This was also called the *Cæsarean Indiction*. It commences on the 24th of September, and it is not unfrequently met with in the ancient chronicles of France and England.

3. The *Roman* or *Pontifical Indiction*, which began on the 25th of December or 1st of January, according as the Christian year was held to commence on the one or other of these days. It is often employed in the papal bulls, especially after the time of Gregory VII.; and traces of its use are found in some of the old French authors.

The first year of the first cycle of Indiction is generally considered to correspond with the year 313 of the Christian era. Some authors, however, regard it as having commenced in 312, others in 314, and some also in 315. The number of cycles, however, is scarcely ever referred to, but only the year in the cycle. Reckoning backwards from 313, the first year of our era is found to be 4 in the cycle of Indiction. Hence to find the Indiction corresponding to any year of the Christian era, add 3 to the date, divide the sum by 15, and the remainder is the Indiction. If there is no remainder, the proposed year is the 15th or last of the cycle.

Era of the Armenians.

The epoch of the Armenian era is that of the council of Tiben, in which the Armenians consummated their schism from the Greek church by condemning the acts of the council of Chalcedon; and it corresponds to Tuesday the 9th of July of the year 552 of the Incarnation. In their civil affairs the Armenians follow the ancient vague year of the Egyptians; but their ecclesiastical year, which begins on the 11th of August, is regulated in the same manner as the Julian year, every fourth year consisting of 366 days, so that Easter and the other festivals are retained at the same place in the seasons as well as in the civil year. The Armenians also make use of the mundane era of Constantinople, and sometimes conjoin both methods of computation in the same documents. In their correspondence and transactions with Europeans, they generally follow the era of the Incarnation, and adopt the Julian year.

To reduce the civil dates of the Armenians to the Christian era, we may proceed as follows. Since the epoch is the 9th of July, there were 176 days from the beginning of the Armenian era to the end of the year 552 of our era; and since 552 was a leap year, the year 553 began a Julian intercalary period. Multiply, therefore, the number of Armenian years elapsed by 365; add the number of days from the commencement of the current year to the given date; subtract 176 from the sum, and the remainder will be the number of days from the 1st of January 553 to the given date. This number of days being reduced to Julian years, add the result to 552, and the sum gives the day in the Julian year, or old style.

In the ecclesiastical reckoning the year begins on the 11th of August. To reduce a date expressed in this reckoning to the Julian date, add 521 years, and the days elapsed from the 1st of January to the 10th of August, both inclusive, of the year 552; that is to say (since 552 is a leap year), 223 days. In leap years, one day must be subtracted if the date falls between the 1st of March and 10th of August.

The following are the Armenian ecclesiastical months, with their correspondence with those of the Julian calendar:—

1. Navazardi begins.........	11th August.
2. Hori	10th Septembe
3. Sahomi	10th October.
4. Dre Thari...................	9th November.
5. Kagoths	9th December.
6. Aracz	8th January.
7. Malegi	7th February.
8. Arcki	9th March.
9. Angi..........................	8th April.
10. Mariri	8th May.
11. Marcacz	7th June.
12. Herodiez.....................	7th July.

To complete the year, five complementary days are added in common years, and six in leap years.

Era of the Hegira.

The epoch of this era, which is universally used in all Mahommedan countries, is Friday the 16th of July, A. D. 622—the day on which Mahommed fled from Mecca to Medina. Some chronologers, however, and the Arabian astronomers in general, refer its commencement to the preceding day; but though the flight of Mahommed probably began on the evening of Thursday the 15th of July, it is certain, from the comparison of modern dates, that the present practice of the Mahommedans, in dating their civil transactions, is to count from Friday the 16th of July 622. It may be remarked that the civil day of the Mahommedans begins at sunset; the astronomers probably began the day at noon.

The Mahommedan year is strictly lunar, and the civil months are adjusted to the course of the moon, by means of a cycle of 30 years, containing 19 common years of 354 days, and 11 intercalary years of 355 days; whence the cycle contains 10,631 days, which amount to 29 Julian years and 39 days. Each year is divided into 12 months, containing alternately 30 and 29 days, excepting that the last month of the intercalary year contains also 30 days.

The intercalary years are the 2d, 5th, 7th, 10th, 13th, 16th, 18th, 21st, 24th, 26th, and 29th of the cycle.

The names of the Turkish months, with the number of days in each, are as follows:—

	Days.		Days.
Moharem	30	Regeb	30
Saphar	29	Shaban	29
Rabiu I.	30	Ramadan	30
Rabiu II.	29	Shawall	29
Jomadhi I.	30	Dhu'l kadah	30
Jomadhi II.	29	Dhu'l hajjah	29, and in intercalary years 30

The months of the Hegira are composed of weeks of seven days. The following are the names of the days in Turkish and modern Arabic:—

	Turkish.	Modern Arabic.
Sunday	Pazar gun	Yom el-Ahad.
Monday	Pazar ertesi	Yom el-Thena.
Tuesday	Sale	Yom el-Thaleth.
Wednesday	Charshambe	Yom el-Arba.
Thursday	Pershambe	Yom el-Khamis.
Friday	Juma, or Adina	Yom el-Juma.
Saturday	Juma ertesi	Yom el-Effabt.

Such are the chronological elements by means of which Mahommedan dates are reduced to the Christian era. As the rules generally given for this purpose are attended with ambiguity, and cannot be depended on to a day, unless corrected by means of a subsidiary table, we will explain at length a method of proceeding by which the correspondence between the two eras is established, without the slightest risk of ambiguity or mistake. The subject is of some interest, in consequence of the era of the Hegira being used over so large a portion of the world.

Having given a Mahommedan date to find the corresponding date in the Christian era,

1. Divide the number of years elapsed by 30; the quotient will be the number of cycles, and the remainder the number of years elapsed since the beginning of the current cycle. Call the quotient A, and the remainder B; and let x be the number of intercalary years in B. Then the number of days that have elapsed from the commencement of the Hegira to the beginning of the year in which the date occurs, is given by the formula,

$$10631\ A + 354\ B + x;$$

for 10,631 is the number of days in the cycle or intercalary period, and 354 is the number of days in the common lunar year. To the sum obtained from this formula add the days since the beginning of the current year, and the result is the number of days from the commencement of the cycle to the given date.

2. To the number of days from the commencement of the Hegira to the given date, add the number of days between the commencement of our era and the Hegira, and the sum is the number of days from the epoch of the Incarnation to the given date. The number of days from the beginning of our era to the beginning of the Hegira is 22,7016; for .... $621 \times 365 = 226665$

for	$621 \times 365 = 226665$
in 621 years there are 155 leap years	155
from 1st of January to 15th July 622, inclusive	196
Sum	227016

3. It now remains only to reduce the sum thus obtained to Julian years. For this purpose divide by 1461 (the number of days in the Julian intercalary period), and call the quotient C. Divide the remainder by 365, and call the quotient D, and the last remainder y. Then 4 C + D is the number of years elapsed since the beginning of the era, and y is the days elapsed of the current year.

Example.—The treaty of peace concluded between the emperor Charles VI. and Gianihi-Ali Pacha, ambassador of the sultan of Constantinople, is dated the 15th of Rabiu I., in the year of the Hegira 1153; required the year, month, and day, in the Christian era.

1. In this case the years elapsed are 1152; therefore,

$$\begin{array}{r} 30)1152(38 = A. \\ 90 \\ \hline 252 \\ 240 \\ \hline 12 = B. \end{array}$$

The intercalary years being the second, fifth, seventh, tenth, thirteenth, &c., the remainder, 12, contains four intercalary years, whence $x = 4$; therefore

$$\begin{array}{rcrcr} 10631\ A & = & 10631 \times 38 & = & 403978 \\ 354\ B & = & 354 \times 12 & = & 4248 \\ x & = & & & 4 \\ \hline & & & & 408230 \end{array}$$

Add days from first of Moharem to 15th Rabiu I.	74
Days from the beginning of the Hegira	408304
2. Add	227016
From beginning of our era to the given date	635320

3. To convert this sum into Julian years;

$$\begin{array}{r} 1461)635320(434 = C \\ 5844 \\ \hline 5092 \\ 4383 \\ \hline 7090 \\ 5844 \\ \hline 365)1246(3 = D \\ 1095 \\ \hline 151 \quad = y \end{array}$$

$$4\ C + D = 4 \times 434 + 3 = 1739.$$

Therefore, as 1739 years have elapsed, the date required is the 151st day of the Christian year 1740. Now since 1740 is a leap year, the 151st day is the 30th of May. This, however, is in Old Style. Add eleven days for the change of style, and we have the 10th of June.

It results, therefore, that the 15th of Rabiu I. of the year of the Hegira 1153 corresponds with the 10th of June 1740 New Style. In this way any Mahommedan date may be reduced to the corresponding Christian date. The arithmetical operation is extremely simple, and can never lead to ambiguity or error.

Era of Yezdegird, or Gelalæan Era.

This era commences with the elevation of Yezdegird III. to the throne of Persia, and dates from the 16th of June in the year of our era 632. Till the year 1075 A. C. the Persian year resembled that of the ancient Egyptians, consisting of 365 days without intercalation; but at that time the Persian calendar was reformed by Gelal-Edin Malek Schah, sultan of Khorasan, and a method of intercalation adopted, which, though less convenient, is considerably more accurate than the Julian. The intercalary period is 33 years; one day being added to the common year seven times successively at the end of four years, and

the eighth intercalation being deferred till the end of the fifth year (See CALENDAR). This era was at one period universally adopted in Persia, and it still continues to be followed by the Parsees of India. The months consist of thirty days each, and each day is distinguished by a different name. According to Alfragan, the names of the Persian months are as follows:

Afrudin-meh.	Merded-meh.	Adar-meh.
Ardisascht-meh.	Schaharir-meh.	Di-meh.
Cardi-meh.	Mahar-meh.	Behen-meh.
Tir-meh.	Aben-meh.	Affirer-meh.

The five additional days (in intercalary years six) are named *Musteraca.*

As it does not appear that the above-mentioned rule of intercalation was ever regularly followed, it is impossible to assign exactly the days on which the different years begin. In some provinces of India the Parsees begin the year with September, in others they begin it with October. We have stated that the era began with the 16th June 632. But the vague year, which was followed till 1075, anticipated the Julian year by one day every four years. In 443 years the anticipation would amount to about 112 days, and the beginning of the year would, in consequence, be thrown back to near the beginning of the Julian year 632. To the year of the Persian era, therefore, add 631, and the sum will be the year of our era in which the Persian year begins.

Chinese Chronology.

From the time of the emperor Yao, upwards of 2000 years B. C., the Chinese had two different years; a civil year, which was regulated by the moon, and an astronomical year, which was solar. The civil year consisted in general of twelve months or lunations, but occasionally a thirteenth was added, in order to preserve its correspondence with the solar year. Even at this early period the solar or astronomical year consisted of $365\frac{1}{4}$ days, like our Julian year; and it was arranged in the same manner, a day being intercalated every fourth year.

According to the missionary Gaubil, the Chinese divided the day into 100 *ke*, each *ke* into 100 minutes, and each minute into 100 seconds. This practice continued to prevail till the 17th century, when, at the instance of the Jesuit Schaall, president of the tribunal of mathematics, they adopted the European method of dividing the day into twenty-four hours, each hour into sixty minutes, and each minute into sixty seconds. The civil day commences at midnight, and ends at the midnight following.

Since the accession of the emperors of the Han dynasty, 205 B. C., the civil year of the Chinese has begun with the first day of that moon in the course of which the sun enters into the sign of the zodiac which corresponds with our sign Pisces. From the same period also, they have employed, in the adjustment of their solar and lunar years, a period of nineteen years, twelve of which are common, containing twelve lunations each, and the remaining seven intercalary, containing thirteen lunations. It is, however, not precisely known how they distributed their months of thirty and twenty-nine days, or, as they termed them, *great* and *small* moons. This, with other matters appertaining to the calendar, was probably left to be regulated from time to time by the mathematical tribunal.

The Chinese divide the time of a complete revolution of the sun, with regard to the solstitial points, into twelve equal portions, each corresponding to thirty days, ten hours, thirty minutes. Each of these periods, which is denominated a *tze,* is subdivided into two equal portions, called *tchong-ki* and *tsie-ki;* the *tchong-ki* denoting the first half of the *tze,* and the *tsie-ki* the latter half. Though the *tze* are thus strictly portions of solar time, yet, what is remarkable, though not peculiar to China, they give their name to the lunar months, each month or lunation having the name of the *tchong-ki* or sign at which the sun arrives during that month. As the *tze* is longer than a synodic revolution of the moon, the sun cannot arrive twice at a *tchong-ki* during the same lunation; and as there are only twelve *tze,* the year can contain only twelve months having different names. It must happen sometimes that in the course of a lunation the sun enters into no new sign; in this case the month is intercalary, and called by the same name as the preceding month.

For chronological purposes, the Chinese, in common with some other nations of the east of Asia, employ cycles of sixty, by means of which they reckon their days, moons, and years. The days are distributed in the calendar into cycles of sixty, in the same manner as ours are distributed into weeks, or cycles of seven. Each day of the cycle has a particular name; and as it is a usual practice, in mentioning dates, to give the name of the day along with that of the moon and the year, this arrangement affords great facilities in verifying the epochs of Chinese chronology. The order of the days in the cycle is never interrupted by any intercalations that may be necessary for adjusting the months or years. The moons of the civil year are also distinguished by their place in the cycle of sixty; and as the intercalary moons are not reckoned, for the reason before stated, namely, that during one of these lunations the sun enters into no new sign, there are only twelve regular moons in a year, so that the cycle is renewed every five years. Thus the first moon of the year 1833 being the first of a new cycle, the first moon of every sixth year, reckoned backwards or forwards from that date, as 1828, 1823, &c., or 1837, 1842, &c., will also commence a new lunar cycle of sixty moons. In regard to the years, the arrangement is exactly the same. Each has a distinct number or name which marks its place in the cycle, and as this is generally given in referring to dates, along with the other chronological characters of the year, the ambiguity which arises from following a fluctuating or uncertain epoch is entirely obviated. The present cycle began in the year 1804 of our era; the year 1832 is consequently the 29th of the current cycle.

The cycle of sixty is formed of two subordinate cycles or series of characters, one of ten and the other of twelve, which are joined together so as to afford sixty different combinations. The names of the characters in the cycle of ten, which are called *celestial signs,* are,

1. Kea; 2. Yich; 3. Ping; 4. Ting; 5. Woo;
6. Ke; 7. Kang; 8. Sin; 9. Jin; 10. Kwey.

And in the series of 12, denominated *terrestrial* signs,

1. Tse; 2. Tchow; 3. Yin; 4. Maou; 5. Shin; 6. Sze;
7. Woo; 8. We; 9. Shin; 10. Yew; 11. Seo; 12. Hae.

The name of the first year, or of the first day, in the sexagenary cycle, is formed by combining the first words in each of the above series; the second is formed by combining the second of each series, and so on to the tenth. For the next year the first word of the first series is combined with the eleventh of the second; then the second of the first series with the twelfth of the second; after this the third of the first series with the first of the second, and so on till the sixtieth combination, when the last of the first series concurs with the last of the second. Thus Kea-tse is the name of the first year, Yih-tchow that of the second, Kea-seo that of the eleventh, Yih-hae that of the twelfth, Ping-tse that of the thirteenth, and so on. The order of proceeding is obvious.

In the Chinese history translated into the Tartar dialect by the orders of the emperor Kang-hi, who died in 1722, the characters of the cycle begin to appear at the year 2357 B. C. From this it has been inferred, that the

Chinese empire was established previous to that epoch; but it is obviously so easy to extend the cycles backwards indefinitely, that the inference can have very little weight. The characters given to that year 2357 B. C. are Kea-shin, which denote the 41st of the cycle. We must, therefore, suppose the cycle to have begun 2397 B. C., or forty years before the reign of Yao. This is the epoch assumed by the authors of *L'Art de Verifier les Dates*. The mathematical tribunal has, however, from time immemorial, counted the first year of the first cycle from the eighty-first of Yao, that is to say, from the year 2277 B. C.

Since the year 163 B. C. the Chinese writers have generally dated the year from the accession of the reigning emperor. An emperor, on his accession to the throne, gives a name to the years of his reign. He ordains, for example, that they shall be called Ta-te. In consequence of this edict, the following year is called the first of Ta-te, and the succeeding years the second, third, fourth, &c. of Ta-te, and so on, till it pleases the same emperor, or his successor, to ordain that the years shall be called by some other appellation. The periods thus formed are called by the Chinese Nien-hao. According to this method of dating the years, a new era commences with every reign; and the year corresponding to a Chinese date can only be found when we have before us a catalogue of the Nien-hao, with their relation to the years of our era.

The Chinese chronology is discussed with ample detail by Freret, in the *Memoirs of the Academy of Inscriptions*, tom. xviii.; and an abridgment of his memoir is given in *L'Art de Verifier les Dates* (tom. ii. p. 284, *et seq.* Ed. in 4to, 1818), from which the preceding account is principally taken.

Indian Chronology.

The method of dividing and reckoning time followed by the various nations of India resembles in its general features that of the Chinese, but is rendered still more complex by the intermixture of Mahommedan with Hindu customs. Like the Chinese, the Hindus have a solar year, which is generally followed in the transaction of public business, especially since the introduction of European power; and they have also a lunar year, which regulates their religious festivals, and which they follow in their domestic arrangements. Their solar year, or rather sidereal year, is measured by the time in which the sun returns to the same star, and is consequently longer than our astronomical year, by the whole quantity of the precession of the equinoxes. It is reckoned by the Hindus at 365 days, 6 hours, 12 minutes, 30 seconds, and consequently exceeds a Gregorian year by one day in sixty years. The Indian zodiac is divided into twelve solar and twenty-eight lunar signs; and the year begins with the sun's arrival at the first degree of the first sign. The month is the time the sun takes to pass through one sign; and as each sign contains the same number of degrees, the months vary somewhat in length, according as the sun is nearer the apogee or perigee. The longest month may contain 31 days, 14 hours, 39 minutes, and the shortest only 29 days, 8 hours, 21 minutes. The civil months, however, depend solely on the moon; though, with the same perversion of ingenuity which we have already remarked with regard to the Chinese, and of which it would be difficult to find an example, except in the east of Asia, they derive their names from the solar signs of the zodiac. The first civil month commences with the day after the full moon of that lunation in the course of which the sun enters the first Hindu sign, and so on with the others. When the sun enters into no new sign during the course of a lunation, the month is intercalary, and is called by the name of that which precedes or follows it, which some prefix, to distinguish it from the regular month. In some provinces of India, as in Bengal, the civil month commences with the day after the new moon; but in the upper or northern provinces, it begins, as we have stated, with the day after the full moon. From the manner in which they are reckoned, it is evident that the Hindu months, both solar and lunar, neither consist of an entire number of days, nor are regulated by any cycle, but depend solely on the motion of the sun and moon. The time of their commencement is different on every different meridian; and a Hindu has no means of knowing beforehand on what day any month begins, excepting by consulting his almanack. The civil day in all parts of India begins at sunrise.

The Hindu eras have been the subject of much controversy. According to the dreams of Indian mythology, the duration of the world is limited to four *yugs* or ages, three of which have already passed, and the fourth, which is the *kali-yug*, is the last and most deteriorated. It is this only which has any reference to authentic chronology. It forms the principal era of India, and comprehends several others in common use, as the era of Vicramaditya, of Salivahana, the Bengalee era, and the cycle of sixty years.

The *Kali-yug* commenced in the year 3101 B. C. The year is sidereal, and begins when the sun enters the first sign of the Hindu zodiac, which at present happens about the 11th of April. Owing to the precession of the equinoxes, the beginning of the year advances in the seasons at the rate of about one day in sixty years.

The *Era of Vicramaditya* is reckoned from the year 56 B. C., which corresponds to 3045 of the Kali-yug. This era, the years of which are called *Samvat*, prevails chiefly in the higher or northern provinces of India, and in Guzerat. Its name is derived from that of a sovereign of Malwa, who, by defeating Soka, king of Delhi, acquired possession of the principal throne of India. Whether the year from which it is reckoned was that of the accession or death of this prince, is uncertain. The years are reckoned in the same manner as those of the Kali-yug; and it may be remarked of the Indian eras in general, that though some of them profess to be counted from the deaths of their kings, or other historical events, they all commence at the time the sun reaches the same point in his annual course through the zodiac.

The *Era of Salivahana* is the year 78 A. C., which corresponds to 3179 of the Kali-yug, and 134 of the Vicramaditya. The name is derived from Salivahan, who is said to have reigned many years over the kingdom of Norsinga, and to have been a liberal encourager of the arts and sciences. It is generally used in records or writings of importance, but is most prevalent in the southern provinces of Hindustan. The years are called *Saka*.

The *Fuslee Era*, from the near coincidence of its dates with those of the Hegira, seems to have been imposed on the natives of India by their Mahommedan conquerors. It is principally used in revenue transactions, and is pretty generally known over India. There are several eras of this name; but the most common is that which is reckoned from the year 590 A. C. At Madras, the commencement of the Fuslee year is fixed on the 12th of July. In Bengal it begins in September, or with the full moon preceding the autumnal equinox.

The *Bengalee Era* is also supposed to be derived from the Hegira; but the year is measured by solar time, and therefore differs entirely from the Mahommedan year, which is purely lunar. At the present time, the Bengalee epoch is about nine years later than the Hegira; the year 1245 of the Hegira having commenced in July 1829, and the Bengalee year 1236 in April 1829. The sidereal year exceeds the lunar year by 10 days $21\frac{1}{2}$ hours nearly; consequently, by reckoning backwards, it will be found

that the dates of the Bengalee era and of the Hegira coincided about the middle of the sixteenth century. History is silent on the subject; but it seems probable, that though the epoch of the Hegira was partially adopted in India, the Hindus pertinaciously resisted all attempts to disturb their ancient methods of reckoning the subdivisions of the year.

Besides the Indian eras here enumerated, there are some others which are less generally known, or which are followed only in particular provinces. The cycle of sixty years is also sometimes used, particularly in connection with the era of Vicramaditya. According to the Bengal account, the first cycle began 3185 years B. C.; and the year 1832 of our era is consequently the thirty-seventh of the eighty-fourth cycle. In the Telinga account the first cycle began 3114 B. C.; and the year 1832 is the twenty-fourth of the eighty-third cycle.

We will conclude this part of the article with the following table, showing the dates at which the different eras above described respectively commenced.

Julian period began	4713	B. C.
Olympiad of Corœbus	July 776	
Era of Rome, according to Varro	21st April 753	
Jewish era	October 3761	
First Canicular period	2785	
Era of Constantinople	1st September 5509	
Era of Alexandria	5503	
Mundane era of Antioch	September 5493	
Era of Nabonassar	26th February 747	
Era of the Seleucidæ	September 311	
Era of Alexander	September 323	
Era of Tyre	19th October 126	
Cæsarean era of Antioch	October 48	
Julian era	1st January 45	
Era of Spain	1st January 38	
Era of Actium	1st January 30	
Era of Diocletian	29th August 284	A. D.
Era of the Armenians	9th July 552	
Era of the Hegira	16th July 622	
Era of Yezdegird	16th June 632	
First Chinese cycle of sixty years	2277	B. C.
Kali-yug	3101	
Era of Vicramaditya	56	
Era of Salivahana	78	A. D.
Fuslee era	590	
Bengalee era	593	

The utility of chronological and synchronistic tables in the illustration of history has been long perceived. Of the more ancient writers who devoted their labours to this object, the principal are, Diodorus Siculus, Julius Africanus, Eusebius of Cæsarea, and George Syncellus, to whom we are indebted for the preservation of some curious fragments of Berosus, Sanconiathon, and Manetho. The modern works of this kind are exceedingly numerous. It will be sufficient to refer the reader to Petau, *de Doctrina Temporis;* Usher's *Annales Veteris et Novi Testamenti;* Newton's *Chronology;* Blair's *Chronology and History of the World;* Playfair's *Chronology;* and the *Tables Chronologiques de l'Histoire Ancienne et Moderne* of Thouret; without mentioning a multitude of smaller tables, of various degrees of merit. But the most complete work on chronology is the *Art de Verifier les Dates,* an immense compilation, for which the student of history is indebted to the Benedictines of the congregation of St Maur. We may likewise mention, as a very extensive and useful work, though printed in a most inconvenient form, the *Tableaux Historiques Chronologiques et Geographiques* of Buret des Longchamps, the second edition of which was published at Brussels in 1822.

The subjoined table of political events has been compiled with great care for the present edition of the Encyclopædia. Though necessarily of limited extent, it will be found to contain a useful summary of the principal events of ancient and modern history. In the early period, the dates are taken from Usher and Blair, as being those followed by the majority of chronologers. (T. G.)

A CHRONOLOGICAL TABLE *of the Principal Events of Political History, and of the most important Inventions and Discoveries, from the Creation of the World to the Year* 1854.

B. C.

4004 Creation of the World, according to the Hebrew text of the Scriptures.
2349 Commencement of the Deluge.
2200–2100 Kingdoms of Babylon, Assyria, and Egypt, supposed to have been founded respectively by Nimrod, Assur, and Menes.
2089 Kingdom of Sicyon established.
1981 Call of Abraham.
1856 Kingdom of Argos established by Inachus.
1764 Deluge of Ogyges.
1700 The shepherd kings possess Egypt.
1556 Cecrops, first king of Athens.
1503 Deluge of Deucalion.
1493 Cadmus comes into Greece.
1491 The Israelites leave Egypt.
1485 Danaus comes to Greece from Egypt.
1480 Troy built by Dardanus.
1453 The Pentateuch, or five books of Moses, written.
1451 The Israelites enter Canaan.
1406 Minos reigns in Crete; gives laws to the Cretans.
1362 Pelops comes to Greece from Asia.
1352 Corinth said to be founded by Sisyphus.
1344 The kingdom of Mycenæ begins.
1325 Isthmian games instituted.
1294 First colony from Italy to Sicily: second, 1264.
1263 The Argonautic expedition.
1257 Theseus unites the cities of Attica.
1252 Tyre, the capital of Phœnicia, built.
1243 Evander conducts a colony of Greeks into Italy.
1225 to 1215 First and second wars of Thebes.
1193 The Trojan war begins.
1184 Troy taken and burnt by the Greeks.
1104 The Heraclidæ conquer the Peloponnesus.
1102 Sparta becomes a kingdom.
1079 Saul king of Israel.
1070 Athenians abolish regal government. Medon first Archon. Codrus.
1055 David king of Israel.
1044 Migration of the Ionian colonies.
1008 Dedication of Solomon's Temple.
979 Rehoboam. Judah and Israel separate kingdoms.
974 Jerusalem plundered by Shiskah (Sesostris) king of Egypt.
894 Gold and silver money coined at Argos.
884 Lycurgus reforms the republic of Lacedæmon.
869 Dido leads a colony of Phœnicians to Africa; founds Carthage.
821 Fall of Nineveh. Sardanapalus. Arbaces.
799 Kingdom of Lydia founded.
790 Pul founds a new Assyrian empire.
776 Commencement of the Olympic era.
760 The Ephori, popular magistrates, instituted at Lacedæmon.
758 Syracuse built by Archias of Corinth.

B. C.
754 Athenians limit the office of archon to ten years. Charops.
753 Rome founded by Romulus.
747 Nabonassar extends the Assyrian empire. Medes.
— Era of Nabonassar begins 26th February.
746 Government of Corinth republican.
721 Captivity of the ten tribes of Israel.
711 Sennacherib, king of Assyria, invades Judea. The Medes revolt. Deioces.
703 Corcyra (Corfu) founded by the Corinthians.
702 Deioces builds Ecbatana, the capital of Media.
685 Second Messenian war begins; continues fourteen years.
684 Athenians make the archonship annual. Creon.
681 Esarhaddon re-unites the kingdoms of Babylon and Nineveh (Assyria).
670 Psammeticus king of all Egypt. Byzantium founded by an Athenian colony.
659 Cypselus usurps the government of Corinth. Periander.
635 Scythians get possession of Upper Asia; Cimmerians of Lydia. Both are dispossessed (607) by Cyaxares.
625 Nabopolassar seizes Babylon; renders himself independent.
624 Draco archon and legislator of Athens.
606 Destruction of Nineveh by Nabopolassar king of Babylon, and Cyaxares king of Media.
598 Nebuchadnezzar takes Jerusalem; carries the Jews into captivity.
596 Perdiccas founds the monarchy of Macedonia.
594 Solon archon and legislator of Athens.
591 The Pythian games instituted in Greece.
588 First irruption of the Gauls into Italy.
580 Copper money coined at Rome.
571 Tyre taken by Nebuchadnezzar. Egypt subdued.
562 Comedies first exhibited at Athens by Thespis.
560 Pisistratus tyrant of Athens.
546 Kingdoms of Media and Lydia destroyed by Cyrus king of Persia.
539 Marseilles built by the Phocæans.
538 Babylonian empire subverted by Cyrus. The Jews released from captivity.
534 The Jews begin to rebuild their temple; are engaged in this work nine years.
529 Death of Cyrus the Great. Cambyses king of Persia.
525 Cambyses conquers Egypt.
510 The Pisistratidæ expelled from Athens. Democracy restored.
509 Tarquin expelled from Rome. Consular substituted for regal government. Brutus.
508 First alliance between the Romans and the Carthaginians.
— Darius Hystaspes, king of Persia, subdues Thrace; makes an unsuccessful invasion of Scythia.
504 The Athenians, by burning Sardis, embroil themselves with the Persians.
498 Dictatorship instituted at Rome. Lartius.
493 The port of Piræus built by the Athenians.
490 Battle of Marathon. Tribunes of the people created at Rome.
486 Darius, king of Persia, succeeded by his son Xerxes.
483 Quæstors instituted at Rome.
481 Xerxes renews the war with Greece.
480 Battles of Thermopylæ and Salamis. Leonidas. Themistocles.
479 The Persians ravage Attica,—burn Athens,—suffer defeats at Platæa and Mycale. Xerxes leaves Greece.

B. C.
476 Themistocles rebuilds Athens.
471 Volero renders more popular the election of consuls and other magistrates at Rome.
470 Battles of the Eurymedon. Persians defeated by Cimon.
465 Third Messenian war begins; lasts ten years.
463 The Egyptians, assisted by the Athenians, throw off the Persian yoke.
451 Roman decemvirate. Laws of the twelve tables.
449 Cimon negotiates a peace between the Greeks and Persians.
448 First sacred war concerning the temple of Delphi. Battle of Coronea.
445 Military tribunes substituted for consuls at Rome.
437 Censorship instituted. Pericles powerful at Athens.
431 Peloponnesian war begins; continues twenty-seven years.
421 Peace of six years and ten months between the Athenians and Lacedæmonians; each continues at war with the other's allies.
416 Sicily becomes the field of the Peloponnesian war.
414 The Athenians are defeated before Syracuse.
409 The Carthaginians enter Sicily; are repulsed by Hermocrates.
405 Battle of Ægospotamos. Usurpation of Dionysius.
404 Athens taken by Lysander. End of the Peloponnesian war. Government of the thirty tyrants.
401 Battle of Cunaxa, and death of the younger Cyrus. Retreat of the ten thousand Greeks. Sparta involved in war with Persia.
— Persecution and death of Socrates. Expulsion of the thirty tyrants. Thrasybulus.
396 The Lacedæmonians invade Asia. 395, Corinthian alliance assists Persia. 394, Battles of Cnidos and Coronæa. Agesilaus.
387 Peace of Antalcidas. Greek cities of Asia become tributary to Persia.
385 Rome burnt by the Gauls under Brennus.
382 Lacedæmonians seize the citadel of Thebes; (380) are expelled by Pelopidas and Epaminondas.
376 Sea-fight of Naxos. Chabrias.
371 Epaminondas defeats the Lacedæmonians at Leuctra.
367 Institution of the prætorship at Rome. Licinian law. Plebeian consul.
363 Battle of Mantinea. Death of Epaminondas.
359 Philip king of Macedon.
358 Greek social war. Battle of Methone.
357 Dionysius the Younger expelled from Syracuse.
356 Birth of Alexander the Great. Temple of Diana at Ephesus burnt by Erostratus. Phocian or sacred war.
350 Darius Ochus subdues Egypt.
348 Philip of Macedon takes Olynthus. Sacred war ends.
347 Dionysius recovers the tyranny of Syracuse; is finally expelled (343) by Timoleon.
343 War between the Romans and Samnites begins; continues with interruptions to 272.
340 Timoleon defeats the Carthaginians at Agrigentum.
338 Battle of Cheronæa. 337, Philip chosen to lead the Greeks to the invasion of Persia. 336, Murdered. Alexander. Darius Codomannus.
336 Alexander destroys Thebes; 335, Is chosen generalissimo of the Greeks; Marches into Asia; 334, Defeats the Persians on the banks of the Granicus; 333, Again at Issus; 332, Subdues Egypt and takes Tyre; 331, Defeats the Persians at Arbela. 330, Darius is killed; end of the Persian empire.

Chronology.

B. C.

328 Alexander invades India; penetrates to the Ganges; his admiral, Nearchus, sails from the Indus to the Euphrates.
324 Death of Alexander at Babylon—an event followed by wars among his officers, and the dismemberment of his empire.
315 Restoration of Thebes.
312 Era of the Seleucidæ.
311 Appian way and aqueducts constructed at Rome.
304 Demetrius Poliorcetes besieges Rhodes; restores (303) the liberty of the Grecian cities.
301 Battle of Ipsus. Dismemberment of the empire of Alexander completed.
300 Seleucus founds Antioch, Edessa, and Laodicea.
286 Law of Mœnius; the Roman senate bind themselves to sanction all decrees of the people.
285 Astronomical era of Dionysius of Alexandria.
283 Alexandrian library founded.
281 Achæan league negotiated.
280 Pyrrhus, invited by the Samnite allies, invades Italy. Battles of Lyris and Asculum.
277 Greek (Septuagint) version of the Scriptures made by order of Ptolemy Philadelphus.
274 Battle of Beneventum. Pyrrhus withdraws from Italy.
272 Samnite war ended. Rome mistress of all the southern states of Italy.
266 Silver money first coined at Rome.
264 First Punic war begins. Chronology of Paros (Arundel marbles) composed.
256 Regulus defeats the Carthaginians in the sea-fight of Ecnoma; lands in Africa; reduces Clupea and other towns; is vanquished (255) by Xantippus, and taken prisoner.
250 Parthia, under Arsaces, becomes an independent kingdom.
241 Catulus destroys the navy of Carthage. End of first Punic war.
240 Plays (the composition of Livius Andronicus) first acted at Rome.
237 Conquest of Spain attempted by the Carthaginians.
235 Temple of Janus shut; open since reign of Numa.
231 Sardinia and Corsica subdued by the Romans.
227 War between Sparta and the Achæan league; ended (222) by the battle of Sellasia. Cleomenes. Aratus.
225 to 220 Gauls repeatedly defeated and driven from Cisalpine Gaul. Illyria subdued.
219 Hannibal the Carthaginian besieges Saguntum, and brings on the second Punic war.
218 Hannibal leads an army from Spain into Italy, defeats the Romans at Ticinum and Trebia; 217, at Thrasymene; 216, at Cannæ; 215, concludes an alliance with Philip (2d) of Macedon.
212 Philip defeats the Ætolians, allies of Rome. Marcellus takes Syracuse.
211 P. Scipio sent into Spain. Antiochus conquers Judea.
207 Asdrubal, conducting supplies to Hannibal, is defeated and slain at the Metaurus. Gold money at Rome.
204 Scipio, having reduced Spain, carries the war into Africa.
203 The Carthaginians recal Hannibal.
202 Battle of Zama. 201, Submission of Carthage. End of second Punic war.
197 Defeat of Philip at Cynocephale. End of first Macedonian war.
192 to 189 War between the Romans and Antiochus, king of Syria. Battle of Magnesia.

B. C.

188 Philopœmen abrogates the laws of Lycurgus.
172 to 168 Second Macedonian war. Battle of Pydna. Macedon becomes a Roman province.
170 Antiochus Epiphanes takes Jerusalem.
168 First library at Rome.
166 Judas Maccabæus delivers the Jews from the Syrians.
149 Third Punic war begins.
147 Rome defends Sparta against the Achæan league.
144 Corinth, Thebes, Chalcis destroyed. Greece becomes a Roman province.
— Carthage destroyed. Carthaginian territory reduced into a province.
141 War of Numantia.
135 to 132 Servile war in Sicily.
133 Tiberius Gracchus slain. Numantia taken. Pergamus annexed to the Roman empire.
121 Caius Gracchus slain.
117 Gallia Narbonensis becomes a Roman province.
111 to 106 Jugurthan war. Metellus. Marius.
109 Cimbri and Teutones invade Gaul; 105, cut off a Roman army of 80,000 on the banks of the Rhone.
102 Marius exterminates the Teutonic army at Aix, and the Cimbrian (101) on the banks of the Athesis.
91 Italian (social) war begins; lasts three years.
88 Mithridatic war. Marian civil war.
87 Marius seizes Rome; 86, dies. Cinna.
84 Sylla conquers and makes peace with Mithridates; 83, attacks the Marian party in Italy; 82, seizes Rome, and is made perpetual dictator; resigns his office (78).
77 Civil war of Sertorius in Spain, and of Lepidus and Catulus in Italy.
74 Mithridatic war renewed. Lucullus.
73 to 71 Servile war in Italy. Spartacus. Crassus.
67 Pompey reduces the pirates; 64, subdues Mithridates and Tigranes; 63, reduces Syria into a Roman province.
62 Conspiracy of Catiline. Cicero.
59 First triumvirate; Pompey, Crassus, Cæsar.
58 Cæsar begins the conquest of Gaul; 55, invades Britain. Crassus goes to Syria; slain (53) by the Parthians.
52 Clodius murdered by Milo.
50 Subjugation of Gaul completed.
49 Civil war. Cæsar drives Pompey from Italy, and disperses his army in Spain.
— Commencement of the era of Antioch.
48 Battle of Pharsalia. Murder of Pompey in Egypt.
47 War in Egypt. Destruction of the Alexandrian library. Defeat of Pharnaces.
46 African war. Cato. Reformation of the calendar; this the year of confusion.
45 War in Spain; Battle of Munda. Cæsar declared perpetual dictator.
44 Cæsar assassinated. Brutus. Cassius.
43 Battle of Mutina. Second triumvirate; Octavius, M. Antony, Lepidus.
42 Battles of Philippi. The triumviri masters of the empire.
40 Accommodation between Sextus Pompey and the triumviri; broken, 39.
36 Pompey driven from Sicily; put to death.
35 Lepidus deprived of power.
32 War between Octavius and Antony.
31 Battle of Actium. Era of the Roman emperors.
27 Name of Octavius changed, by the senate, to Augustus.
15 Rhæti and Vindelici defeated by Drusus.

B. C.
12 Pannonia subdued by Tiberius.
10 Temple of Janus shut.
8 Augustus corrects the calendar, suppressing the intercalary days for twelve years.
4 Birth of Christ, four years before the vulgar era.

A. D.
9 Three Roman legions under Varus cut to pieces in Germany.
14 Tiberius emperor of Rome.
25 End of the Olympiads.
33 Crucifixion of our Saviour.
37 Caligula emperor.
40 The followers of our Saviour called Christians.
41 Claudius emperor.
43 Expedition of Claudius to Britain. 44, Successes of Plautius.
50 London founded by the Romans. 51, Caractacus carried to Rome.
54 Nero emperor.
61 Boadicea defeats the Romans. Suetonius Paulinus.
64 Rome set on fire—burned six days. First persecution of the Christians.
66 Jewish war begins.
68 Galba emperor. 69, Otho—Vitellius. 70, Vespasian. Destruction of Jerusalem.
77 The Parthians ravage Armenia.
79 Titus emperor. Herculaneum and Pompeii destroyed by an eruption of Vesuvius.
80 Agricola completes the pacification of South Britain.
81 Domitian emperor.
85 Agricola defeats the Caledonians; circumnavigates Britain.
88 Dacian war begins.
95 Second Christian persecution.
96 Nerva emperor. 98, Trajan.
103 to 107 Dacia and other eastern countries subdued.
118 Adrian emperor. Conquests of Trajan abandoned. Euphrates, eastern frontier.
120 Adrian's wall (from Tyne to Solway) built.
132 to 135 Second Jewish war. Jews driven from their country.
138 Antoninus Pius emperor.
139 Lollius Urbicus subdues Britain to the Moray Frith; builds the wall of Antoninus between the Forth and Clyde.
161 Marcus Aurelius and Lucius Verus joint emperors.
163 Fourth Christian persecution.
166 to 178 War with the Marcomanni, Quadi, &c.
171 Death of Verus. Aurelius sole emperor.
180 Commodus. Goths seize the eastern part of Dacia.
189 The Saracens (now first noticed in history) defeat the Romans.
193 Pertinax. Didius Julian. Pescennius Niger. Septimius Severus.
202 Fifth Christian persecution.
209 Severus rebuilds the wall of Antoninus (Graham's Dyke).
211 Caracalla and Geta emperors. 212, Geta murdered.
213 First mention of the Alemanni (Germans), a union of tribes on the Upper Rhine.
217 Macrinus emperor. 218, Heliogabalus. 222, Alexander Severus. The Goths bribed not to molest the empire.
226 Alexander defeats the Persians; 235, is murdered by Maximin.
236 Sixth Christian persecution. 237, Defeat of the Sarmatians.
238 Papienus and Balbinus joint emperors. Gordian.

A. D
242 Gordian defeats Sapor the Persian.
244 Philip the Arabian emperor.
249 Decius emperor. Seventh Christian persecution. First notice of the Franks, a union of tribes on the Lower Rhine.
251 Vibius, Gallus, emperors.
253 The Goths, Burgundians, &c. break into Mœsia and Pannonia.
254 Valerian emperor. 257, Eighth Christian persecution.
259 Sapor ravages Syria; takes Valerian prisoner. The Germans advance to Ravenna.
260 Gallienus emperor. Thirty tyrants.
261 Sapor takes Antioch. 263, The Franks invade Gaul; 267, the Heruli Greece.
268 Claudius emperor; defeats (269) 320,000 of the Goths and Heruli.
270 Aurelian emperor.
271 The Alemanni and Marcomanni ravage the empire.
272 Ninth Christian persecution.
273 Zenobia, queen of Palmyra, defeated by Aurelian at Edessa.
274 Silk brought from India.
275 Tacitus emperor. Goths seize Dacia.
277 Probus emperor; drives the Alemanni from Gaul; defeats the Franks.
282 Carus, (284) Diocletian, emperors. The northern nations redouble their attacks.
292 Partition of the empire by Diocletian.
298 Constantine Chlorus defeats the Alemanni near Langres.
302 Tenth Christian persecution.
304 Constantine and Galerius emperors. 306, Constantine (the Great) becomes sole emperor; stops the persecution of the Christians.
313 Constantine publishes the edict of Milan in favour of the Christians; defeats the Franks; also (321) the Saracens.
325 First general council meets at Nice.
329 Seat of empire transferred from Rome to Constantinople.
337 Constantine II., Constans, and Constantius joint emperors.
350 Franks possess extensive settlements in Gaul.
357 Julian defeats the Germans at Strasburg.
361 Julian emperor; slain (363) in battle with the Persians.
364 Valentinian emperor of the West. Valens, of the East.
373 Scriptures translated into the language of the Goths.
375 "Migration of Nations." The Huns cross the Don and Wolga.
376 Valens allows the Goths to settle in Thrace. They advance (378) to the gates of Constantinople.
379 Theodosius the Great emperor of the East, in 392 also of the West. Christianity becomes the religion of the state.
381 Second general council held at Constantinople.
383 Huns overrun Mesopotamia; are defeated by the Goths; invade (395) the eastern provinces.
400 Alaric the Visigoth ravages Italy; is defeated (403) by Stilicho.
406 The Vandals, Alans, and Suevi invade France and Spain.
410 Alaric sacks Rome.
411 The Vandals established in Spain.
420 Pharamond, first king of the Franks, supposed to begin his reign.
424 Valentinian III. emperor of the West.

Chronology.

A. D.
426 The Romans withdraw finally from Britain.
429 The Vandals pass into Africa.
431 Third general council—held at Ephesus.
439 Vandals take Carthage; establish themselves in the African province.
442 Theodosius II. concludes a disgraceful treaty with Attila the Hun.
445 to 448 Attila ravages the eastern provinces; exacts a tribute from the emperor; 450, invades Germany and France; sustains a defeat at Chalons.
451 Saxons assist the Britons against the Scots and Picts.
—— Fourth general council—held at Chalcedon.
452 Foundation of the city of Venice.
455 Rome sacked by the Vandals. Genseric.
468 The Visigoths expel the Romans from Spain.
470 Ælla the Saxon occupies the kingdom of Sussex defeats (471) all the British princes.
475 Romulus Augustulus last emperor of the West; deposed (476) by Odoacer, king of the Heruli. Extinction of the western empire.
481 Clovis king of the Franks.
485 Battle of Soissons. Syagrius.
488 Theodoric the Ostrogoth defeats Odoacer; becomes king of Italy.
497 Clovis, with his Franks, embraces Christianity; 500, exacts tribute from the Burgundians; 507, subdues the Visigoths settled in Gaul; 510, makes Paris the capital of France. 511, The kingdom divided.
516 Computation of time by the Christian era introduced by Dionysius Exiguus.
529 Belisarius defeats the Persians. Code of Justinian published.
534 Kingdom of the Vandals in Africa destroyed.
537 Rome taken from the Ostrogoths; recovered (547) by Totila.
540 Antioch destroyed by the Persians.
547 Northumbrian kingdom founded by Ida the Saxon.
550 Rise of the kingdom of Poland.
553 Ostrogothic kingdom of Italy destroyed by Narses.
559 France re-united under Clotaire.
568 The Lombards conquer Italy.
580 Latin ceases to be the spoken language of Italy.
585 Kingdoms of the Saxon Heptarchy established, some before, others about this period. Britons in Wales, Cornwall, and Brittany. Civil wars of the Saxons begin.
596 Augustine the monk preaches Christianity to the British Saxons.
602 Papal supremacy authorized by Phocas, emperor of the East.
604 St Paul's Church in London founded.
616 Jerusalem taken by the Persians under Cosroes II.
622 Era of the Hegira, or flight of Mahommed from Mecca to Medina.
625 Constantinople besieged by an army of Persians, Huns, and Sclavonians.
632 Abubeker—633, Omar, succeed Mahommed as caliphs of the Saracens.
636 Omar takes Jerusalem—640, Alexandria—orders the Alexandrian library to be burnt.
648 The Saracens take Cyprus—653, Rhodes—658, agree to pay the emperor tribute—669, ravage Sicily—672, make a fruitless attack on Constantinople—675, fail in an attempt to establish themselves in Spain.
680 Sixth general or œcumenical council of Constantinople.

A. D.
690 Pepin d'Heristal (Maire du Palais) regent of France.
698 The Saracens seize Carthage—699 and 700, sustain defeats from the emperor of the East—713, make themselves masters of Spain.
714 Charles Martel (Maire du Palais) regent of France.
718 Christian kingdom of the Asturias founded by Pelagius.
729 The Saracens ravage France—are defeated (732) by Charles Martel, in the battle of Tours.
742 Childeric III. (last of the Merovingian dynasty) king of France.
749 The Abassidæ caliphs of the Saracens.
751 Pepin (le Bref.) deposes Childeric, and founds the Carlovingian dynasty of French kings.
754 Pepin takes Ravenna from the Lombards, and confers it on the pope—hence origin of the pope's sovereignty.
756 Abdarrahman king of Cordova. Didier last king of Lombardy.
762 Almanzor caliph of the Saracens, makes Bagdad the seat of his government.
767 The Turks (a Tartar tribe) ravage Asia Minor.
768 Charles (Charlemagne) and Carloman kings of France.
772 Charlemagne sole ruler.
774 Charlemagne subdues the kingdom of Lombardy—778, Spain to the Ebro—779, Navarre and Sardinia—785, Saxony.
785 Haroun Alraschid, caliph of the Saracens, ravages part of the empire of the East—encourages science among the Arabs.
787 The Danes pay their first visit to England. Seventh general council—held at Nice.
794 Charlemagne defeats and disperses the Huns.
797 The Saracens ravage Cappadocia, Cyprus, and Rhodes.
800 Charlemagne crowned emperor of the Romans. Clocks brought from the East to Europe.
814 Louis (le Debonnaire) emperor and king of France —817, divides his dominions among his sons.
827 Egbert unites the kingdoms of the Saxon heptarchy into one—England. The Danes begin to infest the English coast.
838 Ethelwolf king of England. Tithes.
843 Kenneth M'Alpin reduces the whole of North Britain into the monarchy of Scotland.
853 Separation of the Greek and Latin churches.
855 Kingdom of Navarre founded by Garcias.
855 Ethelbald and Ethelbert—866, Ethelred—872, Alfred, kings of England. The Danes commit destructive ravages.
874 Iceland peopled by the Norwegians.
875 Norway, Orkney, Shetland, and the Hebrides, subject to Harold Harfager.
877 Louis (the Stammerer) emperor of Germany and king of France. Hereditary feudal system begins to prevail in France.
878 to 890 Alfred the Great destroys the Danish power in England; establishes a militia—a navy; divides England into counties, hundreds, &c.; publishes a code of laws.
880 The Normans ravage France; 885, besiege Paris.
886 University of Oxford founded by Alfred.
900 Louis IV. (last Carlovingian) emperor of Germany
901 Edward the Elder king of England.
904 The Russians before Constantinople.
911 Conrad, duke of Franconia (a German), elected emperor by the princes of the empire.

Chronology.

A. D.

912 Rollo the Norman extorts a grant of the province of Neustria (Normandy) fiom Charles the Simple.
915 University of Cambridge founded.
928 Athelstan king of England.
931 Rise of the republic of Pisa. Geneva in the hands of the Saracens.
941 Edmund I.—948, Edred—955, Edwy—959, Edgar, kings of England. Wolves extirpated by Edgar.
961 Candia retaken from the Saracens.
964 Otho the Great re-unites Italy to Germany.
967 Antioch retaken from the Saracens.
970 Greenland discovered by Gunbiorn, an Icelander.
976 Edward II. and 978, Ethelred II., kings of England.
977 Greece, Macedon, and Thrace, ravaged by the Bulgarians.
986 Louis V. (last Carlovingian) king of France.
987 Hugh Capet, count of Paris, ascends the throne of France—third dynasty.
991 The arithmetical figures introduced into Europe by the Arabians.
999 Boleslaus first king of Poland.
1002 Massacre of the Danes settled in England, by Ethelred; the cause of an invasion by Sueno, king of Denmark, in 1013, and by Canute, his son, in 1014.
1016 Edmund Ironside king of England. War with Canute, king of Denmark.
1017 Canute becomes king of England.
1018 The Normans invade Italy.
1030 Caliphat of Cordova dismembered.
1036 Harold Harefoot king of England.
1039 Hardicanute (last Danish) king of England.
—— Macbeth murders Duncan—usurps the throne of Scotland.
1041 Edward the Confessor (son of Ethelred II.) king of England. Danish power in England annihilated.
1043 The Turks subdue Persia—1055, take Bagdad—deprive the caliphs of temporal authority—suffer them to retain the spiritual.
1056 Milan a republic.
1057 Macbeth slain by the English. Malcolm Canmore, son of Duncan, king of Scots.
1058 Guiscard the Norman expels the Saracens from Sicily.
1062 A council of bishops decrees that the cardinals alone shall nominate supreme pontiffs.
1065 The Turks take Jerusalem from the Saracens.
1066 Harold king of England. William, duke of Normandy, disputes his title; defeats Harold at Hastings, and gains the crown.
1070 Feudal law introduced into England by William the Conqueror.
1073 Pope Gregory VII. (Hildebrand) publishes a bull against the investiture and marriage of priests; 1076, excommunicates and deposes the emperor Henry IV.
1079 Doomsday book begun by order of William the Conqueror—finished 1085 or 1086.
1085 Alphonso of Castile takes Toledo and Madrid from the Saracens.
1086 Carthusian order of monks established.
1087 William II. (Rufus) king of England; Robert, his brother, duke of Normandy.
1091 Saracens in Spain assisted by the Moors, who take possession of their dominions.
1095 Council of Clermont. First crusade. Peter the hermit.

A. D.

1098 The crusaders take Antioch, and, 1099, Jerusalem; erect a Christian kingdom; Godfrey of Bouillon sovereign. Knights of St John instituted.
1100 Henry I. king of England.
1102 Guiscard the Norman assumes the title of king of Naples.
1106 Normandy re-annexed to England.
1108 Louis VI. of France incorporates towns; abridges the power of the feudal chiefs.
1110 Order of the Templars instituted.
1119 War between England and France. Battle of Andeli.
1135 Stephen king of England.
1137 Pandects of Justinian discovered at Amalphi.
1138 Battle of the Standard; David First of Scots defeated by the earl of Albemarle.
1139 Civil war in England between Stephen, and Matilda, daughter of Henry I.; 1141, Battle of Lincoln.
1140 Canon law introduced into England. Faction of the Guelphs and Ghibellines.
1147 Second crusade. Bernard of Clairvaux. Moscow founded. Alphonso Henriquez takes Lisbon from the Moors; assumes the title of king of Portugal.
1150 Study of civil law revived at Bologna. Scholastic philosophy cultivated.
1152 Frederic Barbarossa emperor of Germany.
1153 Treaty of Winchester; compromise between Stephen and Prince Henry, son of Matilda.
1154 Henry II. (Plantagenet) king of England. Guelphs and Ghibellines at war in Italy.
1157 Bank of Venice established.
1160 Religious sect of the Albigenses begins to attract notice.
1163 London bridge built of stone.
1164 Teutonic order of knighthood instituted in Germany.
—— King of England attempts to retrench clerical usurpations. Council of Clarendon. Becket.
1172 Ireland conquered by Henry II. Strongbow earl of Pembroke.
1175 Division of England into four circuits; appointment of itinerant judges.
1179 University of Padua founded.
1180 Philip (Augustus) king of France. Guelphic party repulsed. Bills of exchange in use.
1187 Jerusalem taken by Saladin, sultan of Egypt.
1189 Richard I. king of England. Third crusade; the leaders, Frederick of Germany, Richard of England, Philip of France.
1191 Ptolemais reduced by the crusaders; Battle of Ascalon; truce of three years, three months, three weeks, three days, &c. with Saladin.
1200 Universities establishing in many large towns.—First historical notice of the mariner's compass.
1202 Fourth crusade, under Baldwin, earl of Flanders; bursts upon Constantinople. Baldwin becomes emperor of the East.
1204 The inquisition established by Pope Innocent III.
—— Provinces of Normandy, Anjou, &c. re-united to France.
1206 Gengis Khan. Mogul empire. Dispute between John, king of England, and the pope; settled 1213.
1208 London obtains a charter for electing its own magistrates.
1210 Crusade against the Albigenses.
1212 Battle of Toledo; Christians defeat the Moors.

Chronology.

A. D.

1213 King of England becomes a vassal of the holy see.
1215 Magna Charta signed by John.
1216 Henry III. king of England.
1217 Fourth crusade, under Andrew, king of Hungary.
1218 Switzerland a province of the German empire.
1219 Damietta taken by the crusaders.
1222 Assembly of estates of France called a parliament.
1226 St Louis king of France. Institution of the monastic orders of St Dominic and St Francis.
1227 Gengis Khan and the Moguls (Western Tartars) overrun the empire of the Saracens.
1228 Sixth crusade under the emperor Frederic II.
1234 Inquisition committed to the Dominicans.
1237 Russia subdued by the Moguls.
1248 Seventh crusade under St Louis.
1254 Interregnum in Germany to 1273.
1256 Hanseatic league formed.
1258 Bagdad taken by the Moguls. End of the empire of the Saracens.
1261 Battle of Largs. Norwegians defeated by Alexander III. king of Scots. Use of the mariner's compass known in France.
1264 Borough deputies sit, for the first time, in the English parliament. Earl of Leicester. Battle of Lewes and (1265) of Evesham.
1266 Charles, count of Anjou, defeats Mainfroy, king of Naples and Sicily; 1268, succeeds him as king.
1272 Edward I. king of England. Florentine academy founded.
1273 Rodolph of Hapsburg (first of the Austrian family) emperor of Germany.
1279 The Moguls subdue China.
1282 Sicilian vespers. King of Aragon obtains possession of Sicily; academy de la Crusca instituted.
1283 Edward I. conquers Wales.
1290 Death of Margaret of Norway queen of Scots. Competition of Bruce, Baliol, &c. for the crown. Edward I. arbiter.
1291 Ptolemais taken by the Turks. End of the crusades.
1292 Edward extorts an admission of his feudal superiority from the Scots barons; decides the disputed succession in favour of Baliol.
1295 First English House of Commons assembled.
1296 Edward dethrones Baliol; attempts to annex Scotland to his other dominions. Battles (1297) of Stirling and (1298) Falkirk. Sir William Wallace.
1299 Othman (founder of the Ottoman empire) makes Prusa the seat of the Turkish power.
1301 King of England's eldest son created prince of Wales. Spectacles used.
1305 Robert Bruce attempts to restore the independence of Scotland; 1306, is crowned at Scone.
1307 Establishment of the Swiss republics. William Tell. Edward II. king of England.
1308 Pope transfers his residence from Rome to Avignon.
1310 Lincoln's Inn Society established. Rhodes taken by the knights of St John. Chimneys used in domestic architecture.
1312 Order of Templars suppressed.
1314 Battle of Bannockburn. Independence of Scotland secured.
1319 Catalonia and Valencia united to Aragon. University of Dublin established.
1325 First treaty of commerce between England and Venice.
1327 Edward III. king of England.

A. D.

1328 Philip of Valois king of France. Salic law
1329 David II. (Bruce) king of Scots.
1331 The Teutonic knights settle in Prussia.
1332 to 1336 Crown of Scotland contended for by David Bruce, and Edward, son of John Baliol. Battle of Halidon Hill.
1336 Crown of France claimed by Edward III.—the cause, in 1339, of war between France and England.
1340 Gunpowder invented by Swartz, a monk of Cologne. Oil painting by John Van Eyk.
1341 Petrarch crowned at Rome.
1345 Canary islands discovered by the Genoese. Fire-arms in use.
1346 Battles of Cressy and Durham. Siege of Calais.
1347 Rienzi tribune of the people at Rome. University of Prague founded.
1350 Order of the Garter instituted by Edward III.
1351 John king of France.
1352 The Turks first enter Europe.
1355 The Golden Bull fixes the constitution of the German empire.
1356 Battle of Poictiers. Black Prince.
1357 Coals first used in London.
1360 Peace of Bretigni. Aquitaine ceded to England.
1361 The Turks conquer Adrianople; settle in Europe; establish the military order of Janizaries.
1362 Edward III. abolishes the use of French in the English courts of law.
1365 Universities of Vienna and Geneva founded.
1370 War between England and France renewed.
1377 Pope returns to Rome. Richard II. king of England. Doctrines of Wickliffe propagated.
1378 Two popes, Urban VI. at Rome, Clement VII. at Avignon.
1380 Tamerlane (or Timour) the Mogul conqueror, subdues Chorasan.
1381 Wat Tyler and Jack Straw's insurrection in England. Bills of exchange used by the English.
1383 Cannon employed in the defence of Calais.
1384 First navigation act in England. Windsor Castle built.
1386 Tamerlane subdues Georgia.
1388 Battle of Otterburn. Douglas. Percy.
1392 Cape of Good Hope discovered by the Portuguese.
1395 Hungarians defeated by the Turks.
1398 Delhi taken by Tamerlane.
1399 Henry IV. (of the house of Lancaster) king of England. Order of the Bath instituted.
1400 Wenceslaus, emperor of Germany, deposed by the electoral princes.
1401 First final law against heresy in England. William Sautré, a Wickliffite, the first victim.
1402 Battle of Homeldon; 1403, of Shrewsbury.
—— Moguls under Tamerlane defeat the Turks under Bajazet at Angoria; 1405, death of Tamerlane.
1406 James I. king of Scots.
1411 University of St Andrews founded.
1412 Algebra taught in Europe by the Arabs.
1413 Henry V. king of England. Persecution of the Lollards.
1414 Council of Constance deposes two popes. Pontificate vacant for three years.
1415 Civil war of the Burgundians and Armagnacs in France. Invasion of Henry V. Battle of Agincourt. John Huss and (1416) Jerome of Prague consigned to the flames for heresy by the council of Constance.
1417 First mention of the Bohemians or gypsies in Europe. Paper made from linen rags.

Chronology.

A. D.

1420 The island of Madeira discovered by the Portuguese. Treaty of Troyes. Henry V. regent of France.

1421 The Turks invest Constantinople; conclude a ten years' truce with the Christians.

1422 Henry VI. king of England and (by treaty of Troyes) of France. Charles VII. takes arms in support of his claim to the crown of France.

1424 French and Scots defeated at Verneuil by the Duke of Bedford.

1425 Court of Session in Scotland instituted by James I.

1428 Siege of Orleans; raised by Joan of Arc.

1430 Charles VII. crowned at Rheims; Henry VI. at Paris.

1431 Maid of Orleans (Joan of Arc) burnt for sorcery.

—— Rise of the Medici family at Florence.

1432 The Azores discovered by the Portuguese.

1437 James II. king of Scots.

1439 Temporary re-union of the Greek and Latin churches.

1440 Art of printing invented by John Guttenberg.

1442 African slave trade commences.

1444 Truce with Turkey broken by the Christians. Battle of Varna. Scanderbeg frees Albania from the Turkish yoke.

1445 Constantine Palæologus last emperor of the East.

1446 Vatican library founded at Rome.

1450 Mahommed II. emperor of the Turks.

1453 The Turks take Constantinople, and extinguish the eastern empire of the Romans. A standing army established in France. The English retain Calais alone of their continental possessions. War in France at an end.

1454 University of Glasgow founded.

1455 Civil war between the royal houses of York and Lancaster, or "war of the Roses." Battle of St Albans.

1456 The Turks defeated before Belgrade by John Hunniades.

1459 Engraving on copper invented.

1460 James III. king of Scots. Battles of Northampton and Wakefield.

1461 Edward (of the house of York) proclaimed king of England by his party. Battle of Towton. Louis XI. king of France.

1464 Stages, diligences, and posts established in France.

1468 The Orkney and Shetland islands united to the kingdom of Scotland.

1470 Edward IV. driven from England. Henry VI. restored to the throne.

1471 Return of Edward. Battles of Barnet and Tewkesbury; destruction of the Lancastrian party.

1474 Cape Verde Islands discovered by the Portuguese.

1477 University of Aberdeen established.

1479 Ferdinand and Isabella unite the kingdoms of Aragon and Castile; establish the inquisition in their dominions. Russia freed from Tartar subjection.

1481 Death of Mahommed II.

1483 Charles VIII. king of France. Edward V. king of England murdered. Richard III. king of England.

1485 Richard (last English king of the Plantagenet dynasty) is slain in the battle of Bosworth. Henry earl of Richmond becomes king; styled Henry VII.

1486 and 1487 Imposture of Lambert Simnel.

1488 James IV. king of Scots.

1491 Granada, the last possession of the Moors in Spain, subdued by Ferdinand and Isabella. Bretagne, the last independent fief in France, re-united to the crown. Opposition of Henry VII.; bought off (1492) by the treaty of Estaples.

1492 Hispaniola and Cuba discovered by Christopher Columbus.

1493 Maximilian I. emperor of Germany.

1494 Invasion of Italy by Charles VIII. Continent of America discovered by Columbus.

1496 Newfoundland discovered by Sebastian Cabot.

1497 Vasco de Gama, a Portuguese, doubles the Cape of Good Hope, and sails to the East Indies.

1498 Louis XII. king of France.

1499 North America discovered by Cabot. Execution of Perkin Warbeck, pretended son of Edward IV. Conquest of the Milanese by Louis XII.

1500 The Portuguese discover Brazil.

—— to 1504 War between the kings of France and Spain for the possession of Naples. Treaty of Blois. Pope Julius II.

1507 Madagascar discovered by the Portuguese.

1508 Julius II. forms the league of Cambray against Venice. Porto Rico, Jamaica, and Cuba colonized by the Spaniards.

1509 Henry VIII. king of England. Battle of Aignadel.

1510 Julius dissolves the league of Cambray; acts against his ally Louis XII. General wars.

—— to 1515 Goa, Malacca, Ormus, conquered by the Portuguese. Albuquerque.

1512 Council of Pisa. Navarre united to Spain. Battle of Ravenna.

1513 Invasion of France by Henry VIII. Battle of Spurs. Invasion of England by the Scots. Battle of Flodden; James IV. slain. James V. king of Scots. South Sea entered by Nugnez Balboa.

1514 General pacification among the European powers.

1515 Francis I. king of France. Invasion of Italy. Battle of Marignan. The Milanese submit to France.

1516 Charles of Austria (the grandson of Ferdinand) king of Spain.

1517 Reformation in Germany begun by Luther. The Turks end the sway of the Mamelukes in Egypt. China visited by Ferdinand d'Andrada, a Portuguese.

1518 Pope Leo X. condemns Luther's doctrines.

1519 Charles king of Spain is elected emperor of Germany. Magellan explores the South Seas.

1520 Reformation in Switzerland. Zuinglius. Sweden and Denmark united. Massacre of Stockholm by Christiern II.

1521 Luther cited before the diet of Worms. Gustavus Vasa king of Sweden. Cortez completes the conquest of Mexico. General wars renewed by Charles and Francis. Ladrone and Philippine islands discovered by Magellan.

1522 First voyage round the world performed by a ship of Magellan's squadron. Rhodes taken by the Turks; also Belgrade in 1523.

1523 The Spaniards subdue Chili.

1524 Sweden and Denmark embrace Lutheranism.

—— Battle of Biagrassa. Death of the Chevalier Bayard.

1525 Grand Master of the Teutonic order makes himself hereditary duke of Prussia. Battle of Pavia. Captivity of Francis I.

1526 Treaty of Madrid. Holy League. The Turks acquire the sovereignty of Moldavia and Wallachia.

1527 Rome sacked by the army of Charles V. Pope made prisoner. Pizarro begins the conquest of Peru. The Bermudas discovered by John Bermudez, a Spaniard.

1529 The Turks threaten Vienna. Peace of Cambray.

Chronology.

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Diet of Spire. The reformers acquire the name of Protestants. Papal opposition to the dissolution of Henry VIII.'s marriage with Catherine of Spain precipitates the reformation in England.
1530 Diet and confession of Augsburg. League of Smalcalde. Secretary of state appointed in England.
1532 Treaty of Nuremberg; the German Protestants obtain liberty of conscience. Court of Session remodelled by James V.
1533 Henry VIII. quarrels with the Holy See; 1534, is declared by parliament "The only supreme head of the church of England upon earth."
1534 Anabaptist republic at Munster. Jack of Leyden. Barbarossa seizes the kingdom of Tunis.
1535 Society of the Jesuits instituted by Loyola. Expedition of Charles V. against Tunis.
1536 Renewal of war between Charles and Francis; Milan the cause. Invasion of France.
1538 Dissolution of all the monasteries in England. English Bible read in the churches. Turks defeat the Germans at Essek on the Drave. Barbarossa ravages the coasts of Italy. Truce of Nice.
1540 Reformation at Geneva. Calvin. Variation of the compass noticed by Cabot.
1541 Great part of Hungary subdued by the Turks. Disastrous expedition of Charles V. against Algiers.
1542 Renewal of hostilities between France and the empire. The Turks allies of Francis. Henry VIII. makes war with Scotland. Battle of Solway Moss. Mary Queen of Scots. Japan visited by Ferdinand Mendez Pinto.
1544 Battle of Cerisoles. Peace of Crespi.
1545 Battle of Ancrum Muir.
1546 Peace concluded between Charles V. and Turkey. Council of Trent meets. Religious war in Germany.
1547 Battle of Mulhausen. Henry II. king of France; Edward VI. king of England; Duke of Somerset protector. Battle of Pinkey. Orange trees brought from China to Portugal.
1548 The Interim published and enforced in Germany.
1549 English liturgy completed. Telescopes invented.
1551 War of Parma.
1552 The German Protestants assisted by Henry II. of France. Peace of religion concluded at Passau. War with France continues; siege of Metz.
1553 Lady Jane Grey proclaimed queen of England; obliged to resign the crown to the Princess Mary. Queen Mary attempts to restore the Catholic religion, and (1555) persecutes the Protestants.
1555 Recess of Augsburg. Charles V. resigns the Spanish dominions to his son Philip, and Germany to his brother Ferdinand. Truce of Vaucelles.
1556 War rekindled in Italy and the Low Countries. Waigat's Strait discovered by Stephen Borrough.
1557 England joins Spain against France. Battle of St Quentin. Calais taken by the French.
1558 Elizabeth queen of England. Marriage of Mary queen of Scots to the dauphin.
1559 Peace of Chateau Cambresis. Francis II. king of France.
1560 Charles IX. king of France. Struggle between the French Catholic and Protestant parties commences. Papal jurisdiction abolished, and Presbyterian worship established in North Britain by the Scots Parliament. John Knox.
1561 Mary queen of Scots returns from France to her own dominions. Persecution of the Dutch and Flemish Protestants by Philip II. of Spain; the cause (in 1566) of a war in the Low Countries.
1562 Religious war rages in France. Battle of Dreux.
1563 The Protestants obtain toleration.
1564 The Turks fail in an attempt to take Malta.
1565 Marriage of the queen of Scots to Lord Darnley. Catholic or Holy League of Bayonne negotiated.
1566 Revolt of the Low Countries from Philip II. His governor (Duke of Alva) commits great cruelties. Flemish refugees establish manufactures in England.
1567 Religious war in France renewed. Battle of St Denis. Lord Darnley murdered. A resignation of the crown is extorted from Mary; her son is proclaimed king (James VI.), and the Earl of Murray appointed regent. Solomon Isles discovered by Mendana.
1568 Battle of Langside. Mary escapes into England; is put under restraint by Elizabeth. Philip II. employs the inquisition to exterminate the Moors in Spain.
1569 The Regent Murray assassinated. French Protestants defeated at Jarnac and Moncontours.
1570 Treaty of St Germain en Laye. The French Protestants obtain an amnesty, liberty of conscience, and other privileges. Queen Elizabeth excommunicated by the pope.
1571 The Turks conquer Cyprus; are defeated in the naval action of Lepanto.
1572 Massacre of St Bartholomew. The Brille taken by Flemish privateers (the Gueux).
1573 Siege of Haarlem. Requesens succeeds Alva in the Low Countries. Siege of Rochelle. Toleration granted to the French Protestants.
1574 Henry III. king of France. Africa invaded by Don Sebastian, king of Portugal. Siege of Leyden.
1576 The Catholic league in France formed against the Protestants. Frobisher's Straits discovered by Sir Martin Frobisher.
1578 Elizabeth supports the insurgents in the Low Countries. The Spaniards are defeated at Rimenant.
1579 Union of Utrecht. Battle of Alcagar; king of Portugal slain.
1581 Philip II. takes possession of Portugal. The world circumnavigated by Sir Francis Drake. Parish registers kept in England.
1582 Raid of Ruthven; James VI. seized by the Earl of Gowrie. Reformation of the calendar by Pope Gregory XIII.
1584 William Prince of Orange murdered. Siege of Antwerp by the Duke of Parma. Virginia discovered by Sir Walter Raleigh. Tobacco used in England.
1586 Babington's conspiracy against the life of Elizabeth.
1587 Mary Queen of Scots beheaded. French Protestants defeat the army of the league at Coutras. Davis' Straits explored by John Davis.
1588 Spanish Armada sent to invade England.
1589 Henry III. joins the Protestants under the king of Navarre; besieges Paris; is assassinated. Henry IV. (of Navarre) king of France. Coaches first used in England.
1590 Henry obtains aid from England; defeats the army of the league at Ivri. Telescopes first made.
1591 Elizabeth re-endows the University of Dublin.
1594 Earl of Tyrone's rebellion in Ireland. Falkland Isles discovered by Hawkins.
1595 The Dutch establish factories in Java.
1597 Watches brought to England from Germany.

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1598 Edict of Nantes in favour of the French Protestants. Reduction of Cadiz by an English armament. Peace of Vervins between France and Spain. Philip III. king of Spain.

1599 Eastern possessions of Spain and Portugal seized by the Dutch. Earl of Essex sent to suppress Tyrone's insurrection in Ireland.

1600 Gowrie's conspiracy in Scotland. English East India Company established. Battle of Nieuport. Thermometer.

1601 Ostend invested by the Archduke Albert.

1602 Decimal arithmetic invented at Bruges.

1603 Union of the Crowns of England and Scotland, James VI. of Scotland becoming king of Great Britain.

1604 Ostend reduced by Spinola.

1605 Gun-powder plot.

1606 English colonies settled in Virginia and New England.

1608 Galileo constructs telescopes; discovers the satellites of Jupiter; spots; rotation of the sun.

1609 Spain acknowledges the independence of the United Provinces. Evangelical union and Catholic league formed in Germany.

1610 Henry IV. murdered by Ravaillac. Louis XIII. king of France. Hudson's Bay discovered.

1611 Baronets first created in England by James I. Smolensko seized, and Moscow burnt by the Poles.

1614 Logarithms invented by Napier of Merchiston. New river brought to London by Sir Hugh Middleton.

1616 The English establish factories in Amboyna, Banda, &c. Baffin's Bay discovered. Cape Horn.

1617 Family compact of the Emperor Mathias; alarming to the evangelical union.

1618 Beginning of the Thirty Years' War.

1619 Ferdinand II. emperor of Germany. Circulation of the blood discovered by Dr Harvey. Vanini burnt at Toulouse for atheism.

1620 Battle of Prague. Elector Palatine loses his dominions. Catholicism forced upon the Protestants of Bearn. The French reformers take arms with the intention of establishing a republic. The English make a settlement at Madras.

1621 Philip IV. king of Spain. Batavia built by the Dutch. The English House of Commons claim unlimited freedom of debate; beginning of the disputes concerning privilege and prerogative.

1623 Knights of Nova Scotia instituted by James I. Peace between Louis XIII. and his Protestant subjects. Edict of Nantes confirmed.

1624 Massacre of the English settlers in Amboyna by the Dutch.

1625 Charles I. king of Great Britain. Barbadoes colonized by the English.

1626 League of the Protestant princes of Germany against the emperor. War between Louis XIII. and his Protestant subjects renewed; the latter supported by England. Richelieu. Buckingham.

1627–8 Siege of Rochelle. English Bill of Rights.

1629 France and (1630) Sweden join the enemies of the emperor.

1631 Battle of Leipsic; Imperialists defeated. Description of the Vernier published.

1632 Battle of Lutzen; Gustavus Adolphus slain Christina queen of Sweden. English non-conformists emigrate in great numbers to North America, and form many settlements.

1632 to 1697 The Buccaneers wage implacable war with the Spaniards in America.

1634 Battle of Nordlingen. Evangelical union disposed to peace.

1635 Treaty of Prague. Sweden and France continue the war. French academy instituted.

1637 Ferdinand III. emperor of Germany.

1638 Bagdad taken by the Turks.

1639 The Scottish Covenanters take arms in defence of Presbytery. Reflecting telescope constructed by Mersenne.

1640 John, duke of Braganza, recovers the kingdom of Portugal. Long Parliament assembled.

1641 Earl of Strafford beheaded. Irish rebellion; massacre of the Protestants in Ulster.

1642 Civil war between Charles I. and the Long Parliament. Battle of Edgehill. Van Diemen's Land and New Zealand discovered by Tasman.

1643 Louis XIV. king of France. Anne of Austria regent. Battle of Rocroi. Solemn league and covenant between the English and Scottish parliaments. Friendly Islands; Tasman. Barometer; Torricelli.

1644 The Tartars subdue China. Battle of Marston Moor.

1645 Execution of Archbishop Laud. Battle of Naseby.

1646 Royalist force completely broken; Charles surrenders to the Scottish army; civil war ended.

1648 Peace of Westphalia. War of the Fronde at Paris. Exclusion of Presbyterians from the House of Commons (Pride's Purge). Rump Parliament.

1649 Charles I. beheaded. Monarchy abolished in England. Commonwealth. Prince of Wales assumes the title of Charles II. The Covenanters declare him king of Scotland. Cromwell storms Drogheda and Wexford; 1650, defeats Charles at Dunbar; and 1651, at Worcester. Commonwealth recognised by every dependence of the British kingdoms, and by foreign states.

1651 Office of stadtholder abolished by the Dutch. English act of navigation passed.

1652 First war between the English and Dutch.

1653 Dissolution of the Rump Parliament by Cromwell.

—— and 1654 The Dutch defeated in several naval actions.

1654 End of the commonwealth of England. Cromwell lord protector.

1655 Persecution of the Waldenses. Cromwell joins France in a war against Spain. Jamaica reduced by Penn, an English admiral. Blake destroys the shipping in the harbours of Tunis and (1657) Santa Cruz. Fourth satellite of Saturn discovered by Huygens. Pendulum clocks made.

1656 Frederick William, elector of Brandenburg, procures a recognition of the independence of Prussia.

1658 Spaniards totally defeated near the Downs. Dunkirk taken and delivered to the English. Richard Cromwell lord protector of England. Copenhagen besieged by Charles X. of Sweden.

1659 Peace of the Pyrenees between France and Spain. Richard Cromwell resigns his office. Rump Parliament re-assembles. Micrometer; Huygens.

1660 Charles II. restored to the throne of Great Britain. Peace of Oliva between Sweden, Denmark, and Poland.

1661 Sir Henry Vane, the Marquis of Argyle, and others, executed for treason.

1662 Act of uniformity passed by the English Parliament; two thousand clergymen in one day resign their benefices. Dunkirk sold back to the French. Royal Society of London instituted.

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1663 Carolina planted. Bombay taken by the English. French academy of inscriptions instituted.

1664 to 1667 Second Dutch war. Many naval actions fought; success various.

1665 Charles II. king of Spain. Great plague in London. Rotation of Jupiter, Mars, and Venus, observed by Cassini.

1666 Great fire of London. Tea first imported into England. The academy of sciences instituted in France. The Covenanters defeated on Pentland Hills.

1667 Peace of Breda; end of second Dutch war. Louis invades the Spanish Netherlands. Triple alliance.

1668 Peace of Aix la Chapelle.

1669 Candia taken by the Turks. *Cabal* administration in England. Secret treaty with France against Holland.

1670 English Hudson's Bay Company incorporated.

1671 The Danes seize the island of St Thomas. Fifth satellite of Saturn discovered by Cassini.

1672 Louis and Charles unite against the Dutch. Naval action of Southwold. Louis overruns the greater part of the seven United Provinces. Office of stadtholder restored.

1673 Catholics excluded from office in Britain by the test act. Spain and Germany support the Dutch. French evacuate the United Provinces.

1674 Separate treaty concluded between Great Britain and Holland. Louis continues the war alone. Battle of Seneffe. John Sobieski king of Poland.

1674–5 Palatinate devastated by Turenne.

1676 Charles concludes a secret treaty with Louis; becomes a pensioner of France. Carolina colonized by the English.

1677 War between Russia and Turkey. Marriage of the Princess Mary, presumptive heiress of the British crown, to the Prince of Orange.

1678 A British force is raised to assist the Dutch, but immediately disbanded, through the influence of French gold over the king and House of Commons. Peace of Nimeguen. Popish plot.

1679 Habeas Corpus act passed by the parliament of England. Rising of the covenanters in the west of Scotland. Battle of Bothwell Bridge. Whig and Tory become party names.

1680 Bill for excluding the Duke of York (because a papist) from the succession passed by the Lower and rejected by the Upper House. Pennsylvania colonized.

1682 Peter the Great czar of Muscovy. Charters of London and other towns seized by Charles.

1683 Rye-House plot. Execution of Lord Russell and Algernon Sydney. Turks defeated before Vienna by John Sobieski.

1684 Louis XIV. acquires Strasburg and Luxemburg.

1685 James II. king of Great Britain. Louis XIV. revokes the edict of Nantes. Duke of Monmouth invades the west of England. James suspends the test act.

1686 Newtonian philosophy published. Air-pump. League of Augsburg against France.

1687 Expulsion of the president and fellows of Magdalen College, Oxford.

1688 Declaration of general indulgence issued by James. Prosecution of the primate and six bishops. Union of all parties in defence of the constitution. Prince of Orange lands in England. James escapes to France. The Revolution.

1689 English and Scottish conventions settle the British crown on William and Mary, 13th February. Act of toleration. Presbytery established in Scotland. Battle of Killicrankie; death of Dundee. Siege of Londonderry.

1690 Battle of the Boyne. The English establish themselves at Calcutta.

1691 Treaty of Limerick. Ireland renounces the authority of James.

1692 Massacre of Glencoe. Battle of La Hogue. Reduction of Namur by the French. Battle of Steinkirk. Hanover made an electorate.

1693 Funding system commenced. Bank of England established.

1694 Triennial bill. Death of Queen Mary.

1695 Namur retaken by William.

1697 Peace of Ryswick. Peter the Great defeats the Turks and takes Azoph. Charles XII. king of Sweden. Prince Eugene defeats the Turks at Zenta.

1698 England, Holland, and France, concert a secret treaty for the partition of Spain on the death of Charles II. Charles makes a will in favour of the Elector of Bavaria.

1699 Peace of Carlowitz between the Christian powers and Turkey. Scots plant a colony at Darien. Death of the Elector of Bavaria.

1700 Second partition treaty. Will of Charles in favour of the Duke of Anjou, second son of the Dauphin. Poland, Denmark, and Russia, form an alliance against Sweden. Charles XII. takes Copenhagen. Academy of Berlin. New Britain discovered by Dampier.

1701 Succession to the crown of Great Britain settled on the Princess Sophia of Hanover and her protestant heirs. Death of Charles II. of Spain. Duke of Anjou proclaimed by the title of Philip V. The emperor disputes his claim, and takes the field in Italy. Grand alliance. Battle of Narva; the Russians defeated by Charles XII. Death of James II. His son acknowledged king of Great Britain by Louis. England joins the grand alliance. War of the Spanish succession.

1702 Anne queen of Great Britain. Marlborough commander-in-chief of the allied army in Flanders. Battle of Friedlingen; the imperialists defeated. Spanish and French fleet destroyed in the harbour of Vigo. Charles XII. takes Warsaw; defeats Augustus, king of Poland, at Clissaw; enters Cracow. French send colonies to the Mississippi.

1703 Duke of Savoy and king of Portugal join the grand alliance. Villars defeats the imperialists at Hochstet. Archduke Charles assumes the title of king of Spain. Charles XII. defeats Augustus at Pultusk. St Petersburg founded.

1704 Battle of Blenheim. Gibraltar taken; French fleet defeated off Malaga by Sir G. Rooke. Augustus dethroned, and Stanislaus Leczinski chosen king of Poland.

1705 Joseph I. emperor of Germany. The Archduke Charles, supported by a British armament, reduces Valencia and Catalonia. The Russians, entering Poland, are defeated and driven beyond the Dnieper by Charles XII.

1706 Battle of Ramillies. Siege of Turin; raised by Prince Eugene. Madrid taken by the English and Portuguese; retaken by Philip. Majorca and Ivica reduced by a British fleet. Battle of Frauenstadt; Russians and Saxons defeated. Augustus acknowledges Stanislaus as king of Poland.

Chronology.

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1707 Legislative union of England and Scotland finally arranged (March 6). Italian dominions of Spain subdued by the allies. Battle of Almanza; the allies defeated. The French carry war into Germany; penetrate to the Danube. Siege of Toulon.

1708 The Pretender makes a fruitless attempt to enter the Forth with a French armament. Battle of Oudenarde. Siege of Lisle. Sardinia and Minorca reduced by the British. Charles XII. invades Russia.

1709 Louis XIV. offers the whole Spanish dominion to the house of Austria, and large concessions to the other allies; these proposals rejected. Siege of Mons. Battle of Malplaquet; the French defeated, and Mons taken. Battle of Pultowa; king of Sweden defeated by the czar. Augustus restored to the throne of Poland.

1710 Conferences of Gertruygdenberg. Douay, Aire, and other places within the French frontier reduced. Battle of Almenara. The allies again at Madrid, and again obliged by the French and Spaniards to retire. Trial of Dr Sacheverel. Change of the English ministry. Intrigues in favour of the Pretender; abetted by the queen. The czar conquers Carelia and Livonia. St Paul's Cathedral rebuilt.

1711 Charles, competitor with Philip for the crown of Spain, becomes emperor of Germany. Secret treaty negotiated between the French and English Courts. Creation of British peers to support the measure. The czar invades Turkey. Concludes (to save his army from destruction) a disadvantageous treaty with the Porte. English South Sea Company incorporated.

1712 The Duke of Ormond supersedes Marlborough; separates the British from the allied forces. The French retake Douay and other towns.

1713 Treaty of Utrecht signed 31st March. Hostilities continued by the emperor alone. Landau, Freyberg, and other towns reduced by the French. Pragmatic sanction.

1714 Treaty of Rastadt. George I. (elector of Hanover) king of Great Britain. Louis XV. king of France; Duke of Orleans regent. Peter the Great defeats the Swedes at Sea; subdues the isle of Oeland.

1715 An army of Prussians, Danes, and Saxons, besieges Stralsund; the defence conducted by Charles XII. Rebellion in Scotland. Battle of Sheriffmuir. The Turks take the Morea from the Venetians. Compensation pendulum; Graham.

1716 Charles XII. invades Norway. Bill for Septennial parliaments passed by the British legislature. Emperor supports Venice against Turkey. Battle of Peterwaradin; the Turks defeated.

1717 Prince Eugene invests Belgrade; defeats the Turkish army; takes the town.

1718 Peace of Passarowitz. Turkey retains the Morea. Quadruple alliance. England attacks Spain by sea, France by land. Charles XII. falls at the siege of Fredericksball: his death followed by a cessation of arms among the northern powers.

1719–20 Mississippi scheme in France. South Sea scheme in England.

1720 Philip of Spain accedes to the terms of the quadruple alliance. Treaties of peace concluded by the sovereigns of Hanover, Sweden, Prussia, and Denmark. Duke of Savoy becomes king of Sardinia. Inoculation practised in England.

1721 George I. supports Sweden against Russia. Treaty of Nystadt. Peter assumes the title "Emperor of Russia." Ruin of the South Sea scheme. Great mercantile distress in Britain.

1722 Peter the Great supports the schah of Persia against the Afghans; obtains the cession of three provinces on the shores of the Caspian. Jacobite conspiracy in favour of the Pretender defeated.

1723 Duke of Orleans, regent of France, dies.

1724 Philip V. resigns the crown of Spain to his son Louis; resumes it after his son's death. Academy of sciences of St Petersburg instituted.

1725 Catherine empress of Russia. Treaty of Vienna between the emperor and the king of Spain; and of Hanover between France, England, Holland, Prussia, Denmark, and Sweden, in opposition to the former.

1726 A British fleet sent to blockade Porto Bello.

1727 Siege of Gibraltar by the Spaniards. Congress of Soissons. George II. king of Great Britain. Peter II. emperor of Russia.

1728 Treaty between Great Britain and Holland. Books printed at Constantinople. Behring Strait discovered.

1729 Peace of Seville concluded between France, Spain, and Great Britain. Corsica revolts from the Genoese. Rise of methodism in England; John Wesley.

1730 The Persians under Kouli Khan defeat the Turks. Aberration of the fixed stars observed by Dr Bradley. Fahrenheit's thermometer.

1731 Treaty of Vienna. Pragmatic sanction guaranteed by the parties to the peace of Seville. Don Carlos, son of Philip V., succeeds to the duchies of Parma and Placentia.

1732 Culture of coffee introduced by the English into their American settlements.

1733 Death of Augustus II. War for the crown of Poland. Stanislaus the ex-king supported by France and Spain; the elector of Saxony by the emperor and Russia.

1734 The French and their allies take Philipsburg; possess themselves of Naples and Sicily; defeat the imperialists at Bitonto, Parma, Guastalla. Treaty of commerce concerted between Great Britain and Russia.

1735 Preliminaries of a treaty (Vienna) settled between the courts of Paris and Vienna—Stanislaus to resign Poland and obtain the duchy of Lorraine—the Duke of Lorraine, Tuscany—Don Carlos, the kingdom of the Two Sicilies, in exchange for Parma and Placentia.

1736 Empress of Russia (Anne) commences hostilities against Turkey; reduces Azoph; ravages the Crimea. Kouli Khan seizes the throne of Persia; takes the name "Nadir Schah." Porteous mob at Edinburgh.

1737 Ockzakoff taken by the Russians.

1738 Definitive treaty of Vienna, between France and Germany. The emperor joins Russia against Turkey. Nadir Schah subdues Candahar.

1739 The Turks defeat the imperialists in Hungary; conclude an advantageous peace with Germany and Russia. Convention of Prado. War between Great Britain and Spain. Reduction of Porto Bello.

1740 Frederick III. (the Great) king of Prussia. Death of the emperor Charles VI. Pragmatic sanction, securing the hereditary dominions of Austria to

Maria Theresa, daughter of Charles, disregarded. War of the Austrian succession.

1741 Battle of Molwitz; Frederick defeats the Austrians; receives the submission of Silesia. The elector of Bavaria claims Bohemia and the imperial crown; gains the support of France; carries Prague by assault; is crowned king of Bohemia. British parliament grants a subsidy to Maria Theresa. Sweden declares war against Russia; battle of Wilmanstrand. Siege of Carthagena. Expedition to the South Sea under Commodore Anson.

1742 Elector of Bavaria chosen emperor (Charles VII.). British army sent into the Netherlands to support Maria Theresa. The Austrians recover Linz; take Munich. Battle of Czaslau. Peace of Breslau between Austria, Prussia, and Poland. Retreat of the French and Bavarians; siege of Prague. Convention of Turin between Austria and Sardinia. Austrian dominions in Italy attacked by Spain; with little success.

1743 French driven from the Palatinate. Battle of Dettingen. French defeated by the British. Treaty of Worms between Austria and Sardinia. Family compact; France and Spain. Peace of Abo; Russia and Sweden. War between Nadir Schah and Turkey. Society of Sciences of Copenhagen. University of Erlangen.

1744 Invasion of England, in favour of the Pretender, attempted by France. War declared between France and England. French and Spaniards overrun Savoy. Treaty of Frankfort between France and Prussia.

1745 Death of Charles VII.; his son Maximilian Joseph consents to guarantee the pragmatic sanction, and concludes peace with Maria Theresa. France and Spain continue the war. Battle of Fontenoy. Francis duke of Tuscany (husband of Maria Theresa) chosen emperor. Treaty of Dresden; internal peace of Germany restored. Prince Charles Edward, grandson of James II. lands in Scotland; takes Edinburgh; defeats the king's army at Prestonpans; marches into England. Habeas corpus act suspended; militia called out. Duke of Cumberland takes the command of the army. The prince retreats into Scotland.

1746 Siege of Stirling castle. Battle of Culloden. The rebellion entirely suppressed. Flanders, Brabant, and Hainault subdued by the French. Battle of Roucoux gained by the French, and of St Lazaro by the Austrians. Ferdinand VI. king of Spain. Genoa garrisoned by Austrians; the garrison expelled by the Genoese. Madras reduced by the French.

1747 Neutral territory of the United Provinces invaded by the French. Prince of Orange (William IV.) declared stadtholder, and hostilities commenced with France. Battle of Val; allies under the Duke of Cumberland defeated. Bergen-op-Zoom taken by the French. Siege of Genoa. French defeated at sea; off Cape Finisterre by Admiral Anson; off Belleisle by Admiral Hawke. Nadir Schah assassinated.

1748 Pondicherry in the East, Cuba and Hispaniola in the West Indies, attacked by British armaments. Siege of Maestricht. Peace of Aix-la-Chapelle, between Great Britain, France, Spain, Austria, Sardinia, and Holland.

1749 Kingdom of Afghanistan founded by Achmet Abdallah, a general of Nadir Schah. League of the Pope, Venetians, &c. against Algiers. English and French in the East Indies take opposite sides in a contest of native princes for the nabobship of Arcot.

1750 Treaty of Copenhagen between Sweden and Denmark concerning Holstein. Commercial treaty between Great Britain and Spain. Academy of Sciences at Stockholm. Royal Society of Gottingen. Westminster Bridge finished.

1751 Siege of Arcot. Captain Clive. Death of Frederick Prince of Wales.

1752 New style adopted in Britain; September 2d reckoned September 14th.

1753 Hostilities in India continued; advantage generally on the British side. British Museum established.

1754 The French (having connected Canada and Louisiana by a chain of forts) attempt to circumscribe the British American colonies; attack Nova Scotia and Virginia. War in India concluded; non-interference with native governments a stipulation of the treaty.

1755 Armaments sent by Great Britain and France to support their respective American colonies. Expeditions of General Braddock against the French posts on the Ohio, of Sir W. Johnson against Crown Point, of General Shirley against Niagara,—all unsuccessful. Maritime commerce of France distressed by British cruizers. Treaty between George II. and Russia for defence of Hanover. Foundation of the Burman empire in the eastern peninsula of India. Destruction of Lisbon by an earthquake.

1756 Kings of Britain and Prussia conclude a treaty for the exclusion of foreign troops from Germany; Austria, Russia, Sweden, and France, another for the partition of Prussia. Minorca attacked by the French. Declaration of war between Great Britain and France. Militia bill; rejected by the Peers. German mercenaries brought to defend Britain from invasion. Admiral Byng attempts to relieve Minorca; fails; the island submits. Calcutta taken by the Soubahdar of Bengal; garrison thrust into the *Black Hole;* 123 die of suffocation. King of Prussia invades Saxony (beginning of the Seven Years' War); takes Dresden; enters Bohemia; defeats the Austrians at Lowositz. William Pitt prime minister of George II.

1757 Admiral Byng tried for misconduct off Minorca; shot. French troops pass the Rhine to invade Hanover. Pitt, opposing British interference with the affairs of Germany, is dismissed from office. Duke of Cumberland sent to defend the electorate. Battle of Reichenberg; the Austrians, repulsed by the Prussians, retreat to Prague. Battle; siege of Prague; battle of Colin; siege raised. Memel taken by the Russians. Duke of Cumberland repulsed and driven from the electorate. Convention of Closter-Seven. Pitt reinstated. Frederick gains the battles of Rosbach and Lissa; the Russians return home. The Hanoverians rise against the French. Colonel Clive recovers Calcutta; defeats the Soubahdar of Bengal at Plassy; lays the foundation of the British power in India.

1758 The Hanoverians drive the French across the Rhine. Britain and Prussia engage not to treat but in concert, and the former grants the latter a large subsidy. Battle of Crevelt; the French defeated by Prince Ferdinand of Brunswick. Battle of Sangershausen; the prince defeated. Frederick en-

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ters Moravia; invests Olmutz; raises the siege to oppose the Russians; defeats them at Zorndorff; is defeated at Hochkirchen by the Austrians; expels them from Silesia and Saxony. The works of Cherburg demolished; islands of Cape Breton and St John on the coast of America, and French settlements on the coast of Africa, reduced by British armaments. Achromatic telescope; Dollond.

1759 Frankfort on the Maine (a neutral city) seized by the French. Battle of Minden; French defeated by Prince Ferdinand. The Russians enter Silesia; defeat Frederick at Cunersdorff. Guadaloupe reduced. Battle of Quebec; death of General Wolfe; surrender of Quebec. British gain advantages in the East Indies; take Surat. French fleet under Conflans, destined for the invasion of Britain, destroyed by Admiral Hawke; another, under Thurot, pillages Carrickfergus; is captured off the Isle of Man (February 1760).

1760 Three armies, Austrian, Russian, and Swedish, surround Frederick at Lignitz; he defeats the Austrians, and prevents their junction. The Russians pillage Berlin. Battle of Torgau; the Austrians again defeated. Siege of Quebec by the French; raised. Province of Canada submits to Britain. Siege of Pondicherry. George III. king of Great Britain.

1761 Pondicherry taken; French power in India destroyed. Negotiations for a general pacification opened at London and Paris. Belleisle reduced by a British armament. Family compact of the Bourbons; Pitt proposes instant war with Spain; resigns; Earl of Bute succeeds as premier. Negotiations broken off.

1762 War declared by the courts of London and Madrid. Spaniards invade Portugal; are expelled by British assistance. Peter III. emperor of Russia: he concludes an offensive and defensive alliance with Sweden, a peace with Prussia. Catherine II. empress of Russia; adheres to the peace, but withdraws her troops. The West India islands belonging to France, the town of Havannah, with a great part of Cuba, and the Philippine Islands, belonging to Spain, subdued by British armaments. Preliminaries of a treaty signed at Fontainbleau (November 3).

1763 Treaties of Paris and Hubertsburg; France cedes to Britain Canada, Cape Breton, St Vincent, Tobago, and the coast of Senegal; Spain cedes Florida; Prussia and Austria mutually restore conquests; end of the Seven Years' War. Parliaments of Paris, Rouen, &c. declare against the arbitrary imposition of taxes. Grenville administration formed. Wilkes expelled from the House of Commons.

1764 Stanislaus Poniatowski king of Poland. Byron's voyage.

1765 British government suggests the taxation of the North American colonies. Stamp act. Opposition of the colonies. Rockingham administration.

1766 Repeal of the stamp act. Grafton administration. Civil war in Poland arising out of religious differences. Death of James Stuart, son of James II.

1767 Jesuits banished from Spain and the Indies, Naples and Sicily. British government imposes new taxes on the American colonies. Russia and Prussia interfere in the domestic broils and government of Poland. Otaheitê discovered by Wallis.

1768 Riots at Boston in North America. Corsica ceded by Genoa to France. War between Russia and Turkey, arising out of the interference of the former in the affairs of Poland. Royal Academy established. Voyage of Bougainville.

1769 House of Commons annul the votes of the Middlesex electors. Wilkes. Luttrel.

1770 Dispute between Britain and Spain respecting the Falkland Islands; compromised without honour to Britain (1771). Russians send an armament into the Mediterranean; obtain a footing in the Morea; destroy Turkish fleet off Scio; subdue Moldavia and Wallachia. Blackfriars Bridge finished.

1771 House of Commons issue an order for the apprehension of the printers and publishers of certain parliamentary debates. Crosby, lord mayor, and Oliver, an alderman of London, resisting the execution of the order, are sent to the Tower by command of the house. From this period the proceedings in both houses of Parliament have been regularly reported in the newspapers. Members of the parliament of Paris deprived of their offices, and banished to different parts of the country. Turks defeated near Bucharest, and in the Crimea. Cooke's first voyage.

1772 Treaty between Russia, Prussia, and Austria, for the partition of Poland. British American colonies claim the sole right of legislating for themselves.

1773 First partition of Poland. Society of the Jesuits suppressed in France. Constitution of the British East India Company settled by act of Parliament, on nearly the existing basis. Assembly of Massachusetts Bay pass a resolution against the importation of tea; a quantity thrown into the sea at Boston.

1774 Peace of Kainargi; the Crimea independent; Russian frontier advanced into Turkey. Port of Boston closed by act of Parliament. Congress of twelve provinces at Philadelphia. Louis XVI. king of France. New Caledonia discovered by Cook.

1775 War of American independence. Battle of Bunker's Hill. General congress of thirteen provinces. Washington commander in chief. Louis XVI. restores the parliament of Paris. Spain engaged in war with the Moors and Algerines.

1776 The United States of North America declare themselves independent (July 4). Philosophical administration in France.

1777 Capitulation of General Burgoyne at Saratoga. Alliance between France and Switzerland.

1778 To prevent an alliance between the American colonies and France, the British government offer to concede the right of self-taxation to the colonial assemblies—without effect: the alliance is concluded. A British fleet is sent to cruise against the French. War of the Bavarian succession; Austria and Prussia the belligerents. Sandwich Islands discovered by Cook.

1779 Treaty of Teschen between Austria, Prussia, and Bavaria. Spain joins France in the war against Britain. Islands St Vincent and Grenada reduced by the French. Holland refuses Britain the assistance stipulated by treaty 1678. Captain Cook killed at Owhyhee.

1780 War in India with the Mahrattas and Hyder Ali. Riots in London; Lord George Gordon. South Carolina reduced. The Americans defeated at Camden. Spanish fleet defeated off Cape St Vincent, and French in the American seas, by Rodney. Armed neutrality; Russia, Denmark,

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Sweden, Holland, Portugal, German and Italian States, the parties. War declared against Holland.

1781 St Eustatia and the colonies of Berbice, Essequibo, and Demerara taken from the Dutch. Jersey invaded by France. Gibraltar besieged by Spain. Minorca reduced by the French and Spaniards; Tobago by the French. Army of Cornwallis surrenders to Washington. Planet Uranus discovered by Herschell.

1782 House of Commons condemns the American war. Rockingham; Shelburne administration. Ireland declared independent of the British parliament. St Christophers reduced by the French. Their fleet defeated by Rodney. Floating batteries employed against Gibraltar destroyed by General Elliot. Tippoo Saib, son of Hyder Ali, continues the war in India. Revolutions attempted in Geneva and some of the Swiss cantons.

1783 Treaties of peace concluded between Great Britain and her enemies. Independence of the United States of America recognised. Washington president. The Crimea seized by Russia. Pitt administration.

1784 Peace concluded with Tippoo Saib. Board of control established for regulation of affairs of India.

1785 German league. Treaty of commerce negotiated with France; concluded in 1786.

1786 Death of Frederick the Great; Frederick William succeeds. Contest for power between the stadtholder and the pensionaries of several of the states of Holland. Sinking fund established for the extinction of the national debt of Great Britain. Impeachment of Warren Hastings.

1787 Civil war in Holland. The stadtholder obtains aid from Prussia; secures an extension of authority. First assembly of the notables of France, at Versailles. Turkey engaged in hostilities with Russia and Austria.

1788 Second assembly of the notables. The Swedes attack Russia; the Danes Sweden. Oczakoff taken from the Turks. Great Britain, Holland, and Prussia conclude a defensive alliance; compel Sweden and Denmark to abstain from hostilities. Prince of Wales regent for four months. Charles IV. king of Spain. Convict colony of Botany Bay founded. Death of Prince Charles Edward Stuart at Rome.

1789 Abolition of the slave trade proposed in the British parliament. The states-general of France meet at Versailles (May 5). French revolution. Constituent assembly. Bastille destroyed (July 14.) National guard instituted. Feudal privileges and tithes suppressed. Jacobin club. Insurrection in the Low Countries. Suwarrow defeats the Turks. The Austrians take Belgrade.

1790 France divided into eighty-three departments. Religious orders suppressed. Hereditary nobility abolished. Assignats. Civil constitution of the clergy. Belgic confederation at Brussels. Alliance of Prussia with Poland and Turkey. Peace of Werela between Russia and Sweden. Capture of Ismael by Suwarrow. The Austrians enter Brussels. War with Tippoo Saib renewed; concluded 1792.

1791 Flight; arrest of Louis XVI. He is conducted to Paris; accepts the constitution of 1791. Legislative assembly. Party of the Girondists. Convention of Pilnitz. The pope issues a bull against the civil oath of the French clergy. Peace of Szistowa between Austria and Turkey.

1792 France declares war against Austria. An Austrian and Prussian army invades France. Thuilleries attacked. Swiss guards massacred by an armed mob. Royal authority suspended (Aug. 10). Royal family imprisoned in the Temple (14). Massacre of the state prisoners at Paris (Sept. 2 and 3). Battle of Valmy. National convention. Abolition of royalty (21). Republic proclaimed. Battle of Jemappes. Savoy incorporated with the French republic. Peace of Jassy between Russia and Turkey. Disturbances in St Domingo. City of Washington founded.

1793 Execution of Louis XVI. (Jan. 21). First coalition against France. Reign of terror. Levy *en masse* of all Frenchmen between eighteen and twenty-five years of age. Toulon taken by the English. Christian religion abolished. New era introduced, to date from 22d Sept. 1792. Queen beheaded (Oct. 16). Toulon retaken from the English. Bonaparte. Second partition of Poland. Pondicherry reduced by the English.

1794 Fall of Robespierre. Struggle of the Poles against Russia. Kosciusko. Habeas Corpus act suspended. Telegraph invented. Victory of Lord Howe (June 1). Exchequer bills issued. American minister received at Paris. Retreat of the British army in Flanders. Battle of Praga; 30,000 Poles butchered by Suwarrow. Trial of John Horne Tooke. The Duke of York leaves the Continent. Missionary societies established in England.

1795 Battle of Fleurus. Occupation of Amsterdam by the French. Revolution in Holland; United Provinces dependent on France. Third and last partition of Poland between Russia, Austria, and Prussia. End of the elective kingdom of Poland. Peace of Basle between France and Prussia. Death of Louis XVII. in the Temple. Peace between France and Spain; St Domingo wholly yielded to the former. Martinique, St Lucia, Guadaloupe, Cape of Good Hope, Ceylon, taken by the English. Belgium and Liege united to the French republic. Insurrection of the 13th Vindemiaire (Oct. 5). Barras. Bonaparte. New Constitution. Councils of Ancients and Five Hundred. Executive Directory. Polytechnic School. National Institute of France. Mungo Park.

1796 Italian campaign of Bonaparte. Battles of Montenotte and Monte-lezino (April 14). King of Sardinia cedes Savoy and Nice to the republic. Battle of Lodi (May 10). Sovereigns of Naples and Parma make peace. Conquest of the Milanese. Cisalpine republic. Retreat of Moreau from the Danube. Paul emperor of Russia. War between England and Spain (Oct. 5). Battle of Arcole (Nov. 15). Irish insurrection act. Lithography; Sennefelder.

1797 Mutiny in the British navy. Battle of Rivoli. Part of the papal territory ceded to France. Bonaparte traverses the Tyrol; subdues Carinthia, Styria, &c.; opens negotiations with the court of Vienna at Leoben (April 18). Successes of Hoche and Moreau on the Rhine; arrested by the negotiations. Venice revolutionized (May 12), and Genoa (21). Spanish fleet defeated off Cape St Vincent. Trinidad taken by the English. Treaty of Campo Formio (Oct. 7). French frontier extended to the Rhine. Dutch fleet defeated off Camperdown (Oct. 11). Britain menaced with invasion. Rebellion in Ireland.

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1798 Rome revolutionized (Feb. 15). The French sow discord in Switzerland. Geneva incorporated with France. Helvetic confederation. Batavian republic. Malta reduced, and Egypt invaded, by Bonaparte. Battle of Aboukir; Nelson; Brueys. Rebellion in Ireland continues; 1000 French troops land; are taken prisoners. Russia and Turkey unite against France. Vaccination; Jenner.

1799 Austria and Naples renew the war. Naples taken by the French. Forces of the republic under Jourdan, Massena, and Moreau, pressed by the Austrians and Russians in Switzerland, Germany, and Italy. Syria invaded by Bonaparte. Siege of Acre; Sir Sydney Smith. Defeat of the Turks at Aboukir (July 25). Return of Bonaparte to Europe. Capture of Seringapatam; fall of Tippoo Saib; partition of Mysore. Rome recovered by the allies. The English and Russians invade Holland; give up 8000 French prisoners to obtain a safe retreat (Oct. 18). French directory subverted. Bonaparte first consul (Nov. 10). Death of Washington.

1800 The Irish parliament vote for a legislative union between Great Britain and Ireland. Bill, to effect this, obtains the royal assent (July 2). Genoa taken by the Austrians. Battles of Montebello and (June 14) of Marengo. Prince of Parma made king of Etruria. Moreau penetrates into Bavaria. Battle of Hohenlinden. Republic of the seven Ionian Islands. First congress at Washington. Royal institution founded.

1801 Treaty of Luneville (Feb. 9); Austria makes further concessions to France. Malta taken by the English. Armed neutrality formed against Great Britain by Russia. Battle of Alexandria (March 21). Death of Abercromby. Alexander emperor of Russia (24). Addington administration. Danish fleet attacked before Copenhagen by Lord Nelson (April 2). Convention between Great Britain and Russia, Sweden, and Denmark (June 17). French troops in Egypt agree to evacuate the country (Sept. 2). Planet Ceres discovered by Piazzi.

1802 Peace of Amiens (March 27). Catholicism re-established in France. Bonaparte first consul for life (July 29.) French expedition against St Domingo; Toussaint L'Ouverture. First consul gives new constitutions to the French, Cisalpine, Ligurian, and Helvetian republics; regulates the internal arrangements of Germany. Legion of Honour instituted. Planet Pallas discovered by Olbers.

1803 Disputes between the courts of London and Paris (March). War renewed (May 16). Invasion threatened by France; preparations to repel it made in Britain. Insurrection in Ireland. The French reduce Hanover. England declares war against Holland. St Lucia, Tobago, Demerara, Essequibo, reduced by British armaments. St Domingo independent; Dessalines. Marquis Wellesley defeats the native powers of India. Concludes a treaty (Dec. 17), by which the British possessions are greatly extended. Treaty of neutrality between Great Britain and Sweden. Louisiana acquired by the United States of America.

1804 Conspiracy against the first consul. Duke D'Enghien seized in the territory of a neutral state (Baden), and shot. Mr Pitt resumes office (May 7). Bonaparte emperor of the French. The emperor of Germany assumes the style "Emperor of Austria." Ohio a state of the North American Union. Dessalines proclaimed emperor of Haiti. Planet Juno discovered by Harding.

1805 Spanish South American fleet destroyed by a British armament; war declared between the countries (Jan. 24). Impeachment of Lord Melville for misapplication of public money. Catholic claims debated. Napoleon crowned king of Italy at Milan (May 26). Genoa annexed to the empire (June 4). Coalition of Great Britain, Austria, and Russia, against France. Napoleon crosses the Rhine; compels General Mack, with 20,000 men, to surrender at Ulm (Oct. 20). Battle of Trafalgar (Oct. 21); the navies of France and Spain destroyed. Death of Nelson. The French enter Vienna (Nov. 13). Battle of Austerlitz (Dec. 2). Peace of Presburg (25). War with the Mahratta chief Holkar; siege of Bhurtpore; peace (Dec. 24); the Company's territory extended.

1806 Cape of Good Hope reduced by the English (Jan. 18). Death of Mr Pitt (23). Administration of Mr Fox and Lord Grenville. Slave trade restricted. Acquittal of Lord Melville. The Prussians take possession of Hanover. Joseph Bonaparte king of Naples. Louis Bonaparte king of Holland. British force lands in Calabria. Battle of Maida (July 4). Confederation of the Rhine (12). Death of Charles James Fox (Sept. 13). Negotiations for peace broken off. King of Prussia declares war against France (Oct. 9). Battles of Saalfeld, Jena, Auerstadt. Capture of Berlin. Conquest of Silesia. Invasion of Poland. Battle of Pultusk. "The Continental System" published at Berlin. British fleet sent into the Tagus. Christophe ruler of the black republic of Haiti.

1807 War between Russia and Turkey. England co-operates with the former; sends expeditions to the Dardanelles and Egypt. Act of parliament to abolish the slave trade sanctioned (March 25). Bill to remove Catholic disabilities brought forward by ministers; opposed by the king; change of administration. Duke of Portland. Battle of Eylau. Dantzic taken by the French (May 20). Battle of Friedland (June 14). Conference of the sovereigns of France, Russia, and Prussia, upon a raft in the Niemen (25). Peace of Tilsit (July 7). Jerome Bonaparte king of Westphalia. Bombardment of Copenhagen; surrender of the Danish fleet (Sept. 7). Invasion of Portugal by the French; the royal family embark for Brazil. French troops enter Spain; seize the strongest towns. Kingdom of Etruria annexed to the empire. Planet Vesta discovered by Olbers.

1808 A new French nobility created by Bonaparte (Jan.). Charles IV. of Spain resigns the sovereignty to his son Ferdinand (March 19). Napoleon compels the resignation of both (May 5). Joseph Bonaparte king of Spain. Murat king of Naples. Junta of Seville proclaim Ferdinand VII.; declare war against the French (May 29). Sir Arthur Wellesley in Portugal. Battles of Roleia and Vimeira (Aug. 21). Convention of Cintra (30). British army enters Spain. Battles of Durango, Espinosa, Tudela. Conference of Napoleon and Alexander at Erfurt; produces offers of peace to England. Napoleon joins the army in Spain. Madrid taken (Dec. 4). The British retreat.

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1809 Battle of Corunna; fall of Sir John Moore (Jan. 16). Convention between Spain and Great Britain. Duke of York's direction of the army the subject of parliamentary investigation. He resigns the office of commander-in-chief. Abdication of Gustavus IV. of Sweden; Charles XIII. king. Soult enters Portugal. Oporto taken. Battle of Medellin (March 19). Sir Arthur Wellesley opposes Soult; recovers Oporto. Emperor of Austria declares war against France (April 8); invades Bavaria; battle of Eckmuhl; capitulation of Vienna (May 13); Austrians repulsed in Italy; papal territory incorporated with the dominions of France (17). Battle of Essling (21 and 22); of Wagram (July 6); of Talavera (28). Insurrection in the Tyrol; Hofer. British expedition to Walcheren. Cayenne, Martinique, Ionian Islands, taken from France. War between Russia and Persia. Britain concludes treaties with Turkey and Persia. Peace of Vienna between France and Austria (Oct. 14). Defeat of the Spaniards at Ocana and Alba de Tormes. Mr Perceval prime minister. Jubilee.

1810 Sir Francis Burdett committed to the Tower by the House of Commons. Napoleon marries Maria Louisa, daughter of the emperor of Austria; dethrones his brother Louis; annexes the United Provinces to France (July 1). The United States of America prohibit all intercourse with Great Britain and France. Marshal Bernadotte chosen crown-prince of Sweden (Aug. 18). Massena reduces Ciudad Rodrigo and Almeida; battle of Busaco (Sept. 27). Meeting of the Spanish cortes (28). Siege of Cadiz. Isle of Bourbon, Mauritius, settlements in Madagascar belonging to the French, Amboyna and Banda, to the Dutch, reduced by British armaments. Mental derangement of George III. Prince of Wales regent.

1811 Massacre of the Mamelukes at Cairo (March 1). Massena commences a retreat from Portugal (5). Battle of Fuentes d'Honor; of Albuera (May 16). The Spanish American colonies refuse submission to the Cortes; claim independence. Java, with all its dependencies, reduced by the British. Riots at Nottingham.

1812 Ciudad Rodrigo stormed by Lord Wellington (Jan. 19). Constitutional code promulgated in Spain (March 20). Badajos stormed (April 6). Assassination of Mr Perceval (May 11). Administration of Lords Liverpool and Castlereagh. The United States declare war against Britain (June 18); invade Canada. Treaties of alliance; Russia with Sweden, with Great Britain, with the Spanish Cortes; of peace, with Turkey, the Pruth the frontier. War between France and Russia (June 24). Battle of Salamanca (July 22). Smolensko taken (Aug. 18). Battle of Borodino (Sept. 7). Entry of the French into Moscow (14); the city burnt by the inhabitants. Napoleon offers peace; retreats from Moscow (Oct. 22). Frost and the Russians destroy the French army.

1813 Prussia joins the enemies of France (Feb. 22). Napoleon enters Germany. Battle of Lutzen (May 2); of Bautzen (21 and 22); of Richenbach; truce (June 4); the French to occupy Silesia. Sweden and Austria join the allies. England contributes largely towards the expenses of the war. Battle of Vittoria gained by Lord Wellington (June 21). St Sebastian stormed (August 31). The allies resume hostilities with 180,000 men; Napoleon with as many. Battles of the Katzbach (August 26); Dresden (September 4 and 5), &c.; Leipsic (October 16, 18, 19). Bavaria joins the allies. Lord Wellington enters France (October 18). Battle of Hanau (October 30). Revolution in Holland (November 16). Prince of Orange restored (December 2). British trade to India partially opened.

1814 The allies invade France at different points; after many conflicts with various success, enter Paris (March 31). Bonaparte abdicates (April 11); embarks at Frejus for Elba (28). Louis XVIII. enters Paris (May 3); Ferdinand VII. Madrid (14). Peace of Paris between France and the allies (30), France reduced to her limits on the 1st January 1792. King of Spain suppresses the Cortes; re-establishes the Inquisition, Jesuits' College, &c. Norway united to Sweden (August 14). City of Washington taken by the British (24). Congress of Vienna (September 26); Belgium united to Holland. Hanover a kingdom. Peace of Ghent between Great Britain and America (December 15).

1815 Congress of Vienna guarantees the integrity of the twenty-two Swiss cantons; issues a manifesto against Bonaparte on his return to France. Bonaparte leaves Elba (February 26); lands at Cannes (March 1); enters Paris (21). Britain, Russia, Austria, Prussia, bind themselves to bring 150,000 men each into the field against Bonaparte (25). Murat attacks the Austrians; loses the battle of Tolentino (May 3), and the kingdom of Naples (20). The three legations restored to the Pope (29). Bonaparte leaves Paris (June 10) to oppose the allies. Conflicts at Charleroi, Quatre Bras, Ligny (15, 16, 17). Battle of Waterloo (18). Bonaparte abdicates in favour of his son (24). The allies enter France. Capitulation of Paris (July 3). Return of Louis XVIII. to the capital (8). Bonaparte surrenders to Captain Maitland, H. B. M. S. Bellerophon (15). Ney, Labedoyere, shot. Holy alliance concluded (September 26). Bonaparte at St Helena (October 13). Ionian republic established (November 5). New treaties, providing for the military occupation of France by foreign troops for five years, and further contracting the French frontier, concluded between the allies and Louis XVIII. (November 20). Congress of Vienna adjusts the boundaries of the states formerly dependent on the French empire; fixes the federative constitution of Germany.

1816 Majority of thirty-seven in the House of Commons against the property-tax (March 19). Princess of Wales married to Prince Leopold of Saxe-Coburg-Saalfeld (May 2). Bombardment of Algiers by Lord Exmouth (August 27). Declaration of South American independence issued at Buenos Ayres. Duke of Cambridge governor-general of Hanover (Nov. 2). Distress; riots in England. Spa Fields Mob (December 2).

1817 Habeas Corpus Act suspended (March 7). Insurrection at Nottingham. Convention between Louis XVIII. and the pope; privileges of the Gallican church secured. Spain disturbed, and Portugal threatened with popular tumults. Waterloo Bridge opened (June 18). Bolivar supreme chief of the government of Venezuela. Death of

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the Princess Charlotte (November 6). Pindarri war in India; ended (December 17).

1818 Habeas corpus suspension act repealed (January 31). Bernadotte king of Sweden (February 30). Censorship of the press enforced by Louis XVIII. France, Spain, and the Netherlands, agree to measures proposed by England for the suppression of the slave trade. Duke of Clarence marries the Princess of Saxe-Meiningen; Duke of Kent the Princess of Saxe-Coburg (July 13). A papal bull allows benefices in Spain to remain two years vacant, and yields the revenues to the service of the government (August 12). Congress of Aix-la-Chapelle (September 29). Army of occupation withdrawn from France (October 9). Death of Queen Charlotte (November 17).

1819 Southwark Bridge opened (March 26). Princess Victoria born (May 23). Radical reform meetings (June 23). Congress of Carlsbad (August 1). Manchester massacre (16). Chili, Buenos Ayres, Colombia, *de facto* independent. The "Six Acts" sanctioned by the British legislature. Spain cedes the Floridas to North America. New South Shetland discovered.

1820 Revolution in Spain; Constitution of 1812 proclaimed (January 1). Death of George III. (29). The king of Spain swears to the constitution; inquisition suppressed (March 8). Expulsion of the Jesuits from Russia (25). Revolution at Naples (May 15). Carbonari. Constitutional junta in Portugal (October 1).

1821 Revolution in Brazil (January 1). Congress of Leybach. Austrian army occupies Naples (8). Disturbances in Piedmont; the king resigns in favour of his brother (April 10). Death of Napoleon Bonaparte (May 5). Coronation of George IV. (July 19). Austrian troops occupy the kingdom of Sardinia (29). George IV. visits Dublin (August 17), and Hanover (October 10). Catholic bill lost in the House of Peers.

1822 The Greeks declare themselves free (January 1). The Prince Royal of Brazil institutes a representative government (February 16). Spanish Cortes meet at Madrid (March 1). The Greeks victorious at Larissa, Salonica, and Thermopylæ. The king of Portugal swears to the new constitution (October 1). Brazil independent; the Prince Regent proclaimed emperor (12). Congress of Verona (20). Great distress in Ireland. George IV. visits Scotland.

1823 Mediation of the holy alliance rejected by the cortes of Spain (January 9); removal of Ferdinand to Seville, thence to Cadiz (March 20). French army enters Spain (April 7), and Madrid (May 23). The king of Portugal suppresses the constitution (June 5). Cadiz invested by the French (25). Guatemala proclaims its independence (July 20). Battle of the Trocadero before Cadiz (August 31). Riego taken (September 15); executed at Madrid (November 27). Proceedings of the cortes from 7th March 1820 annulled; end of the Spanish revolution (October 1). Mexican constitution proclaimed (4). The government of Great Britain sends consuls to the new states of South America.

1824 The English troops defeated by the Ashantees (January 21). Bolivar dictator of Peru (February 10). Lord Hastings, the governor-general of India, declares war against the Burmese (March 5). Capture of Rangoon (May 5). The Ashantees driven from Cape Coast Castle (July 22). Charles X. king of France. Treaty between the United States and Colombia (Oct. 3). Provisional government in Greece (12). The Turks evacuate Moldavia (Nov. 23). Mechanics' Institutions formed. Union of the Scotch dissenters. Catholic rent.

1825 Great Britain concludes a treaty of commerce with the united provinces of Rio de la Plata (February 2). Mr Adams president of the United States of North America (9). Ibrahim Pasha invades Greece (26). Convention concluded between Russia and Great Britain for the freedom of navigation, commerce, and fishery on the Pacific Ocean, and the north-west coast of America (28). Independence of St Domingo confirmed by the king of France (April 17). Treaty between Great Britain and Colombia (18). Ibrahim Pasha defeats the Greeks near Forgi (19). Treaty between Great Britain and Mexico (April 29). Ports in the East Indies belonging to the Dutch opened to the ships of all nations (July 21). Resolution of the provisional government of Greece to have recourse to the protection of England (24). The provinces of Upper Peru declare their independence, and take the name of the Bolivian republic (August 6). Treaty of commerce and navigation concluded between Great Britain and the Hanse Towns (September 26). The Spaniards evacuate Mexico (November 18). Death of Alexander, emperor of Russia (December 1). General Campbell defeats the Burmese near Prome (1, 2, 5). Act against the Catholic association. Petitions against the Corn Laws. Joint stock company mania; Commercial distress; Failures.

1826 War between Brazil and Buenos Ayres (January 3). Bhurtpore stormed by the British troops under Lord Combermere. Sir A. Campbell defeats the Burmese near Malloun (20). Surrender of Callao (23); Peru evacuated by the Spaniards. Treaty of navigation between Great Britain and France (26). Peace concluded between the East India Company and the Burmese (February 24). Death of John VI. emperor and king of Portugal. Don Pedro grants the Portuguese a charter; confirms the regency (April 26); abdicates in favour of his daughter Donna Maria da Gloria (May 2). Treaty of navigation between Great Britain and Sweden (19). Departure of the Ottoman troops from Wallachia. Opening of the first congress of the Bolivian republic (25). Landing of the Greeks near Salonichi; battle with Omer Pasha (June 1). Importation of foreign silks into Great Britain permitted from June 5. Insurrection of the Janissaries at Constantinople. New organization of the Ottoman army. Defeat of the Janissaries; suppression of the corps (14, 15, 16). Convocation of a general congress in Chili to frame a constitution (15). Death of ex-presidents Adams and Jefferson on the fiftieth anniversary of the declaration of North American independence (July 4). The national congress constitutes Chili a confederative state (11). Ashantees defeated by the English (August 7). National assembly of Greece called together in the Isle of Paros (14). Bolivar president of Peru for life (19). Nicholas, emperor of Russia, crowned at Moscow (September 3). Russia declares war against Persia. Colombian flag admitted into

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French ports (September 28). The infant Don Miguel takes the oath of fealty to the Portuguese constitution at Vienna (October 4). Lotteries cease in England (18). Treaty between Great Britain and Brazil for the abolition of the slave trade. The Portuguese rebels take Lamego; Portugal entreats the assistance of Great Britain (Dec. 3). English troops arrive at Lisbon (25).

1827 Death of the Duke of York (January 5). The Duke of Wellington appointed commander-in-chief (22). Lord Liverpool becomes incapable of transacting public business (February 17). Subject of Catholic claims brought before the House of Commons by Sir Francis Burdett; majority against concession four (March 5, 6). Departure of the Hecla, Captain Parry, from Deptford, on the northern expedition (25). Mr Canning appointed first lord of the treasury (April 10); the Duke of Clarence lord high admiral (17). National guard of France disbanded by Charles X. (April 30). Unitarian marriage bill assented to by the House of Peers (June 26). Resolution of the Bank of England to discount bills at four per cent. (July 5). Death of Mr Canning (August 8). Lord Goderich appointed premier (11); Duke of Portland president of the council (17). Return of Captain Parry from the northern expedition (September 29). Battle of Navarino (October 20). French chambers dissolved; seventy-six new peers created (November 5). The bank of Lisbon suspends its payments (Dec. 7).

1828 Resignation of Lord Goderich (January 8). Duke of Wellington premier. British troops withdrawn from Portugal. Usurpation of Don Miguel. Finance committee appointed (February 15). Test and corporation acts repealed (26). Law commission appointed (29). Catholic relief bill rejected by the Upper House (January 9); majority forty-four. Mr O'Connell, a Catholic, elected M. P. for the county of Clare. Catholic association. Brunswick clubs.

1829 Settlement of the Catholic question recommended in a speech from the throne (February 5). Catholic association suppressed by act of Parliament (March 5). Catholic relief bill receives the royal assent (April 13). The Irish forty-shilling freeholders disfranchised. Agricultural distress. Partial disturbances in England (November and December).

1830 Measures of reform proposed in the House of Commons; by the Marquis of Blandford (February 18), by Lord John Russell (23), by Mr O'Connell (May 28), unsuccessfully. Death of George IV. (June 26); William IV. king of Great Britain. Revolution of July in France. Duke of Orleans becomes "King of the French." Revolution in Belgium. Riots in England; great destruction of agricultural produce. Reform associations and political unions formed at Birmingham, &c. Duke of Wellington resigns (November 16). Earl Grey premier; Mr Brougham lord high chancellor. Revolution of the 19th November in Poland.

1831 Reform bill announced to the House of Commons by Lord John Russell (March 1); read a first time (14); frustrated in committee by a motion of General Gascoyne; Parliament dissolved; debated in a new House of Commons from June 15 to September 22; carried by a final majority of 109; rejected by the Peers (October 7) by a majority of 41. Parliament prorogued. Riots at Derby, Nottingham, and Bristol. Prince Leopold accepts the crown of Belgium. Warsaw surrenders to the Russians; the Poles are reduced to complete submission. Insurrection at Lyons (November). Cholera Morbus breaks out at Sunderland.

1832 The Reform bill (introduced again into the House of Commons December 12, 1831), is debated until the 22d March; and endangered in the House of Peers by a motion of Lord Lyndhurst (May 7). Ministers resign. The House of Commons and the country present to the king addresses expressing confidence in the retired ministry. The Duke of Wellington attempts to form an administration; fails; Earl Grey and his colleagues are recalled (May 18). Royal assent given to the English Reform bill (June 7), to the Scotch (July 17), to the Irish (August 7). Hereditary peerage abolished in France. Prince Otho of Bavaria accepts the sovereignty of Greece (May 7). Carlist and republican insurrection in Paris (June 5, 6). The city declared in a state of siege. The diet of Frankfort publishes resolutions abridging the liberties of Germany (28). Don Pedro, ex-emperor of Brazil, lands at Oporto (July 9); civil war for the possession of Portugal. Death of young Napoleon (July 22). Don Pedro defeats the Portuguese royalists at Vallongo. Ibrahim Pasha defeats the Grand Vizier in Syria (July 30). The Miguelites repulsed from Oporto (Sept. 19). Formation of a French ministry under Soult (Oct. 10). Eruption of Mount Ætna (Nov. 18). The Grand Vizier defeated by the Pasha on the plains of Konieh (Dec. 21). Antwerp surrendered to the French after a bombardment of 20 days (Dec. 24).

1833 King Otho lands at Napoli (Jan. 31). Turkey applies to Russia for succours (Feb. 2). Miguelites twice repulsed from Oporto (March 4 and 24), and from Monte Cavello (April 9). Peace concluded between Turkey and Egypt (April 14). Don Carlos proclaims himself successor of the Spanish king (April 29). Mehemet Ali confirmed in his government of Egypt and Candia, with the annexation of Damascus, Tripoli, Seyd, and Safed (May 6). Ibrahim repasses the Taurus (May 9). Temporary settlement of the affairs of Holland and Belgium (May 21). Cortes convened to swear allegiance to the Infanta (June 20). Military disturbances in Rhenish Bavaria, in Basle, and Schwytz. Admiral Napier captures Don Miguel's squadron (July 2). Miguelites repulsed from Lisbon (Sept. 5). Death of the king of Spain (Sept. 29). The Mexican insurgents defeated by the president Santa Anna (Oct. 4). Various actions of the Carlists in Spain.

1834 Invasion of Savoy by Polish and other refugees (Feb. 1). Miguelites repulsed at Santarem (Feb. 18). Claims of the United States rejected in the French Chamber (Feb. 27). Riots at Lyons and Brussels. Carlists defeated in Lower Navarre (April 22). Treaty concluded at London between England, France, Spain, and Portugal, by the expulsion of Don Carlos and Don Miguel (April 22). Don Miguel capitulated (May 26). Don Pedro abolishes monastic establishments in Portugal (May 28). Cholera in Sweden and Denmark. Don Carlos retired to England (June 18), landed again in Spain (July 10). Lord Napier arrives at Canton (July 16). Insurrections in Syria (July 20). Slavery abolished in the British dominions (July 31). Death of Don Pedro (Sept. 24). Houses of Parliament

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destroyed by fire (Oct. 16). Sir Robert Peel prime minister (Dec. 8). Insurrection of the Caffres at the Cape of Good Hope (Dec. 25).

1835 Mohammed Mirza king of Persia. Emperor of Austria died (March 2). Lord Melbourne prime minister (April 18). The life of Louis Philippe attempted by Fieschi (July 28). Freedom of the press restrained in France. Spain recognised the independence of her American colonies (Aug. 9). Halley's comet seen (Aug. 20). Marshal Clausel takes the headquarters of Abd-el-Kader (Dec. 6).

1836 Marriage of Ferdinand Augustus Duke of Saxe-Coburg to Donna Maria Queen of Portugal (Jan. 1). Massacre of Carlist prisoners at Barcelona (Jan. 5). Queen of Naples died (Jan. 31). Madame Bonaparte died at Rome (Feb. 2). Mediation of Great Britain between France and America accepted (Feb. 8). French ministry organized under Thiers (Feb. 22). Cracow occupied by Russian and Austrian troops (Feb. 22). The British fleet co-operates with the Carlists on the coast (March 22). Revolt of the National Guard at Malaga, and proclamation of the Constitution of 1812 (Aug. 3). Revolution at Madrid, and acceptance of the Constitution by the Queen Regent (Aug. 12). Resignation of Thiers (Sept. 7). Repulse of the Carlists (Oct. 1). Insurrection of Louis Napoleon Bonaparte at Strasburg, and his dismissal to America (Oct. 29). Insurrection in Lisbon (Sept. 9). Bilbao invested unsuccessfully by the Carlists (Dec. 24).

1837 General Espartero drives the Carlists from Hernani (May 15). William IV. died (June 20). Queen Victoria proclaimed (June 22). The Duke of Cumberland becomes king of Hanover, and abrogates the constitution of 1833 (June 27). The Carlists defeated at Valencia (July 15). Parliament dissolved (July 17). The Carlists threaten Madrid (Aug. 11). Cholera raging in Rome, the Two Sicilies, &c. Don Carlos victorious near Herrera (Aug. 24). Saldanha and Terceira defeated in Portugal (Sept. 18). Canadian insurgents defeated at St Charles (Nov. 26). Insurrection extended to Upper Canada (Dec. 4).

1838 Bahia retaken by the Emperor of Brazil (March 16). Brazilian troops defeated by the insurgents (April 29). Great Western arrived at New York (June 17). Defeat of the Carlists at Penacerrada (June 22). Victory of the Carlists at Altura (25). Coronation of Queen Victoria (June 28). Hostilities commenced between France and Mexico (July 12). Revolution at Lima (July 29). Chilean troops enter Lima (Aug. 21). Coronation of the Emperor of Austria at Milan (Sept. 6). British troops enter Afghanistan to aid the legitimate king of Cabul. Rebellion in Lower Canada (Nov. 5). General Santa Cruz enters Lima (Nov. 10). The insurgents enter Monte Video (Nov. 11). The rebellion in Canada suppressed (Nov. 17). War proclaimed between France and the Mexican republic (Nov. 30). Chartist meetings throughout the country (Dec. 12).

1839 Eruption of Vesuvius (Jan. 2). Decision of Conference on the Dutch and Belgian question (Jan. 23). War declared between the Uruguay republic and Buenos Ayres (March 10). Arrest of British merchants by the Chinese government (April 15). Treaty between Holland and Belgium signed (April 19). Indian army occupies Candahar (April 21). Mexican Federalists defeated near Nocarigo (May 7). Lord Melbourne resigned, but immediately reinstated (May 7). Riots at Paris (May 11). Hostilities commenced between Ibrahim Pasha and Hafiz Pasha (June 10). Sultan Mahmoud II. succeeded by Abdul Medjid (June 27). Riots in Birmingham (July 15). Anglo-Indian army capture Ghiznee (July 23). Treaty between France and Texas (Sept. 25). Newport attacked by Chartists (Nov. 4). Trade between England and China suspended by edict of the imperial commissioner (Nov. 24). King of Denmark died (Dec. 3).

1840 Penny postage established (Jan. 10). Marriage of Queen Victoria and Prince Albert (Feb. 10). Morella the Carlist general surrenders (May 28). Death of Frederick William III. king of Prussia (June 7). Cabrera Carlist general is arrested (July 1). Capture of Chusan (July 5). Prince Louis Napoleon made prisoner at Boulogne (Aug. 6). Revolutionary outbreak at Madrid (Sept. 1). Beyrout bombarded (Sept. 19). The king of Holland abdicates (Oct. 7). Dost Mahommed Khan defeated (Oct. 18), surrenders (Nov. 2). St Jean d'Acre bombarded (Nov. 3). Remains of Napoleon deposited in the Hôtel des Invalides (Dec. 15.)

1841 Capture of the Bogue forts at Canton (Jan. 7). Union of the two Canadas proclaimed at Montreal (Feb. 10). Peace concluded between Mehemet Ali and the Sultan (March 5). Hostilities recommence at Canton (May 21). Plague in Egypt. Insurrection in Candia. Queen Christina declared no longer royal guardian (June 23). Amoy taken (Aug. 26). Recapture of Chusan (Oct. 1). Capture of Tinghai and Ningpo. Formation of new ministry under Sir Robert Peel (Aug. 30). Insurrection in Spain suppressed (Oct. 4). Fire in the Tower of London (Oct. 30). General rising in Cabul (Nov. 2). Birth of the Prince of Wales (Nov. 9).

1842 Massacre of British soldiers while evacuating Cabul (Jan. 8). The Afghans repulsed from Candahar (March 10), and Jellalabad (April 6). General Pollock forces the Khyber Pass. Insurrection of the Boers of Port Natal (May 4), defeated (June 26). Capture of Shang-hai (June 16). Riots in the manufacturing districts of England (Aug. 8). Peace concluded between Great Britain and China (Aug. 29). Ghiznee retaken by General Nott (Sept. 6). Cabul taken (Sept. 6), and evacuated (Oct. 12). Insurrectionists in Barcelona surrender after the bombardment of the city (Dec. 3).

1843 Defeat of the Ameers of Scinde by Sir Charles Napier, and capture of Hyderabad (Feb. 20). Insurrectionary movement of "Rebecca's daughters" in Wales. Thames Tunnel opened (March 25). "Disruption" of the Church of Scotland (May 18). Insurrection in Spain successful by the defection of the government troops (July 23). Pomaré, queen of Otaheite, compelled to place herself under the protection of France (Sept. 9). Revolution at Athens without bloodshed (Sept. 14). Government prohibits a repeal meeting, and Mr O'Connell and John O'Connell arrested (Oct. 14). Queen of Spain declared of age by the Cortes (Nov. 8).

1844 Death of the king of Sweden (March 8). A new constitution adopted by the National Assembly of Greece (March 16). Anti-Irish riots in Philadelphia (May 3 and July 5). Incendiary fires in Suffolk. Tangier bombarded by the Prince de Joinville (Aug. 6). Mogadore bombarded (Aug. 15). Peace concluded between France and Morocco (Sept. 6). Spanish constitution of 1837 abrogated (Oct. 28). Rongé heads the "second re-

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formation" in Germany. Revolution at Lahore (Dec. 18).

1845 Iowa and Florida annexed to the United States. Attack on Lucerne on account of the appointment of the Jesuits to be schoolmasters (April 1). New convention between France and England for the suppression of the slave trade (May 29). Attack on Madagascar on account of the expulsion of European traders (June 15). Annexation of Texas (June 19). A tribe of Moors destroyed by the French in Algeria (June 20). French detachment cut to pieces by Abd-el-Kader (Sept. 16). Insurrection in Rimini and Ravenna (Sept. 23). English and French squadrons destroy the batteries of General Rosas on the Parana (Nov. 19). Battles of Moodkee and Ferozeshah (Dec. 18 and 19). Lord John Russell unable to form a ministry, Sir Robert Peel reaccepted office (Dec. 20). Revolt of Yucatan from Mexico (Dec. 31).

1846 Sir H. Smith checked by the Sikhs (Jan. 21). Defeat of the Sikhs by Sir H. Gough at the Sobraon (Feb. 10). Attempted revolution in Poland (Feb. 22). Treaty of Lahore signed (March 9). Provision riots in Tipperary and Clonmel (April 13). Eruption of Hecla (April 15). Mexicans defeated at Palo Alto by General Taylor (May 8). Louis Napoleon Bonaparte escapes from Ham (May 26). Corn-Law Bill passed the House of Lords (June 25). Lord John Russell forms a cabinet (July 6). Famine in Ireland. Monterey capitulated to General Taylor (Sept. 24). Revolution at Geneva (Oct. 7). Cracow restored to Austria (Nov. 16).

1847 Famine in Ireland. The king of Prussia grants a constitution (Feb. 3). Vera Cruz surrendered to General Scott (March 28). Capture of the Bogue forts at Canton (April 3). Cerro Gordo taken by General Scott (April 18). Peace restored in Portugal (June 18). Military occupation of Ferrara by the Austrians (Aug. 13). General Scott defeats the Mexicans near Mexico (Aug. 19). The Swiss diet decrees the expulsion of the Jesuits from the Catholic cantons (Sept. 3). Riot at Milan (Sept. 8). The territories of Lucca taken possession of by the Grand Duke of Tuscany (Oct. 10). The deputies of the cantons of the Sonderbund retire from the diet (Oct. 27). Friburg surrendered to the Federal troops (Nov. 13). The Federal troops enter Lucerne (Nov. 24). Abd-el-Kader surrenders (Dec. 22). Crime and Outrage Act enforced in several parts of Ireland (Dec. 23).

1848 Riot between the Austrians and Milanese (Jan. 3). Death of Christian VIII. king of Denmark (Jan. 20). Revolution in France and abdication of Louis Philippe (Feb. 24). French republic proclaimed (Feb. 26). Income-tax mob in London, and arrests (March 6). Insurrection at Berlin tranquillized by the appointment of a popular ministry (March 18). Abdication of the king of Bavaria in favour of his son (18). Successful insurrection in Milan against the Austrians (18). Schleswig and Holstein revolt from the Danish government (March 25). Revolution in Madrid crushed (March 26). The Danes defeated the Holsteiners and Germans near Flensborg, and entered Schleswig (April 10). Great Chartist demonstration on Kennington Common (April 10). Sitting of the Sicilian parliament at Palermo. Bombardment of Messina by the king (April 13). Capture of Schleswig and Flensborg by the Prussian army (April 22). Skirmishes of the Poles and Prussians in Posen (April 29). The national guard defeated by the king's troops at Naples (May 15). Emperor of Austria retired from Vienna (May 18). Treaty between Mexico and the United States ratified (May 19). Renewal of the insurrection at Vienna May 27). Defeat of the Austrians by the Sardinian army at Goito (May 29). Attack on the Danish position at Duppeln by the Prussians and Hanoverians (June 5). Bombardment of Prague, and suppression of the insurrection (June 15 and 19). Padua surrendered to the Austrians (June 15). Election of Prince Louis Napoleon to the French National Assembly (June 12). Renewed conflicts in Berlin (June 16). Insurrection in Paris suppressed after great loss of life and property (June 23). Venice and Trieste blockaded (July 3). Revolt of Sclavonia and Croatia against Hungary (July 9). Duke of Genoa proclaimed king of the Sicilians by the Sicilian parliament (July 11). Sardinian army defeated by the Austrians and forced to retreat towards Milan (July 27). Skirmishes with the Irish rebels (July 29). The Sardinian army capitulated to the Austrians (Aug. 4). The Emperor of Austria returns to Vienna (Aug. 12). Armistice signed between the Danes and Prussians (Aug. 26). Rebellion at the Cape quelled by Sir H. Smith (Aug. 29). Messina bombarded and taken by the Neapolitans (Sept. 7). Insurrection in Frankfort suppressed by the troops (Sept. 17). Prince Louis Napoleon again elected to the National Assembly (Sept. 20). Armistice concluded between Sardinia and Austria (Sept. 21). The Ban of Croatia defeated by the Hungarians at Valaneze (Sept. 29). Insurrection at Vienna and assassination of Latour (Oct. 6). Prince Windischgrätz attacks and captures Vienna (Nov. 1). Constitution of the French republic adopted (Nov. 4). The Sikhs defeated before Mooltan (Nov. 7). The Austrians defeated by the Hungarian insurgents (Nov. 8). Death of Ibrahim Pasha (Nov. 10). General Wrangel enters Berlin and dissolves the Assembly (Nov. 10). Berlin in a state of siege (Nov. 12). Count Rossi assassinated, and the Pope compelled to accept a democratic ministry (Nov. 15). Engagement between the Sikh and British troops on the Chenaub (Nov. 22). The Pope fled in disguise from Rome to Gaëta (Nov. 24). Ferdinand I., emperor of Austria, abdicates in favour of his nephew (Dec. 2). The king of Prussia proclaims a new constitution (Dec. 5). Provisional government appointed at Rome (Dec. 11). Austrian forces enter Presburg, and the Hungarians defeated at Weisselburg (Dec. 18). Louis Napoleon Bonaparte proclaimed president of the French republic (Dec. 20). Hungarians defeated by the Croats (Dec. 29). Gold discovered in California (Dec. 30).

1849 Mooltan stormed (Jan. 2). Hungarians driven across the Waag. Buda-Pesth taken by the Austrians (Jan. 5). Sikhs defeated at Chillianwallah (Jan. 13). Conspiracy in Paris suppressed (Jan. 29). Brazilian insurgents repulsed from Pernambuco (Feb. 2). Constituent assembly meets in Rome (Feb. 5). The Grand Duke of Tuscany flies from Sienna, and provisional government proclaimed in Florence (Feb. 7). Republic proclaimed at Rome (Feb. 8). Sikh army defeated at Goojerat by Lord Gough (Feb. 21). King of Naples accepts the ultimatum of France and Spain (March 4). Austrian diet dissolved and a new constitution proclaimed (March 6). The Sardinian government

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renews hostilities with Austria (March 12). The Sikh chiefs surrender (March 14). Death of William II. king of Holland (March 17). Sardinians defeated by the Austrians (March 21). Rout of the Sardinian army at Novara (March 25). Bombardment of Brescia by Haynau (March 30). Insurrection at Genoa (April 2). Surrender of Syracuse to the Neapolitan troops (April 8). Defeat of the Danes by the German army opposite the island of Alsen (April 13). Danish forces again defeated by General Bonin (April 23). Pesth evacuated by the Austrians. Insurrection in Montreal (April 26). Civita Vecchia occupied by the French under Oudinot (April 26). Insurrection at Dresden (May 3). Dresden bombarded and taken (May 7). Capture of Leghorn by the Austrians (May 12). Convention signed between the French and Argentine republics (May 23). Ancona bombarded by the Austrians (May 28). Battle of Eperies between the Hungarians and Russians (June 23). Death of Mehemet Ali (July 2). French troops enter Rome (July 3). Insurrection in Bosnia; Germans defeated by the Danes at Fredericia (July 6). Armistice between Prussia and Denmark (July 10). Defeat of the Croats by the Hungarians at St Thamas (July 14). Battle of Waitzen (July 17). Pope restored to temporal power (July 15). Battles of Komorn, Miskolcz, and Schassburg between the Russians and Hungarians. Defeat and surrender of the Hungarian army (Aug. 13). Surrender of Venice to the Austrians (Aug. 22). Insurrection in Cephalonia and Corfu (Aug. 27). Riots near Montreal (Sept. 15). Komorn surrenders to the Austrians (Sept. 28). Cholera rages in England. Russia demands the expulsion of the Hungarians from Turkey (Nov. 5). British fleet anchors in Basika bay (Nov. 13). Hungarian refugees sent to Konieh, and friendly relations resumed between Russia and Turkey (Dec. 31).

1850 Admiral Sir W. Parker blockades the Piræus (Jan. 18). Death of the Emperor of China (Feb. 25). Treaty signed at Munich between Austria, Bavaria, Saxony, and Wurtemberg (Feb. 27). Submission of the Greek government (April 25). A buccaneering party take possession of Cuba (May 19). Insurrection in Bulgaria (June 12). Death of Sir Robert Peel (July 2). Great Britain, France, Prussia, and Sweden guarantee the integrity of Denmark (July 4). The Danes occupy Flensborg (July 17). Defeat of the Schleswig-Holsteiners by the Danes at Idstedt (July 25). California added to the United States (Aug. 15). Elector of Hesse-Cassel declares his dominions in a state of siege (Sept. 13). The Schleswig-Holstein army repulsed by the Danes at Missunde (Sept. 13). Pius IX. issues a bull establishing a hierarchy in England (Sept. 24). Austria, Bavaria, Saxony, and Wurtemberg establish an alliance (Oct. 4). Schleswig-Holsteiners repulsed from Friedrichstadt by the Danes (Oct. 6). An Austro-Bavarian force enters Hesse-Cassel (Nov. 9). Prussian troops retreat from Cassel (Dec. 5). Martial law established at the Cape of Good Hope.

1851 Turkish Croatia in rebellion (Jan. 29). Bosnian insurgents defeated by Omar Pasha at Mostar (Feb. 9). Russell ministry resigns (Feb. 22); but is immediately reinstated (March 3). Revolt in Senaar against the pasha (March 16). Census in England, Ireland, and Scotland (March 31). Insurrection in Lisbon headed by the Duke of Saldanha (April 10). Exhibition of the Industry of all Nations opened (May 1). Chinese rebellion. Austro-Bavarian army evacuate Hesse-Cassel (Aug. 1). General Lopez invades Cuba (Aug. 12). Coup d'Etat at Paris. Louis Napoleon perpetual President of the French republic (Dec. 2.)

1852 The Emperor of Austria revoked the constitution of 1849 (Jan. 1). Buenos Ayres capitulated to an Argentine and Brazilian force, and a provisional government appointed (Feb. 3). Austrians evacuate Holstein and Hamburg. The Derby ministry supplants the Russell (Feb. 27). Martaban and Rangoon stormed. The Duke of Tuscany re-establishes constitution previous tc 1848 (May 7). General Urquiza assumes extraordinary powers as provisional director of the Argentine republic (June 23). Capture of Prome (July 9). Independence of Paraguay conceded by the Argentine republic (July 17). Cholera rages at Warsaw. General Urquiza deposed (Sept. 10). Death of the Duke of Wellington (Sept. 18). Recapture of Prome (Oct. 9). Capture of Pegu (Nov. 21). Louis Napoleon proclaimed Emperor (Dec. 2). The Derby ministry succeeded by that under the Earl of Aberdeen (Dec. 28). Vera Cruz blockaded (Dec. 30).

1853 Revolution in Mexico. Insurrection suppressed in Milan (Feb. 6). Termination of the Caffre war (Feb. 22). Nankin taken by the insurgents (March 21). Prince Menzikoff claims for the Czar the protectorate of the Greek Christians in Turkey (May 3). The Porte rejects the Russian ultimatum (June 16). Russian army crosses the Pruth (July 2). Exportation of grain prohibited in Naples, Italy, France, &c. Chinese imperialists attack Amoy (Aug. 25). Cholera breaks out in England. The Porte declares war with Russia. Anglo-French fleet enters the Bosphorus (Oct. 22). Russians occupy the Danubian principalities, and Turks cross the Danube. Disaster at Sinope (Nov. 30).

1854 Alliance concluded between Great Britain, France, and Turkey. Declaration of war between Great Britain and Russia (March 24).

LITERARY CHRONOLOGY.

In the following Table, *b* denotes the year of birth, *d* of death, and *l* an approximation to the medium year of the author's life. The letters immediately following the name denote the country in which the author was born: thus, *R.* stands for *Roman; It.* for *Italian; Ger.* for *German*, &c. Where no indication is given, the country to be supplied is *Greece.*

B.C.		
1253	*l.* Musæus.	Poems.
907	*l.* Homer.	"Iliad," "Odyssey," &c.
907	*l.* Hesiod.	"Works and days."
690	*l.* Archilochus.	Satires, Elegies.
681	*l.* Tyrtæus.	Elegies.
610	*l.* Alcæus.	Poems.
610	*l.* Sappho.	Lyrics.
592	*l.* Anacharsis, *Scyth.*	Philos., Hist., Law.
630	*l.* Mimnermus.	Elegies.
636-546	Thales.	Astronomy, Philosophy.
638-558	Solon.	Laws of Athens.
558	*l.* Epimenides.	Epic Poem.
633-553	Stesichorus.	Lyrics.
540	*l.* Pythagoras.	Math., Philosophy.

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B. C.		
536	*l.*	Thespis. Tragedy.
478	*d.*	Anacreon. Lyrics.
508	*l.*	Ocellus Lucanus. Philosophy.
479	*d.*	Confucius, *Chinese.* Philosophy
556-467		Simonides. Lyrics.
476	*d.*	Hecatæus. History.
464	*l.*	Zeno of Elea. Philosophy.
525-456		Æschylus. Tragedy.
472	*l.*	Bacchylides. Lyrics.
522-442		Pindar. Odes.
480	*b.*	Gorgias. Orations.
500-428		Anaxagoras. Philosophy.
467	*b.*	Andocides. Orations.
495-405		Sophocles. Tragedy.
484	*b.*	Herodotus. History.
480-406		Euripides. Tragedy.
364	*l.*	Isæus. Orations.
469-399		Socrates. Philosophy.
471-391		Thucydides. Hist. Pelopon. War.
440	*l.*	Antiphon. Orations.
444-380		Aristophanes. Comedy.
398	*l.*	Ctesias. History.
458-378		Lysias. Orations.
444-359		Xenophon. History.
460-357		Hippocrates. Medicine.
460-361		Democritus. Philosophy.
429-347		Plato. Philosophy.
436-338		Isocrates. Orations.
397-323		Lycurgus. Orations.
384-322		Aristotle. Philos., Nat. Hist., Criticism.
385-322		Demosthenes. Orations.
389-314		Æschines. Orations.
336	*l.*	Dinarchus. Orations.
320	*l.*	Diphilus. Comedy.
298	*l.*	Euclid. Geometry.
342-291		Menander. Comedy.
288	*d.*	Theophrastus. Ethics.
240	*d.*	Callimachus. Hymns, Epigrams.
272	*l.*	Theocritus. Idyls.
259	*l.*	Lycophron. "Cassandra."
272	*l.*	Aratus. "Poem on Astronomy."
341-270		Epicurus. Philosophy.
279	*b.*	Zeno of Citium. Philosophy.
261	*l.*	Manetho, *Egyp.* "History of Egypt."
240	*l.*	Apollonius. "Conic Sections."
238	*d.*	Livius Andronicus, *R.* Tragedy.
287-212		Archimedes. Sphere and Cylinder.
203	*d.*	Cn. Nævius, *R.* Poems.
276-196		Eratosthenes. Math., Cosmogony, &c.
194	*l.*	Apollonius Rhodius. "Argonautics."
184	*d.*	M. A. Plautus, *R.* Comedy.
272	*l.*	Bion. Idyls.
168	*d.*	Statius Cæcilius, *R.* Comedy.
250	*l.*	Moschus. Idyls.
169	*d.*	Q. Ennius, *R.* Epics.
195-159		P. Terentius, Afer. Comedy.
220-130		M. Pacuvius, *R.* Tragedy.
234-149		M. P. Cato, *R.* Hist., Agriculture, &c.
137	*l.*	Nicander. "Theriaca."
180	*l.*	L. Attius, *R.* Tragedy.
129	*l.*	C. Lucilius, *R.* Satires.
204-122		Polybius. Universal History.
140	*l.*	Apollodorus. "Bibliotheca," Mythology.
60	*l.*	Meleager. Epigrams.
95-51		Titus Lucretius, *R.* "De Rerum Natura."
50	*l.*	Conon. Mythology.
74	*d.*	Scymnus. Poetical Geography.
100-44		C. J. Cæsar, *R.* "Commentaries."

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B. C.		
44	*l.*	Diodorus Siculus. General History.
43	*d.*	A. H. Pansa, *R.* Gallic War.
107-43		M. T. Cicero, *R.* Orations, Philosophy.
86-47		Catullus, *R.* Lyrics.
85-35		C. Sallustius, *R.* History.
110-33		T. Pomponius Atticus, *R.* Epistles.
30	*d.*	Cornelius Nepos, *R.* Biography.
115-28		M. T. Varro, *R.* "De Lingua Latina," "Re Rustica."
7	*d.*	Dionysius of Halicarnassus. Roman Antiquities.
20	*l.*	Dionysius Periegetes. Geography.
70-19		P. Virgilius, *R.* "Æneid."
18	*d.*	Albius Tibullus, *R.* Elegies.
59-16		Propertius, *R.* Elegies.
10	*l.*	Vitruvius, *R.* Architecture.
65-8		Q. Horatius Flaccus, *R.* Odes, Satires, &c.
4	*d.*	Verrius Flaccus, *R.* "Fasti Capitolini."
A.D.		
4	*l.*	Hyginus, *R.* "Poeticon Astronomicon."
16	*l.*	Phædrus, *R.* Fables.
43 B.C. 17		Publius Ovidius Naso, *R.* Metamorph., Fasti, &c.
59 B.C. 19		Titus Livius, *R.* History of Rome.
20	*l.*	C. Celsus, *R.* "De Medicina."
25	*d.*	Strabo. Geography.
26	*l.*	Valerius Maximus, *R.* Anecdotes of Great Men.
19 B.C. 30		Velleius Paterculus, *R.* History of Rome.
42	*l.*	Columella, *R.* Agriculture.
45	*l.*	Pomponius Mela, *R.* Geography.
49	*l.*	Quintus Curtius, *R.* History of Alexander.
36-62		Persius, *R.* Satires.
12-65		L. A. Seneca, *R.* Philosophy, Tragedy.
38-65		Lucan, *R.* "Pharsalia."
66	*l.*	Dioscorides. Botany, Medicine.
67	*d.*	Petronius Arbiter, *R.* "Satyricon."
74	*d.*	Silius Italicus, *R.* "Punic War."
78	*d.*	Valerius Flaccus, *R.* "Argonautics."
23-79		Pliny, the elder, *R.* Natural History.
86	*l.*	Sulpicia, *R.* Satire.
93	*d.*	Josephus, *Jew.* "Antiquities of the Jews."
95	*d.*	Dion Chrysostom. Orations.
95	*d.*	M. F. Quintilianus, *R.* Rhetoric, Criticism.
98	*l.*	Epictetus. "Enchiridion," Philosophy.
99	*d.*	Statius, *R.* "Thebais," "Achilleis."
29-104		Martial, *R.* Epigrams.
		Valerius Probus, *R.* Grammar.
108	*d.*	Tacitus, *R.* History.
109	*l.*	Aulus Gellius, *R.* "Noctes Atticæ."
61-113		Pliny, the younger, *R.* Epistles.
115	*l.*	Annæus Florus, *R.* History of Rome.
116	*l.*	Suetonius, *R.* Biography, History.
119	*d.*	Plutarch. Biography, Morals.
48-128		Juvenal, *R.* Satires.
130	*l.*	Ptolemy. Geography, Astronomy.
135	*l.*	Tertianus Maurus. "De Arte Metrica."
140	*l.*	Arrian. "Expedition of Alexander."
140	*d.*	Ælian. Varieties.
142	*l.*	Justin, *R.* History.
148	*d.*	Appian. History.
161	*d.*	Hermogenes. Rhetoric.
161	*l.*	Polyænus. Strategy.
163	*d.*	Justin Martyr. Theology.
163	*d.*	Pausanias. Description of Greece.
163	*l.*	L. Apuleius, *R.* "Golden Ass."
167	*d.*	Polycarp. Theology.
167	*l.*	Hephæstion. "On Metres."
172	*d.*	Athenagoras. "On the Resurrection."
177	*d.*	Lucian. Dialogues.
180	*d.*	M. Aurelius Antoninus, *R.* Philosophy.

Chronology.

A. D.		
186	*d.*	Julius Pollux. "Onomasticon," Rhetoric.
189	*l.*	Jamblichus. "Sinonis and Rhodanes," a novel. Phavorinus. Lexicon.
193	*l.*	Maximus Tyrius. Philosophy.
194	*d.*	Athenæus. "Deipnosophistæ," Anecdotes.
194	*l.*	Caius Jul. Solinus, *R.* "Polyhistor."
200	*d.*	Tertullian, *R.* Apology for Christianity.
207	*l.*	Minutius Felix, *R.* Dialogue in favour of Christianity.
213	*d.*	Oppian. Poems on Field Sports.
214	*l.*	Julius Obsequens, *R.* "De Prodigiis."
222	*d.*	Diogenes Laertius. "Lives of Philosophers."
224	*d.*	Philostratus. "Life of Apollonius."
228	*d.*	Ulpian, *R.* Law.
229	*l.*	Dion Cassius. History of Rome.
238	*l.*	Censorinus, *R.* "De Die Natali."
243	*l.*	Ammonius. Philosophy.
247	*l.*	Herodian. History of Rome.
254	*d.*	Origen. Theology.
258	*d.*	Cyprian, *R.* Theology.
273	*d.*	Longinus. "On the Sublime."
284	*l.*	Nemesianus, *R.* "Cynegetica."
285	*l.*	Julius Culpurnius, *R.* Eclogues.
293	*l.*	Ælius Spartianus, Julius Capitolinus, Ælius Lampridius, Val. Gallicanus, Trebellius Pollio, F. Vopiscus, *R.* Historiæ Augustæ.
301	*l.*	Arnobius, *R.* "Adversus Gentes."
233-304		Porphyrius. Life of Pythagoras, Philosophy.
315	*l.*	Xenophon. "Anthia and Abrocomas," a novel, &c.
325	*d.*	Lactantius *R.* Defence of Christianity.
333	*l.*	Ælius Donatus, *R.* Grammar.
340	*d.*	Eusebius. Ecclesiastical History.
340	*l.*	F. Maternus, *R.* Astronomy, Theology.
356	*l.*	Libanius. Orations and Epistles.
356	*l.*	F. Eutropius, *R.* History of Rome.
360	*l.*	Festus Avienus, *R.* Geographical Poem.
363	*d.*	Julian. Philosophy.
364	*l.*	Aurelius Victor. History.
298-371		Athanasius. Theology.
372	*l.*	Diophantus. Mathematics.
372	*l.*	Eunapius. "Lives of Philosophers."
375	*l.*	Theon. Mathematics.
378	*l.*	Pappus. Mathematics.
380	*d.*	Ammianus Marcellinus, *R.* History of Rome.
386	*l.*	F. Vegetius Renatus, *R.* "De Re Militari."
315-386		Cyril. Theology.
318-389		Gregory Nazianzen. Theology.
392	*d.*	D. M. Ausonius, *R.* Idyls.
395	*l.*	A. Theod. Macrobius, *R.* Saturnalia.
396	*d.*	Gregory Nyssæus. Theology.
396	*l.*	Symmachus, *R.* Epistles.
397	*d.*	Ambrosius, *R.* Theology.
398	*l.*	A. Prudentius Clemens, *R.* Christian Poems.
399	*l.*	C. Claudianus, *R.* Poems.
400	*l.*	Nemesius. "Nature of Man," Philosophy.
405	*l.*	Stobæus. Literary Collections.
357-407		Chrysostom. Theology.
410	*d.*	Rufinus, *R.* Ecclesiastical History.
411	*l.*	Synesius. Orations and Epistles.
412	*l.*	Paulinus Petrocorius. Poem on Martin of Tours.
415	*d.*	Hypatia. Mathematics.
416	*l.*	Orosius, *R.* History of the World.
329-420		Jerome, *R.* Version of the Bible.
420	*d.*	Sulpitius Severus, *R.* Sacred History.
354-430		Augustin, *R.* Theology.
435	*l.*	Sedulius, *R.* Poetical Life of Christ.
443	*d.*	Cyril. Homilies.
445	*d.*	Proclus. Theology.
389-446		Socrates. Ecclesiastical History.
450	*d.*	Sozomen. Ecclesiastical History.
450	*d.*	Theodoret. Ecclesiastical History.
450	*l.*	Olympiodorus. History of Honorius.
457	*l.*	Martianus, Capella, *R.* Satire.
463	*l.*	Victorius, *R.* History of the Church in Africa.
469	*l.*	Iducius, *R.* Chronicles to 468.
470	*l.*	Quintus Smyrnæus. Continuation of Homer.
474	*l.*	Zosimus. History of Roman Emperors.
484	*l.*	Musæus. Poem of Hero and Leander.
488	*d.*	Sidonius Apollinaris, *R.* Poems.
494	*l.*	Nonnus. "Conquest of India by Bacchus."
500	*d.*	Proclus. Platonist.
504	*l.*	Stephanus. Geography.
506	*l.*	Arrian, *Sp.* Law.
521	*d.*	Ennodius, *R.* Christian Poems.
525	*d.*	Boethius, *It.* Philosophy, Poems.
526	*d.*	Priscian, *It.* Grammar.
528	*d.*	Sex. Pomp. Festus, *It.* "De significatione Verborum."
529	*l.*	Tribonianus. Law.
529	*l.*	Achilles Tatius. "Clitophon and Leucippe," a novel.
529	*d.*	Fulgentius Ferrandus, *Sp.* Canon Law.
530	*d.*	Non. Marcellus, *It.* Grammar.
532	*l.*	Coluthus. Poem on Rape of Helen.
468-533		Fulgentius, *It.* Theology.
536	*d.*	Dionysius Exiguus, *It.* Christian Era.
547	*l.*	Simplicius. Comments on Aristotle.
552	*d.*	Jornandes, *It.* History of the Goths.
553	*d.*	Procopius. History of the reign of Justinian
490-556		Arator, *It.* "Acts of the Apostles," in verse.
481-562		Cassiodorus, *It.* History.
565	*l.*	Agathias. Byzantine History.
570	*d.*	Gildas, *Br.* Conquest of Britain.
580	*d.*	Martin, *Sp.* Ethics.
594	*l.*	Evagrius, *It.* Ecclesiastical History.
554-595		Gregory of Tours, *Fr.* History.
596	*l.*	Venan. Fortunatus, *Fr.* Hist., Poems.
		Cædmon, *Br.* Saxon Poems, &c.
612	*l.*	Theophylactus Simocatta. Byzan. Hist.
615	*d.*	Secundus, *It.* History of the Lombards.
617	*l.*	Philoponus. Grammar.
620	*d.*	John of Biclair, *Sp.* Chronicle.
569-632		Mahomet, *Arab.* "Koran."
636	*d.*	Isidore, *Sp.* "Chron. de Goth."
641	*d.*	Geo. Pisidis. History, Poems.
622-657		Lebio, *Arab.* Poems.
		Aharun, *Arab.* Medicine.
667	*d.*	Ildefonso, *Sp.* Polemics.
673	*l.*	Callinicus. Mathematics.
695	*l.*	Cresconius, *It.* Collection of Canons, Verses.
709	*d.*	Aldhelme, *Br.* Latin Poems.
673-735		Bede, *Br.* Ecclesiastical Hist. of England.
742	*l.*	Fredegaire, *Fr.* Chronicle.
750	*d.*	Damascenus. Scholastic Philosophy.
766	*l.*	Egbert of York, *Br.* Ecclesiast. Hist.
		Jafar, *Arab.* Alchemy.
699-767		Abu Hanifah, *Arab.* Theology.
795	*l.*	Theophanes. Byzantine History.
796	*l.*	Ahnamon, *Arab.* Astronomical Tables.
800	*l.*	Mohammed-ben-Musa, *Arab.* Algebra.

Chronology.

A. D.

800 *l.* Syncellus. History.

801 *d.* Paul Wainefred, *It.* History of the Lombards.
804 *d.* Alcuin, *Br.* Theol., Hist., Poetry.
813 *l.* Kendi, *Arab.* Philosophy.
820 *l.* J. ben Serapion, *Arab.* Medicine.
821 *d.* Theodulph, *Fr.* Theology, Hymns.
821 *l.* Benoist, *Fr.* Monastic Regulations, Homilies.
823 *l.* Otfried, *Ger.* Harmony of the Gospels (in Rhyme).
759-826 Theodorus Studites. Sermons.
826 *l.* Abu Mohammed Abdallah, *Arab.* Geog., Literature.
758-828 Nicephorus. History.
740-830 Asmai, *Arab.* Theology.
835 *d.* Bahali, *Arab.* Grammar.
838 *d.* Abu Obeid, *Arab.* Fables.
839 *d.* Eginhard, *Ger.* Hist. of Charlemagne, Annals.
840 *d.* Agobard, *Fr.* Theology.
804-845 A. Temam, *Arab.* Poems.
845 *l.* Nasir Khosru, *Arab.* Metaphysics.
848 *l.* Pachasius Radbert, *Fr.* On Transubstantiation.
849 *d.* Walafrid Strabo, *Ger.* Poems, Theology.
853 *d.* Nethard, *Ger.* Hist. of Wars of France.
776-856 Rubanus Maurus, *Ger.* Theology.
858 *l.* Nennius, *Br.* "Origin of the Britons."
859 *d.* Eulogius, *Sp.* Martyrology.
Alvarez, *Sp.* Biography of Eulogius.
862 *d.* Servatus Lupus, *Fr.* Epistles.
869 *d.* Gottschalk, *Ger.* "On Predestination."
810-870 Bochari, *Arab.* "The Sahib," Traditions.
874 *d.* Honain-ben-Isaac, *Arab.* Translations from Greek.
875 *d.* Ado, *Fr.* Chronicle.
879 *l.* Alfragan, *Arab.* Astronomy.
882 *d.* Hincmar, *Fr.* Epistles.
821-882 Bochteri, *Arab.* Anthology.
883 *d.* J. Scotus Erigena, *Br.* "De Natura Rerum."
805-885 Albumazar, *Arab.* Math., Astronomy.
886 *d.* Anastasius, *It.* Lives of Popes.
887 *l.* Abbon, *Fr.* "Siege of Paris."
888 *l.* Other, *Norweg.* Geography.
889 *d.* J. Kotaibah, *Arab.* History.
Wahab, *Arab.* Travels.
890 *l.* Abuzeid, *Arab.* Travels.
891 *d.* Photius. "Bibliotheca."
896 *l.* Erchempert, *It.* Hist. of the Lombards.
899 *l.* John Malalas. History.
900 *l.* Guido of Ravenna. Geography.

849-901 Alfred, *Br.* Saxon Poems, Translations, &c.
909 *d.* Asser, *Br.* Life of Alfred; Hist. of England.
911 *d.* Leo VI. "On Christian Faith."
912 *l.* Albategni, *Arab.* Astronomy.
915 *l.* Regino, *Ger.* Chron. of France and Germany.
838-922 Abu Jafar, *Arab.* History.
922 *d.* Ruses, *Arab.* Medicine.
931 *d.* Ibn Doraid, *Arab.* Poems.
Ben Musa, *Arab.* Mathematics.
936 *l.* Azophi, *Arab.* Astronomy.
876-937 Said-ben-Batrick, *Arab.* General History.
940 *l.* Eutychius, *Arab.* History.
942 *l.* Genesius. History.
942 *l.* Simeon Metaphrastes. Lives of Saints.
954 *d.* Alfarabi, *Arab.* Aristotelian Philosophy.
957 *d.* Massudi, *Arab.* History and Geography.
905-959 Const. Porphyrogenita. Historical Selections.
961 *l.* Oda of Canterbury, *Br.* Eccles. Constitutions.
965 *d.* Almotannabe, *Arab.* Poems.
965 *l.* Geba, *Arab.* Alchemy.

A. D.
896-966 Flodoard, *Fr.* Chronicle.
968 *l.* Wittekind, *Ger.* Hist. of the Saxons.
968 *l.* Nolger, *Ger.* Translation of the Psalms.
969 *l.* Leontius. History.
970 *d.* Luitprand, *It.* Hist. of his own times.
974 *d.* Batherius, *Ger.* Theology, Grammar.
977 *l.* Severus, *Egyp.* History of Alexandria and of the Saracens.
977 *l.* Ethelwerd, *Br.* Hist. of Great Britain.
993 *l.* Dudon, *Fr.* Hist. of Norm. Conq. in France.
998 *d.* Genhari, *Arab.* Aristotelian Philosophy.
Ibn Hankal, *Arab.* Geography.
Hjalti, *Iceland.* Poems.

1003 *d.* Gerbert, *Fr.* Mathematics.
1004 *d.* Abon, *Fr.* Arithmetic, Astronomy.
1008 *d.* Aimoin, *Fr.* History of France.
1014 *l.* Lambert, *Ger.* General History.
1017 *l.* Ibn Mesna, *Arab.* Medicine.
1018 *d.* Dithmar, *Ger.* Chron. of Saxon Emperors.
932-1020 Ferdusi, *Pers.* "Shah Nameh," Epic poem.
1025 *l.* Papias, *It.* Grammar.
1029 *d.* Fulbert, *Fr.* Epistles.
1030 *d.* Adalberon, *Fr.* Poems.
980-1038 Avicenna, *Arab.* Nat. Philos., Medicine.
1041 *l.* Hermannus Contractus, *Ger.* Universal Hist.
1043 *l.* Abulcasis, *Arab.* Medicine.
1055 *d.* Yaroslav, *Russ.* Code of Laws.
1057 *l.* George Cedrenus. History.
1058 *l.* Witpo, *Ger.* Praise of Hen. III., Biography.
1062 *l.* Michael Psellus. Mathematics.
1069 *l.* Theophylactus. Theology.
1073 *l.* Gelalledin, *Arab.* Correction of the Calendar.
1079 *l.* Arzachel, *Arab.* Astronomy.
1080 *d.* John Xiphilinus. Abridgment of Dion Cassius.
1080 *l.* John Scylitza. History.
1028-1086 Mar. Scotus, *Ger.* Chronicle.
1088 *d.* Berengarius, *Fr.* Theology.
1089 *d.* Lanfranc, *Br.* Theology.
Eadmer, *Br.* Chronicle.
Willeram, *Ger.* Francic Poems.
Almuyadad, *Arab.* Hist. of the Saracens in Sicily.
Achmet, *Arab.* Treatise on Dreams.
1100 *l.* Suidas. Lexicon.

1101 *l.* John of Milan, *It.* "Regimen Sanit. Saler."
1030-1109 Ingulphus, *Br.* History of Croyland.
1033-1109 Anselm, *Fr.* Scholastic Philosophy.
1110 *l.* Anna Comnena. Reign of Emperor Alexius.
1113 *d.* Sigebert. History.
1058-1113 Gazali, *Arab.* Aristotelian Philosophy.
1114 *l.* Alhazin, *Arab.* Optics.
1056-1115 Nestor of Kiew, *Russ.* Chron. of Russia.
1118 *d.* Florence of Worcester, *Br.* Chron. of Eng.
1118 *l.* Zonaras. Hist. of the Romans, Jews, &c.
1119 *d.* Tograi, *Arab.* Poems.
1120 *d.* Theodosius, *Russ.* Annals.
1054-1121 Hariri, *Arab.* Moral Poems.
1121 *l.* C. Theo. Prodonus. "Rhodanthe & Dosicles," a novel.
1121 *l.* Nicetas Acominatus. History.
1123 *d.* Sylvester, *Russ.* Chronicle of Russia.
1123 *d.* Marbodæus, *Fr.* Biography.
1053-1124 Gerbert, *Fr.* Hist. of First Crusade.
Pierre Theutbode, *Fr.* Hist. of the Crusades.
1071-1126 William of Poictiers, *Fr.* First troubadour.
1130 *l.* Athelard of Bath, *Br.* Mathematics.
1131 *l.* Euthymius Zygabenus. Theology.
1075-1132 Ordericus Vitalis, *Br.* Hist. of England.
1057-1133 Hildebert, *Fr.* Poems.

Chronology.

A. D.
1136 *d.* Tabrizi, *Arab.* Commentaries.
1137 *d.* Nicephorus Briennius. Byzantine Affairs.
1097-1140 Hugh de St Victoire, *Fr.* Gecg., Hist., Theol.
1099 *b.* Ben. Idris, *Arab.* Geography.
1079-1142 Pierre Abelard, *Fr.* Theology.
1143 *d.* William of Malmesbury, *Br.* History.
Thorwald, *Iceland.* Ballads.
1148 *d.* Axo, *Iceland.* Annals.
1148 *l.* Geoffroi Gaimar, *Fr.* Anglo-Norm. Chron. in verse.
1150 *d.* Robert Pulleyn, *Br.* Theology.
1150 *l.* Gratian, *It.* Canons.
Bechada, *Fr.* Norman Poetry, "Gestes de Godefroi."
1082-1152 Suger, *Fr.* Life of Louis le Gros.
1152 *l.* Robert Wace, *Fr.* "Roman de Rou."
1152 *l.* Geoffry of Monmouth, *Br.* Hist. of Britain.
1091-1153 Bernard of Clairvaux, *Fr.* Mystic.
1156 *l.* Eustathius. Commentary on Homer.
1158 *d.* Otto, *Ger.* Chronicles.
1160 *l.* Isaac Tzetzes. Commentary on Lycophron.
1164 *d.* Petrus Lombardus, *Fr.* Theology.
1164 *l.* Henry of Huntingdon, *Br.* Chron. of England.
1168 *d.* A. Zohar, *Arab.* Medicine.
1170 *d.* Helmold, *Ger.* Chronicles of the Slavi.
1173 *d.* Richard of St Victor, *Br.* Theology.
1175 *l.* Falcandus, *It.* History of Sicily.
1176 *d.* John Tzetzes. History in verse.
1179 *l.* Constantine Manasses. History.
1180 *l.* Ralph Glanville, *Br.* Collection of Laws.
Simeon of Durham, *Br.* Chron. of England.
1180 *l.* Joseph of Exeter, *Br.* "Trojan War," "War of Antioch," Epics.
1180 *l.* John Ægidius, *Fr.* Poem on Medicine.
1181 *d.* John of Salisbury, *Br.* Life of Becket.
1181 *d.* Feleki, *Per.* Poems.
1182 *l.* Cinnamus. History.
1183 *l.* Walter Mapes, *Br.* Satires, Songs.
1100-1184 William of Tyre. History.
1186 *d.* Kharkani, *Pers.* Poems.
1189 *l.* Giraldus Cambrensis, *Br.* Conq. of Ireland, Itin. of Wales.
1191 *l.* Henry of Valdeck, *Ger.* Minnesinger.
1191 *l.* Berthold Constantiensis, *Ger.* Universal Hist.
1195 *l.* Foukes, *Fr.* A troubadour.
1136-1197 William of Newbury, *Br.* Chron. of England.
1198 *d.* Jaafar ebn Tofail, *Arab.* "Hai ben Yokdan," novel.
1199 *l.* Campanus, *It.* Mathematics.
Ciullo d'Alcama, *It.* Sicilian poetry.
Nigellus, *Br.* Speculum Stultorum.
Egaz Monez, *Sp.* Songs.
Gonzalo Hermiguez, *Sp.* Songs.
1156 *b.* Sæmund, *Iceland.* The Elder Edda.
Sunesen, *Dane.* Law.
Sueno, *Dane.* History of Denmark.
Alchabit, *Arab.* Optics, Astronomy.
1200 *l.* Roger Hoveden, *Br.* Chron. of England.

1202 *d.* Alain de l'Isle, *Fr.* Theology, Ethics.
1203 *l.* Gervase of Canterbury, *Br.* Hist. of Eng.
1204 *l.* Geoffrey de Villehardouin, *Fr.* Conq. of Constantinople.
1206 *d.* Averroes, *Arab.* Aristotel. Philosophy.
1208 *l.* P. Gautier, *Fr.* Alexandriada.
1218 *l.* Gunther, *Ger.* Poems.
1219 *d.* A. Baca, *Arab.* Arithmetic.
1226 *d.* Vinc. Kadlubek, *Pole.* Hist. of Poland.
1227 *d.* Alex. Neckham, *Br.* Theology.
1241 *d.* Snor Sturleson, *Iceland.* "Younger Edda."

A. D.
1243 *l.* W. Rubruquis, *Fr.* Travels.
1244 *d.* Abulden, *Arab.* History.
El Harawi, *Arab.* Travels.
1245 *d.* Alexander Hales, *Br.* Aristot. Philosophy.
1245 *d.* Rodrigo Ximenez, *Sp.* Hist. of Spain.
1246 *d.* Beithar, *Arab.* Botany, Medicine.
1248 *l.* Gilbertus Anglicus, *Br.* Medicine.
1248 *l.* William the Breton, *Fr.* "Deeds of Philip," in verse.
1248 *l.* Nicephorus Blemmidas. Theology.
1249 *d.* Pietro dalla Vigne. *It.* History.
1250 *l.* Vitellion, *Pole.* Optics.
1250 *l.* John of Novogorod, *Russ.* Hist. of Russia.
Roger of Wendover, *Br.* Hist. of England.
1253 *d.* Boguphalus, *Pole.* Chron. of Poland.
1253 *l.* Wm. de Lorris, *Fr.* "Rom. de la Rose."
1254 *d.* Robert Grosteste, *Br.* Natural Philosophy.
1196-1254 Frederick II., *Ger.* "De arte Venandi."
1256 *d.* John Holiwood, *Br.* Math., Astron.
1256 *l.* Bonaventura, *It.* Scholastic Philos.
1257 *l.* Richard of Chichester, *Br.* Chron. of Eng.
John Peckham, *Br.* Theology.
1259 *d.* Matthew Paris, *Br.* History of England.
1182-1260 Accursius, *It.* Law.
1264 *l.* Vincentius of Beauvais, *Fr.* Encyclopædia.
1264 *l.* George Acropolita. History.
1271 *d.* Robert of Sorbonne, *Fr.* Theology.
1201-1273 Nasereddin, *Pers.* Astronomy.
1224-1274 Thomas Aquinas, *It.* Theology.
1274 *d.* Caswin, *Arab.* Natural History.
1175-1275 R. de Peñafort, *Sp.* Decretals.
1277 *d.* John XIX., *It.* Poem on Medicine.
1278 *d.* Martin Polonus, *Pole.* Chron. of Popes and Emperors.
1193-1280 Albertus Magnus, *Ger.* Nat. Philosophy.
1281 *d.* Michael Scot, *Br.* Alchemy, Philos.
1284 *d.* Alphonso X., *Sp.* Astronomy, Alchemy.
1283 *d.* Phil. Moustier, *Fr.* Hist. of France in verse.
1226-1286 Abulfaragi, *Arab.* Universal History.
1288 *l.* Guido of Colonna, *It.* Poems, History.
1291 *d.* Brunetto Latini, *It.* "Il Tesoro."
1193-1291 Saadi, *Pers.* "Gulistan," "Bostan," Poems.
1214-1292 Roger Bacon, *Br.* Chemistry, Optics, &c.
1292 *l.* Arnold of Lubeck, *Ger.* Chron. of the Slavi.
1296 *d.* G. Durand, *It.* Law.
1298 *l.* Marco Polo, *It.* Travels.
1298 *d.* G. de Voragine, *It.* Legends of Saints.
Robert of Gloucester, *Br.* Chronicle in verse.
Sturla Thoridsen, *Dan.* Hist. of Norway.
William Rishanger, *Br.* Hist. of England.
Richard Middleton, *Br.* Theology.
Thomas Lermont, the Rhymer, *Br.* "Sir Tristram," a Romance.
Bohadin, *Arab.* Life of Saladin.
Abdollatif, *Arab.* Topography of Egypt.
Elfaragi, *Arab.* Poems.
Melis Stoke, *Dutch.* Poetic Chronicle.
1235-1300 J. Van Mærlant, *Dutch.* Poems.
1300 *d.* Guido Cavalcanti, *It.* Poems.

1302 *l.* Ferdusi, *Pers.* Poems, History.
1304 *l.* George Pachymer. History.
1305 *l.* Bernard Gordon, *Fr.* Medicine.
1306 *d.* John of Paris, *Fr.* Theology.
1308 *d.* Duns Scotus, *Br.* Philosophy.
1308 *l.* Torreg. Rustechelli, *It.* Commentaries.
1308 *d.* John Fordun, *Br.* Chron. of Scotland.
1312 *l.* Walter Burleigh, *Br.* Philosophy.
1312 *d.* Theod. Metochita, History.
1313 *d.* Arn. Villanova, *It.* Alchemy.

Chronology.

A. D.

1236-1315 Raimund Lully, *Sp.* Alchemy.

1250-1315 Pietro d'Albano. Astrology, Physics.

1260-1318 Jean de Joinville, *Fr.* History of Louis IX.

1319 *l.* Max. Planudes. Anthology.

1265-1321 Dante, *It.* "La Divina Commedia."

1327 *d.* Cecco d'Ascoli, *It.* Astronomy.

1328 *d.* Nicolas Triveth, *Br.* Hist., Med., Theology.

1331 *d.* Novairi, *Arab.* Universal History.

1273-1333 Abulfeda, *Arab.* Geography, History.

1333 *d.* W. Durand, *Fr.* Law.

1275-1340 Manuel Philis. Poems.

1341 *l.* Callistus Xantopulus. Eccles. History.

1343 *l.* Leo Pilatus. Literature.

1344 *d.* E. Hajam, *Arab.* Grammar.

1281-1345 R. Aungerville, *Br.* "Philobiblion."

1347 *d.* W. Occam, *Br.* Law.

1348 *d.* G. Andreas, *It.* Canons.

1260-1348 F. Barberino, *It.* Poems.

1348 *l.* Bartolus, *It.* Law.

1350 *d.* Niceph. Gregoras. History.

1350 *l.* John Tauler, *Ger.* Sermons.

1352 *d.* Lawrence Minot, *Br.* Historical Poems.

1357 *l.* John Cantacuzenus. History.

1358 *d.* Ibn al Wardi, *Arab.* Geography.

1360 *d.* Ralph Higden, *Br.* Chron. of England.

1362 *d.* Juan Manuel, *Sp.* Romances.

1368 *d.* Jafei, *Arab.* Biography.

1370 *d.* Henry Knighton, *Br.* Chron. of England.

1371 *l.* Gerard Groot, *Dutch.* Theology.

1372 *d.* John Maundeville, *Br.* Travels.

1304-1374 Petrarca, *It.* Sonnets, Epic, Literature.

1313-1375 Boccacio, *It.* "Il Decamerone."

1377 *d.* Turan Shah, *Pers.* Hist. of Persia.

1388 *d.* Matthew of Westminster, *Br.* Flowers of History.

1324-1384 J. Wicliffe, *Br.* Theology. Trans. of the Bible.

1395 *d.* Hafiz, *Pers.* Odes.

1326-1396 John Barbour, *Br.* "The Bruce."
Peter Langtoft, *Br.* Anglo-Norman Chronicle.
Philippe of Vitri, *Fr.* Translation of Ovid.
Jan van Heelu, *Dutch.* Chronicles.
Mohammed Ibn Batuta, *Arab.* Travels.
Geo. Codinus. History.
Mon. de Luzzi, *It.* Anatomy.
Adam Davie, *Br.* Metrical Romances.
Hugh de Brachton, *Br.* Law.
R. Langlande, *Br.* "Pierce Plowman," a satire.
Heinrich von Rebdorf, *Ger.* Chronicles.
Jacob von Konigshopen, *Ger.* Chronicles.
John Scheldberger, *Ger.* Hist. of Timour.

1328-1400 Geoffrey Chaucer, *Br.* Canterbury Tales, &c.

1400 *l.* Eman. Moscupulus. Mathematics.

1402 *d.* John Gower, *Br.* Elegies, Romances, &c.

1337-1402 John Froissart, *Fr.* Chronicles.
Andrew of Wyntoun, *Br.* Chron. of Scotland.

1404 *l.* Gobelin Persona, *Ger.* General History.

1412 *l.* Eric Olai, *Swed.* Hist. of Goths and Swedes.

1329-1414 Firuzabudi, *Arab.* "The Camoos."

1415 *d.* Eman. Chrysolorus. Grammar.

1376-1415 John Huss, *Ger.* Theology.

1416 *l.* Paul de Castro, *It.* Law.

1416 *l.* J. W. Gansfoet, *Fr.* Theology.
Felix Hammerlein, *Ger.* Satires.

1420 *l.* N. Gasparini, *It.* Commentary on Cicero.

1421 *l.* W. Lynwood, *Br.* Law.

1424 *l.* Luca de Burgo, *Sp.* Mathematics.

1424 *l.* Cherefeddin-Ali, *Pers.* Life of Tamerlane, &c.

1350-1425 Peter d'Ailly, *Fr.* Astronomy.

A. D.

1356-1429 Ferreti, *It.* History of his own times.

1363-1429 John Gerson, *Ger.* Scholastic Philosophy.

1430 *d.* Bryn Karlsson *Swede.* "Instruction to Kings and Princes."

1432 *d.* Raymund de Sebunda, *Fr.* Theology.

1395-1437 James I. of Scots. "King's Quhair," &c.

1367-1438 Makrizi, *Arab.* History.

1439 *d.* Henry of Balma, *Fr.* Mystic.

1439 *l.* Michael Glycas. Annals to 1118.

1380-1440 John Lydgate, *Br.* Poems.

1440 *d.* T. Walsingham, *Br.* History of Normandy.
Harry the Minstrel, *Br.* "Sir W. Wallace."

1443 *l.* Leonardo Bruni, *It.* Hist. of Florence.
Leonard of Pisa, *It.* Algebra.

1393-1444 Ulug Beg, *Arab.* Astronomy, Chronology.

1444 *l.* Ferdinand de Cordova, *Sp.* "De Artificio omnis Scibilis."

1445 *l.* Nicolas Tudeschi, *It.* Law.

1448 *d.* Edmund Dinter, *Dutch.* Chron. of Brabant.

1450 *d.* Arabshah, *Arab.* Life of Tamerlane.

1450 *d.* Pletho. Philosophy.

1450 *l.* John Fortescue, *Br.* Laws of England.

1453 *l.* Andrelini, *It.* Poems.

1407-1457 Lorenzo Valla, *It.* Literature.

1458 *d.* Alain Chartier, *Fr.* Poems.

1380-1459 Poggio, *It.* Literature.

1396-1459 Gianozzo Manetti, *It.* Oriental Literature

1370-1460 Guarino, *It.* Trans. of Plutarch.

1460 *d.* Bart. Montagnana, *It.* Medicine.

1423-1461 Geo. Von Peurbach, *Ger.* Theory of Planets.

1461 *l.* Corbueil, *Fr.* Satire.

1462 *d.* Mich. Savonarola, *It.* Medicine.

1388-1463 Flav. Blondus, *It.* History of Venice.

1405-1464 Æneas Sylvius, *It.* History, Poems.

1464 *l.* Nic. von Cas., *Ger.* Mathematics.

1415-1466 B. Accolti, *It.* History of Holy War.

1396-1468 Geo. of Trebizond, Aristot. Philosophy.

1468 *l.* Monstrelet, *Fr.* Continuation of Froissart.

1470 *l.* Const. Lascaris. Grammar, &c.

1374-1471 A. Beccadelli, *It.* "Hermaphroditus."

1393-1471 Beccat. Panormita, *It.* Biography.

1380-1471 Thomas à Kempis, *Ger.* Theology.

1395-1472 Bessarion. Theology.

1472 *l.* Martin de Ilkus, *Pole.* Math. Almanac.

1393-1473 P. Vander Heyden, *Dutch.* Chronicle.

1474 *l.* William Caxton, *Br.* Translations from Latin, French, &c.

1476 *l.* George Phranza. History.

1478 *d.* Theodore Gaza. Origin of the Turks, &c.

1410-1480 John Argyrophilus. Aristot. Philosophy.

1415-1480 Dlugossus, *Pole.* History of Poland.

1480 *d.* Bacai, *Arab.* Biography.

1421-1481 Bart. Platina, *It.* Lives of Popes.

1482 *d.* Paul Toscanello, *It.* Astronomy.

1442-1485 Rud. Agricola, *Dutch.* History, Philosophy.

1486 *d.* Jami, *Pers.* Poems.
John Hardyng, *Br.* Chron. of England to 1428.

1487 *d.* Thomas Littleton, *Br.* Law.

1432-1487 Pulci, *It.* "Morgante Maggiore."

1489 *l.* Khondemir, *Pers.* Gen. Hist. to A.D. 1474.

1491 *l.* Laonicus Chalcondyles. History of the Turks.

1490 *d.* M. Boiardo, *It.* "Orlando Inamorato."

1492 *d.* Lorenzo di Medicis, *It.* Poems, Literature.

1493 *l.* Mar. Behaim, *Ger.* Geography.

1493 *l.* Conrad Botho, *Ger.* Chronology.

1463-1494 Pico de Mirandola, *It.* Metaphysics

1425-1495 Pomponius Lætus, *It.* Lives of Cæsar, &c.

1495 *d.* Gabriel Brie, *Ger.* Theology.

1437-1496 F. Buonaccorsi, *It.* Biography.

1452-1498 Girolamo Savonarola, *It.* "Triumphus Crucis."

Chronology.

A. D.
1433-1499 Marsilius Ficinus, *It.* Translation of Plato.
John von Gmünden, *Ger.* Astronomy.
Peter von Andlo, *Ger.* "De Imperio Romano."
Breydenbach, *Ger.* Topography.
Lord Berners, *Br.* Translation of Froissart.
Stephen Hawes, *Br.* "Passetyme of Pleasure."
Douglas of Glastonbury, *Br.* Chronicles of England.

From this point the Literary Chronology of Britain is given in a separate table.

1502 *d.* Bonfinius, *It.* History of Hungary.
1445-1509 Philippe de Commines, *Fr.* History of his times.
1433-1513 Demetrius Chalcondyles. Philology.
1462-1516 John Trithemius, *Ger.* Natural Philosophy.
1437-1517 Francis Ximenes, *Sp.* Polyglot Bible.
1452-1520 Leonardo da Vinci, *It.* "Treatise on Painting."
G. Abrosi, *It.* Astronomy.
1482-1528 Machiavelli, *It.* Politics, History.
1478-1529 B. Castiglione, *It.* "The Courtier."
1530 *d.* Baber, *Turk.* Autobiography.
1484-1531 Zuinglius, *Swiss.* Theology.
1474-1533 Ariosto, *It.* "Orlando Furioso."
1486-1535 Cornelius Agrippa, *Ger.* Physics, Theology.
1476-1536 Erasmus, *Dutch.* Theology, Literature.
1503-1536 Garcillasso de la Vega, *Sp.* Poems.
1482-1540 Guicciardini, *It.* History of Italy.
1492-1540 J. Luis Vives, *Sp.* Philosophy, Theology.
1493-1541 Paracelsus, *Ger.* Chemistry.
1472-1543 N. Copernicus, *Pole.* Astronomy.
1544 *l.* Damian Goez, *Port.* History, Travels.
1544 *l.* Nic. Tartaglia, *It.* Mathematics.
1544 *d.* Olaus Magnus, *Swede.* "Customs of the Northern Nations."
1483-1546 Martin Luther, *Ger.* Theology.
1470-1547 Bembo, *It.* History of Venice.
1483-1553 F. Rabelais. Burlesque Romance.
1555 *l.* A. Zarate, *Sp.* "Discovery of Peru."
1484-1558 J. C. Scaliger, *Fr.* Philology.
1503-1559 R. Stephens, *Fr.* Philology.
1497-1560 Melancthon, *Ger.* Theology.
1523-1563 Fallopius, *It.* Osteology, Anatomy.
1475-1564 M. Angelo Buonarotti, *It.* Poems.
1509-1564 John Calvin, *Fr.* Theology.
1516-1565 Conrad Gesner, *Ger.* Natural History.
1500-1570 Benvenuto Cellini, *It.* Autobiography.
1516-1571 G. Fabricius, *Ger.* Topography.
1515-1572 P. Ramus, *Fr.* Logic.
1512-1574 P. Manutius Aldus, *It.* Commentaries.
1493-1575 Bernardo Tasso, *It.* "Amadis."
1509-1575 F. Commandino, *It.* Mathematics.
1501-1576 Cardan, *It.* Mathematics, Philosophy.
1524-1579 Camoens, *Port.* "The Lusiad."
1580 *d.* Gonsalvo Illescas, *Sp.* "Lives of Popes."
1515-1580 V. Borghini, *It.* History.
1513-1590 A. de Morales, *Sp.* History of Spain.
1590 *d.* Al Jannabi, *Arab.* Universal History.
1529-1590 Hen. Stephens, *Fr.* Philology
1533-1592 Mich. de Montaigne, *Fr.* Essays.
1512-1594 Gerard Mercator, *Ger.* Geography.
1544-1595 Torquato Tasso, *It.* "Gierusalemme Liberata."
1537-1600 J. Accosta, *Sp.* History of West Indies.
1535-1600 Luis Molina, *Sp.* Metaphysics.

1546-1601 Tycho Brahe, *Dane.* Astronomy.
1519-1603 Andrea Cæsalpino, *It.* Botany.
1540-1603 F. Vieta, *Fr.* Algebra.
1543-1603 Pierre Charron, *Fr.* Ethics.

A. D.
1563-1603 F. Bracciolini, *It.* "La Croce Racquistata."
1603 *l.* John Bayer, *Ger.* "Uranometria."
1522-1605 U. Aldrovandi, *It.* Natural History.
1529-1606 B. Davanzati, *It.* History of the English Reformation.
1606 *l.* Jan van Heemskerk, *Dutch.* "Arcadia."
1538-1607 C. Baronius, *It.* Ecclesiastical Annals.
1607 *l.* Ferishta, *Pers.* History of India.
1519-1609 Theodore Beza, *Fr.* Theology, Philology.
1540-1609 J. J. Scaliger, *Fr.* History, Criticism.
1545-1609 Orazio Torsellino, *It.* Grammar, Biography.
1533-1611 Possevini, *It.* Description of Muscovy.
1611 *l.* G. Marini, *It.* Romances.
1538-1613 Guarini, *It.* "Il Pastor Fido."
1560-1613 C. Ritterhuis, *Ger.* Law.
1573-1613 M. Regnier, *Fr.* Satires.
1565-1614 Marq. Freher, *Ger.* History of Germany and France.
1549-1616 Cervantes, *Sp.* "Don Quixote."
1616 *d.* C. Schevenkfield, *Ger.* Natural History.
1553-1617 J. A. de Thou, *Fr.* History of his own times.
1570-1617 B. de Brito, *Port.* History of Portugal.
1585-1619 L. Vanini, *It.* Philosophy.
1619 *d.* J. Fabricius, *It.* Comparative Anatomy.
1542-1621 Bellarmine, *It.* Polemics.
1544-1621 P. Matthieu, *Fr.* History of France.
1555-1621 J. Buxtorf, *Ger.* Philology.
1541-1622 J. Guevara, *Sp.* Publicist.
1552-1623 P. R. Sarpi, *It.* Hist. Council of Trent.
1580-1623 P. Cluvier, *Ger.* Geography.
1537-1624 Juan Mariana, *Sp.* History, Chronology.
1565-1625 Her. y. Tordesillos. History of Spain.
1556-1628 F. Malherbe, *Fr.* Odes.
1585-1629 G. Bartholine, *Swede.* Anatomy.
1566-1631 Bart. di Argensola, *Sp.* Tragedy, History.
1571-1631 John Kepler, *Ger.* Astronomy.
1576-1631 E. C. Davila, *It.* Hist. Civil Wars of France.
1633 *d.* A. de Andrada, *Port.* Travels in Thibet and Cathay.
1561-1635 A. Tassoni, *It.* "Secchia Rapita."
1562-1635 Lope de Vega, *Sp.* Drama.
1576-1635 M. Goldast, *Ger.* History.
1636 *l.* Matheo Riberio, *Port.* Romance.
1567-1637 Ab. Bzovius, *Pole.* Ecclesiastical Annals.
1568-1639 T. A. Campanella, *It.* Philosophy.
1639 *l.* F. de Vasconcellos, *Port.* Poems.
1545-1640 Arn. Jonas, *Iceland.* History of Iceland.
1584-1640 An. Du Chesne, *Fr.* Collection of Histories.
1591-1640 J. I. Pontanus, *Dane.* Danish History.
1609-1640 Paul Fleming, *Ger.* Poems.
1597-1641 C. Acuña, *Sp.* Description of the Riv. Amazon.
1564-1642 Galileo, *It.* Astronomy.
1568-1643 Hen. Spondanus, *Fr.* History.
1577-1644 J. B. van Helmont, *Dutch.* Chemistry.
1579-1644 G. Bentivoglio, *It.* Hist. Civ. Wars, Flanders.
1644 *d.* B. Castelli, *It.* Mathematics.
1644 *d.* John Maccor, *Pole.* Theology.
1570-1645 F. Quevedo, *Sp.* Tales, Satires.
1583-1645 H. de Groot (Grotius) *Dutch.* "De Jure Belli et Pacis." Theology, Philology.
1646 *d.* L. V. de Guevara, *Sp.* "El Diablo Coxuelo."
1646 *d.* E. de Almeyda, *Port.* History of Ethiopia.
1567-1647 Fabio Colonna, *It.* Botany.
1587-1647 P. C. Hooft, *Dutch.* Drama, History of Netherlands.
1594-1647 Beverwyk, *Dutch.* Medicine.
1647 *d.* B. Cavalieri, *It.* Mathematics.
1571-1649 F. Strada, *It.* History of Wars in Flanders.
1576-1649 C. Scioppius, *Ger.* "Ars Critica."
1596-1650 Des Cartes, *Fr.* Metaphysics, Mathematics.

Chronology.

A. D.
1583-1652 Dennis Petau, *Fr.* Chronology.
1586-1652 Pietro della Valle, *It.* Travels.
1596-1652 C. Salmasius, *Fr.* History, Criticism.
1588-1654 Ole Worm, *Dane.* Antiquities, Philology.
1592-1655 P. Gassendi, *Fr.* Philosophy.
1586-1656 G. Calixtus, *Ger.* Historical Theology.
1597-1657 J. F. de Andrada, *Port.* Biography.
1658 *d.* Alb. Coelho, *Sp.* "Wars of Brazil."
1660 *d.* L. Ulloa, *Sp.* Poems.
1623-1662 Blaise Pascal, *Fr.* "Provincial Letters."
1605-1663 Abulgazi, *Arab.* History of the Tartars.
1607-1664 S. Guicheron, *Fr.* Hist. of the House of Savoy.
1616-1664 A. Gryphius, *Ger.* Tragedy.
1599-1667 Bochart, *Fr.* Sacred Geography and Zoology.
1601-1667 Calderon, *Sp.* Drama.
1619-1667 P. Voetius, *Dutch.* Law.
1622-1669 Reinier Anslo, *Dutch.* "Plague of Naples."
1590-1670 Przipcov, *Pole.* Theology.
1611-1671 J. F. Gronovius, *Dutch.* Philology.
1617-1672 Nic. Antonio, *Sp.* Bibliotheca Hispanica.
1615-1673 Salvador Rosa, *It.* Satires.
1620-1673 Molière, *Fr.* Drama.
1673 *d.* Panagioti. Theology.
1595-1674 J. Chapelaine, *Fr.* "La Pucelle."
1609-1674 Diemerbroek, *Dutch.* Anatomy.
1590-1675 Lubienelski, *Pole.* History of Reformation.
1675 *d.* Haji Khalifeh, *Arab.* History.
1632-1677 B. Spinoza, *Dutch.* Theology, Metaphysics.
1616-1678 G. B. Nani, *It.* History of Venice.
1628-1679 F. Burmann, *Dutch.* Theology.
1603-1680 Rochefoucauld, *Fr.* Maxims.
1637-1680 Swammerdam, *Dutch.* Natural History.
1643-1680 L. Moreri, *Fr.* Historical Dictionary.
1606-1681 Her. Conring, *Ger.* Antiquities.
1620-1681 Nicholas Heins, *Dutch.* Poems, Philology.
1638-1683 Lohenstein, *Ger.* Poems.
1606-1684 P. Corneille, *Fr.* Drama.
1604-1685 Olearius, *Ger.* Travels.
1626-1685 Ger. Brandt, *Dutch.* Hist. of the Reformation.
1602-1686 Otto Guerike, *Ger.* Air Pump, &c.
1611-1686 Ant. de Solis, *Sp.* Hist. Conq. of Mexico.
1639-1691 D. G. Morhoff, *Ger.* History, Biography.
1607-1692 Adr. Valesius, *Fr.* "Deeds of the Franks."
1626-1694 M. de Sevigne, *Fr.* Letters.
1628-1694 M. Malpighi, *It.* Anatomy.
1631-1694 S. von Puffendorf, *Ger.* History, Law.
1621-1695 La Fontaine, *Fr.* Fables, Tales.
1625-1695 H. Herbelot, *Fr.* Oriental Literature.
1629-1695 Chr. Huygens, *Dutch.* Mathematics, Mechanics.
1603-1696 Henry Valesius, *Fr.* Ecclesiastical History.
1636-1696 La Bruyère, *Fr.* "Characters."
Villani, *It.* History of Florence.
1626-1697 F. Redi, *It.* Natural History.
1637-1698 Tillemont, *Fr.* Ecclesiastical History.
1614-1699 J. Leusden, *Dutch.* Philology.
1639-1699 J. Racine, *Fr.* Drama.
Nured Shirazi, *Pers.* Metaphysics.
1638-1700 H. Meibomius, *Ger.* History.
1621-1703 V. Viviani, *It.* Mathematics.
1635-1703 J. C. Sturmius, *Dane.* Physics, Mathematics.
1632-1704 Bourdaloue, *Fr.* Sermons.
1647-1704 J. Voetius, *Dutch.* Comment. on Pandects.
1662-1704 Bossuet, *Fr.* History, Sermons.
1647-1706 P. Bayle, *Fr.* Dictionary.
1638-1707 C. Cellarius, *Ger.* Geography.
1656-1708 Tournefort, *Fr.* Botany.
1636-1708 H. Witsius, *Dutch.* Theology.
1625-1709 T. Corneille, *Fr.* Drama.

A. D.
1636-1711 Boileau, *Fr.* Satires, Literature.
1625-1712 G. D. Cassini, *It.* Mathematics, Astronomy.
1633-1714 A. Magliabecchi, *It.* Literature.
1633-1714 A. Marchetti, *It.* Poems, Philosophy.
1661-1714 Meletius. Geography.
1638-1715 Melebranche, *Fr.* "Search after Truth."
1651-1715 Fénélon, *Fr.* "Telemachus."
1645-1716 J. Gronovius, *Dutch.* Greek Antiquities.
1646-1716 Leibnitz, *Ger.* Mathematics, Metaphysics.
1664-1718 G. V. Gravina, *It.* Law.
1639-1720 Torfæus, *Iceland.* History of Norway.
1651-1720 Anne Dacier, *Fr.* Philology.
1654-1720 John Peringskiold, *Dane.* History.
1630-1721 Huet, *Fr.* Philosophy and Theology.
1651-1722 Andrew Dacier, *Fr.* Philology.
1659-1722 C. Vitringa, *Dutch.* Theology.
1632-1723 A. Leuwenhoek, *Dutch.* Natural History.
1653-1723 Fleury, *Fr.* Ecclesiastical History.
1661-1725 Paul Rapin, *Fr.* History of England.
1655-1728 C. Thomasius, *Ger.* Law.
1649-1729 G. Daniel, *Fr.* History of France.
1667-1729 F. Budæus, *Ger.* Divinity.
1670-1730 J. G. Von Eccard, *Ger.* General History.
1677-1730 Saurin, *Fr.* Sermons.
1733 *l.* Daziel, *Pole.* History of Poland.
1660-1734 G. E. Stahl, *Ger.* Chemistry.
1652-1735 J. Ferreras, *Sp.* History of Spain.
1655-1735 Vertot, *Fr.* History.
1668-1736 J. A. Fabricius, *Ger.* Bibliography.
1668-1738 H. Boerhaave, *Dutch.* Medicine.
1671-1738 B. G. Struve. History of Germany.
1655-1741 Montfaucon, *Fr.* Antiquities.
1661-1741 C. Rollin, *Fr.* Ancient History.
1660-1742 F. Hoffman, *Ger.* Medicine.
1663-1742 Massillon, *Fr.* Sermons.
1663 *b.* Arne Magnassen, *Dane.* Collect. of History.
1688-1742 Gravesande, *Dutch.* Mathematics.
1663-1743 Binkerschoek, *Dutch.* Law.
1667-1747 J. Bernouilli, *Ger.* Mathematics.
1677-1747 Ren. Le Sage, *Fr.* "Gil Blas."
Marcus Thamboures. Mechanics.
1675-1748 B. Hederick, *Ger.* Philology.
1680-1748 P. Giannone, *It.* History of Naples.
1672-1750 L. Muratori, *It.* Annals of Italy.
1686-1750 A. Schultens, *Dutch.* Philology.
1750 *d.* V. Tatischoff, *Russ.* Chron. of Russia.
1714-1754 A. G. Baumgarten, *Ger.* Ethics, Metaphysics.
1669-1752 Folard, *Fr.* Strategy.
1680-1754 P. N. Destouches, *Fr.* Comedies.
1684-1754 L. Holberg, *Dane.* Satire, History, Drama.
1754 *d.* Mart. Bouquet, *Fr.* "Receuil d'Histoires."
1675-1755 S. Maffei, *It.* Tragedy.
1695-1755 J. L. Mosheim, *Ger.* Ecclesiastical History.
1698-1755 Montesquieu, *Fr.* "Esprit des Loix."
1657-1756 Fontenelle, *Fr.* "Plurality of Worlds."
1677-1756 G. Cassini, *It.* Astronomy.
1695-1756 F. X. Quadrio, *It.* History of the Valteline.
1683-1757 Réaumur, *Fr.* Natural History.
1716-1758 A. Goguet, *Fr.* "Origin of Laws, Arts," &c.
1718-1759 J. E. Schlegel, *Ger.* Drama.
1760 *l.* Popofski, *Russ.* Translation of Pope.
1696-1761 Oudendorp, *Dutch.* Philology.
1710-1761 B. Buonamici, *It.* History.
1674-1762 Crébillon, *Fr.* Tragedies.
1688-1763 Marivaux, *Fr.* Novels.
1712-1764 F. Algarotti, *It.* "Newtonianism."
1698-1764 Pontoppidan, *Dane.* "Origines Havnienses."
1711-1765 Lomonosoff, *Russ.* Poems, Hist., Science.
1693-1765 Crevier, *Fr.* Ancient History.
1715-1766 C. Villaret, *Fr.* Hist. of France.

Chronology.

A.D.
1718-1768 J. Winckelmann, *Ger.* Antiquities.
1712-1769 A. Genovesi, *It.* Metaphysics.
1685-1770 C. J. F. Henault, *Fr.* Chronol., Hist.
1770 *d.* N. Vattel, *Fr.* "Law of Nations."
1683-1771 B. S. Albinus, *Dutch.* Anatomy.
1715-1771 Helvetius, *Fr.* "De l'Esprit."
1699-1771 Guyot, *Fr.* History of Empires.
1771 *d.* Tomas de Yriarte, *Sp.* Fables.
1700-1772 G. van Swieten, *Dutch.* Medicine.
1707-1772 C. Goldoni, *It.* Comedies.
1772 *d.* Velasquez, *Sp.* Hist. of Castilian Poetry.
1775 *l.* Turgot, *Fr.* Political Economy.
1708-1777 Haller, *Ger.* "The Alps."
1709-1777 De Brosses, *Fr.* Philology, History.
1711-1777 G. F. Meyer, *Ger.* Philosophy.
1695-1778 Voltaire, *Fr.* Tragedy, History.
1707-1778 Linnæus, *Swede.* Natural History.
1729-1781 G. E. Lessing, *Ger.* Drama, Fables.
1698-1782 P. Metastasio, *It.* Operas.
1702-1782 D'Anville, *Fr.* Geography.
1707-1783 Leonard Euler, *Ger.* Mathematics.
1714-1783 F. W. von Gleicken, *Ger.* Natural History.
1717-1783 D'Alembert, *Fr.* Encyclopédie.
1713-1784 J. J. Rousseau, *Fr.* "Emile," "Héloise."
1713-1784 Diderot, *Fr.* Encyclopédie.
1726-1785 C. F. R. Millot, *Fr.* History.
1731-1786 J. A. E. Götze, *Ger.* Entomology.
1707-1787 J. J. Gessner, *Ger.* Numismatology.
1711-1787 R. J. Boscowitch, *It.* Math., Philology.
1707-1788 Buffon, *Fr.* Natural History.
1730-1788 S. Gessner, *Ger.* "Death of Abel."
1749-1789 Mirabeau, *Fr.* Politics.
1790 *d.* J. H. Magalhæns, *Sp.* Natural Philosophy.
1725-1791 Semler, *Ger.* Theology.
1807 *d.* Putter, *Ger.* Law of Nations.
1724-1793 A. F. Büsching, *Ger.* Geography.
1736-1793 Bailly, *Fr.* Astronomy.
1712-1794 Hoogeveen, *Dutch.* Philology.
1731-1794 G. Tiraboschi, *It.* Hist. of Italian Literature.
1743-1794 Lavoisier, *Fr.* Chemistry.
1755-1794 Florian, *Fr.* Tales.
1716-1795 J. J. Barthelemy. "Anacharsis."
1716-1795 A. Ulloa, *Sp.* Mathematics.
1720-1795 C. Beccaria, *It.* "Crimes and Punishments."
1728-1795 J. G. Zimmerman, *Swiss.* On Solitude.
Bulgaris. Mathematics.
1711-1796 G. Raynal, *Fr.* Hist. E. and W. Indies.
1796 *d.* Riga. Natural Philosophy.
1720-1798 P. T. Suhm, *Dane.* Hist. of Denmark.
1737-1798 L. Galvani, *It.* Galvanism.
1751-1798 G. Filangieri, *It.* Legislation.
1725-1799 Montucla, *Fr.* Mathematics.
1729-1799 L. Spallanzani, *It.* Natural History.
1732-1799 Beaumarchais, *Fr.* Comedies.

1741-1801 Lavater, *Swiss.* Physiognomy.
1732-1802 A. Fabroni, *It.* Biography.
1724-1803 Klopstock, *Ger.* "The Messiah."
1749-1803 V. Alfieri, *It.* Tragedy.
1724-1804 Im. Kant, *Ger.* Metaphysics.
1732-1804 Necker, *Fr.* Finance.
1759-1805 F. Schiller, *Ger.* Drama.
1745-1806 Tiedemann, *Ger.* Metaphysics.
1732-1807 J. Lalande, *Fr.* Astronomy.
1729-1807 Lebrun, *Fr.* Poems.
1752-1809 J. von Müller, *Ger.* Universal History.
1755-1809 Fourcroi, *Fr.* Chemistry.
1729-1811 Bougainville, *Fr.* Geography, Voyages.
1744-1811 G. Jovellanos, *Sp.* "Agrarian Law."
1741-1811 P. S. Pallas, *Russ.* Natural History.

A.D.
1745-1812 J. W. von Archenholz, *Ger.* "Seven Years' War."
1736-1813 Lagrange, *Fr.* Mathematics.
1733-1813 Wieland, *Ger.* Romances, Poems.
1730-1813 Bossut, *Fr.* Mathematics.
1731-1813 Denina, *It.* Hist. of Italian Revolutions.
1737-1814 B. St. Pierre, *Fr.* "Paul and Virginia."
1762-1814 J. G. Fichte, *Ger.* Metaphysics.
1725-1815 Desmarets, *Fr.* Natural History.
1743-1816 Cagnoli, *It.* Mathematics, Astronomy.
1816 *d.* Schräter, *Ger.* Astronomy.
1736-1816 Guyton Morveau, *Fr.* Chemistry.
1750-1817 Werner, *Ger.* Geology.
1743-1817 Klaproth, *Ger.* Chemistry.
1768-1817 Madame de Staël, *Fr.* "Corinne," &c.
1726-1817 Deluc, *Fr.* Natural History, Chemistry.
1746-1818 Gaspard Monge, *Fr.* Mathematics.
1761-1819 Kotzebue, *Ger.* Drama.
1743-1819 Jacobi, *Ger.* Philosophy.
1819 *d.* Thorlacksen, *Iceland.* Translation of Milton.
1755-1820 Volney, *Fr.* Travels.
1763-1821 Buhle, *Ger.* Philology, Hist. of Philosophy.
1776-1822 E. T. A. Hoffman, *Ger.* Tales.
1743-1822 Haüy, *Fr.* Crystallography.
1756-1823 Llorente, *Sp.* Hist. of the Inquisition.
1741-1825 H. Fuseli, *Swiss.* Painting.
1763-1825 J. P. Richter, *Ger.* Tales.
1747-1825 Denon, *Fr.* Travels in Egypt.
1765-1826 Karamsin, *Russ.* History of Russia.
1775-1826 Malte Brun, *Dane.* Geography.
1764-1826 Jens Baggesen, *Dane.* Lyrics.
1749-1827 Laplace, *Fr.* Mathematics, Astronomy.
1745-1827 Volta, *It.* Galvanism.
1827 *d.* Philippidas. Hist. of Wallachia.
1752-1827 J. G. Eichhorn, *Ger.* Biblical Criticism.
1776-1827 Ugo Foscolo, *It.* Drama.
1766-1828 Bouterwek, *Ger.* Philosophy.
1764-1829 P. C. Buttmann, *Ger.* Greek Grammar.
1773-1829 F. Schlegel, *Ger.* Philology, Philosophy.
1776-1830 Niebuhr, *Dane.* History of Rome.
1776-1831 C. Spurzheim, *Fr.* Phrenology.
1770-1831 G. W. F. Hegel, *Ger.* Philosophy.
1750-1831 Huber, *Ger.* Natural History.
1760-1831 A. Lafontaine, *Ger.* Tales.
1709-1832 Cuvier, *Fr.* Natural History.
1746-1832 Scarpa, *It.* "Tabula Necrologiæ."
1749-1832 Champollion, *Fr.* "Philology."
1749-1832 Goethe, *Ger.* Drama, Tales, Poems, &c.
1781-1832 C. F. Krause, *Ger.* Metaphysics.
1767-1832 J. B. Say, *Fr.* Political Economy.
1751-1833 Legendre, *Fr.* Mathematics.
1761-1833 G. E. Schulze, *Ger.* Philosophy.
1766-1833 Sprengel, *Ger.* Botany.
1751-1833 Planck, *Ger.* Ecclesiastical History.
1783-1833 Ducange, *Fr.* Novels.
1767-1834 Cicognara, *It.* "History of Sculpture."
1768-1834 Schleiermacher, *Ger.* Theology.
1756-1834 Mannert, *Ger.* History, Geography.
1777-1835 Dupuytren, *Fr.* Surgery.
1767-1835 W. von Humboldt, *Ger.* "Hermann and Dorothea." Philology.
1760-1835 Böttiger, *Ger.* Antiquities.
1783-1835 H. J. von Klaproth, *Ger.* Oriental Literature.
1835 Von Platen, *Ger.* Poems.
1748-1836 A. L. de Jussieu, *Fr.* Botany.
1756-1836 C. L. Stieglitz, *Ger.* Archæology.
1772-1837 C. Fourier, *Fr.* Traité de l'Association Domestique.
1756-1837 F. W. Doering, *Ger.* Philology
1758-1838 S. de Sacy, *Fr.* Oriental Languages.

Chronology.

A. D.

1796-1838 Möhler, *Ger.* "Symbolism."
1781-1838 A. von Chamisso, *Ger.* "Peter Schlemihl."
1793-1839 Nikander, *Swede.* Poems.
1767-1839 J. Michaud, *Fr.* History.
1742-1840 Blumenbach, *Ger.* Natural History.
1758-1840 Olbers, *Ger.* Astronomy.
1753-1840 Bonald, *Fr.* Philosophy.
1797-1840 C. O. Muller, *Ger.* Archæology.
1778-1841 A. P. de Candolle, *Fr.* Botany.
1770-1842 Krug, *Ger.* Philosophy.
1780-1842 P. O. Brondsted, *Dane.* Archæology.
1796-1842 T. S. Jouffroy, *Fr.* Philosophy.
1760-1842 A. H. L. Heeren, *Ger.* History.
1773-1842 Sismondi, *Swiss.* History.
1785-1842 W. Gesenius, *Ger.* Hebrew Literature.
1772-1842 M. J. Degerando, *Fr.* Metaphysics.
1777-1843 De la Motte-Fouqué, *Ger.* Poems, Romances.
1781-1843 Hahnemann, *Ger.* Homœopathy.
1807-1843 H. N. Ulrichs, *Ger.* Archæology.
1803-1843 Maurenbrecher, *Ger.* Jurisprudence.
1763-1845 Royer Collard, *Fr.* Philosophy.
1767-1845 A. W. von Schlegel, *Ger.* "Lectures on Dramatic Art."
1764-1847 F. C. Jacobs, *Ger.* Philology.
1771-1848 H. Zschokke, *Ger.* History, Fiction, &c.
1769-1848 Chateaubriand, *Fr.* "Génie du Christianisme."
1779-1848 Berzelius, *Swede.* Chemistry.
1849 *d.* J. G. Orelli. Philology.
1792-1849 K. G. Zumpt, *Ger.* Philology.
1774-1849 C. F. Becker, *Ger.* Philology.
1780-1849 W. M. L. De Wette, *Ger.* Biblical Criticism.
1850 *d.* Ed. Biot, *Fr.* Natural Philosophy.
1850 *d.* Gay Lussac, *Fr.* Chemistry.
1789-1850 J. A. Neander, *Ger.* Ecclesiastical History
1779-1850 Oehlenschläger, *Dane.* Poems.
1797-1850 W. Beer, *Ger.* Astronomy.
1799-1850 H. de Balzac, *Fr.* Fiction.
1779-1850 Schumacher, *Ger.* Astronomy.
1782-1851 J. J. Audubon, *Fr.* Ornithology.
1777-1851 Oersted, *Dane.* Natural Philosophy.
1793-1851 Lachmann, *Ger.* Biblical Criticism.
1760-1851 H. G. G. Paulus, *Ger.* Philology.
1778-1851 L. Oken, *Ger.* "Physio-philosophy."
1794-1852 Scholz, *Ger.* Biblical Literature.
1783-1853 Orfila, *Fr.* Toxicology.
1774-1853 C. L. von Buch, *Ger.* Geology.
1773-1853 L. Tieck, *Ger.* Poems.
1768-1853 K. R. Lepsius, *Ger.* Archæology.
1786-1853 F. Arago. Natural Philosophy.
1854 L'Abbé Lamennais. Politics and Social Philosophy.

British Literary Chronology from the 16th Century.

1512 *d.* R. Fabyan. Chron. of England and France.
1475-1522 Gawin Douglas. Trans. of Virgil.
1460-1524 Thomas Linacre. Philology, Medicine.
1529 John Skelton. Satires, Odes.
1465-1530 Wm. Dunbar. "Thistle and Rose."
1480-1535 Thomas More. "Utopia."
1538 *d.* Anth. Fitzherbert. Husbandry.
1541 *d.* Thomas Wyatt. Sonnets.
1546-7 *d.* Earl of Surrey. Poems.
1547 *d.* T. Halls. Hist. of Houses of York and Lancaster.
Thomas Elyot. Philology.
1552 *d.* John Leland. English Antiquities.
1475-1555 H. Latimer. Sermons.
1505-1557 W. Cavendish. Life of Wolsey.
1506-1558 Robert Recorde. Arithmetic.

A. D.

1495-1563 J. Ball. Lives of British Writers.
1565 *d.* John Heywood. Drama.
1515-1568 Roger Ascham. "The Schoolmaster."
1522-1570 J. Jewel. Divinity.
1577 *d.* Geo. Gascoigne. Drama.
1580 *d.* Thomas Tusser. Husbandry.
1581 *d.* Ralph Hollingshed. Chronicles.
1581 *d.* Thomas Wilson. Logic and Rhetoric.
1506-1582 Geo. Buchanan. History of Scotland, &c.
1544-1586 Philip Sydney. Arcadia.
1517-1587 J. Fox. Book of Martyrs.
1593 *d.* Christopher Marlowe. Drama.
1553-1598 Edmund Spenser. "Fairy Queen."
1550-1600 John Lylie. Euphues.
1553-1600 R. Hooker. Ecclesiastical Polity.

1540-1603 W. Gilbert. "On the Loadstone."
1527-1605 John Stowe. Chronicles, Topography.
T. North. Translation of Plutarch.
1610 *d.* Richard Knolles. History of the Turks.
1550-1612 N. Fitzherbert. Biography.
1561-1612 J. Harrington. Transl. Ariosto.
1612 *d.* John Owen. Latin Epigrams.
1586-1615 F. Beaumont. Drama.
1553-1616 R. Hackluyt. Naval History.
1560-1616 J. Pits. Biography of Kings, Bishops, &c.
1564-1616 W. Shakspeare. Drama.
1552-1617 Walter Raleigh. Hist. of the World.
1550-1617 John Napier. Logarithms.
1562-1619 J. Daniel. Poems.
1567-1619 Samuel Daniel. Hist. of England.
1551-1623 Wm. Camden. Antiquities.
1576-1625 John Fletcher. Drama.
1560-1626 Francis Bacon. Philosophy, History
1565-1626 L. Andrews. Sermons.
1627 *d.* John Hayward. English History.
1586 *b.* J. Ford. Drama.
1577-1628 S. Purchas. Collection of Voyages.
1555-1629 J. Speed. Hist. of Great Britain.
1563-1631 M. Drayton. Poems.
1570-1631 R. B. Cotton. Antiquities.
1632 *d.* E. Fairfax. Translation of Tasso.
1550-1634 Edward Coke. Law.
1574-1637 Ben Jonson. Drama.
1576-1639 Robert Burton. "Anatomy of Melancholy."
1585-1639 P. Massinger. Drama.
1562-1641 Henry Spelman. Antiquities.
1580-1641 Thomas Roe. Travels in the East.
1609-1641 J. Suckling. Poems.
1577-1643 G. Sandys. Translations, Poems.
1602-1644 W. Chillingworth. Theology.
1568-1645 R. Baker. Chronicle of England.
1581-1648 E. (Lord) Herbert. Hist. of Henry VIII.
1585-1649 W. Drummond. Poems.
1594-1650 Thomas May. History of Parliament.
1584-1654 John Selden. Antiq., Law, Hist.
1580-1656 James Usher. Divinity, History.
1578-1657 William Harvey. Circulation of the Blood.
1600-1661 Brian Walton. Polyglot Bible.
1608-1661 Thomas Fuller. History, Biography.
1573-1662 John Donne. Satires, Essays.
1594-1666 James Shirley. Drama.
1588 1667 George Wither. Satires.
1613-1667 Jeremy Taylor. Divinity.
1618-1667 A. Cowley. Poems.
1600-1667 W. Prynne. History, Politics.
1615-1668 John Denham. Tragedies, "Cooper's Hill."
Mrs Lucy Hutchinson. Biography.
1608-1673 Clarendon. History of the Rebellion.
1608-1674 John Milton. "Paradise Lost."

Chronology.

A. D.

1605-1676 B. Whitlocke. History.
1611-1677 J. Harrington. "Oceana."
1630-1677 Isaac Barrow. Divinity, Math.
1620-1678 A. Maxwell. Poems.
1588-1679 Thomas Hobbes. Metaphysics.
1648-1680 Rochester. Satires.
1605-1682 Thomas Browne. "On Vulgar Errors."
1593-1683 Isaac Walton. Biography. Angling.
1616-1683 John Owen. Theology.
1613-1684 Archbishop Leighton. Divinity.
1633-1684 Roscommon. Poems.
1651-1685 Thomas Otway. Tragedy.
1603-1685 Edmund Castell. Lexicon Heptaglotton.
1605-1686 W. Dugdale. Antiquities, History.
1612-1686 J. Pearson. Divinity.
1605-1687 Edmund Waller. Poems.
1614-1687 H. More. Theology.
1612-1688 Samuel Butler. "Hudibras."
1617-1688 R. Cudworth. Metaphysics.
1628-1688 John Bunyan. "Pilgrim's Progress."
1624-1689 T. Sydenham. Medicine.
1689 *d.* W. Sherlock. Divinity.
1615-1691 R. Baxter. "Saints' Everlasting Rest."
1627-1691 R. Boyle. Theology, Chemistry.
1656-1691 Nat. Lee. Drama.
1630-1694 J. Tillotson. Sermons.
1629-1700 Wm. Temple. History.
1700 *d.* R. Brady. History of England.

1631-1701 John Dryden. Tragedy, Satire, "Virgil."
1635-1702 R. Hooke. Nat. Philos., Chemistry.
1616-1703 John Wallis. Geometry.
1667-1703 J. Pomfret. "The Choice."
1632-1704 John Locke. Metaphysics, &c.
1628-1705 John Ray. Natural History.
1620-1706 J. Evelyn. "Sylva."
1678-1707 Geo. Farquhar. Comedies.
1676-1700 John Philips. "Splendid Shilling."
1638-1713 Thomas Rymer. "Fœdera."
1643-1715 Gilb. Burnet. "Hist. of his time."
1633-1716 R. South. Divinity.
1662-1714 M. Henry. Theology.
1679-1717 Thomas Parnel. "The Hermit."
1673-1718 Nicholas Rowe. Tragedy.
1642-1719 Isaac Newton. "Principia."
1646-1719 J. Flamsteed. Astronomy.
1672-1719 Joseph Addison. "Spectator," "Cato."
1678-1720 S. Ockley. Oriental History.
1664-1721 Matthew Prior. Poems.
1666-1726 J. Vanbrugh. Comedy.
1672-1728 W. Congreve. Comedy.
1671-1729 Richard Steele. Drama, Essays.
1671-1730 L. Echard. History of England.
1660-1731 Daniel Defoe. "Robinson Crusoe."
1685-1731 Brook Taylor. Mathematics.
1688-1732 John Gay. "Beggar's Opera," Fables.
1670-1733 B. de Mandeville. "Fable of the Bees."
1678-1735 Thomas Hearne. History and Antiquities.
1643-1737 John Strype. Eccl. History, Biography.
1682-1739 Nicolas Sanderson. Mathematics.
1661-1740 R. Bentley. Divinity, Philology.
1683-1740 D. Waterland. Divinity.
1740 *d.* Eph. Chambers. Cyclopædia.
1651-1742 Abraham Sharpe. Astronomy.
1656-1742 Edmund Halley. Astronomy.
1696-1742 A. Clarke. Divinity, Philosophy.
1710-1742 James Hammond. Elegies.
1692-1743 W. Somerville. "The Chace."
1698-1743 Richard Savage. Poems.
1688-1744 Alexander Pope. Poems.

A. D.

1667-1745 Jonathan Swift. Satires, Tales, &c
1696-1746 Colin Maclaurin. Mathematics.
1699-1746 R. Blair. "The Grave."
1674-1747 John Potter. Antiquities.
1694-1747 F. Hutcheson. Moral Philosophy.
1674-1748 Isaac Watts. Hymns.
1700-1748 James Thomson. "The Seasons," &c.
1683-1750 C. Middleton. "Life of Cicero," &c.
1687-1750 A. Baxter. Metaphysics.
1672-1751 Bolingbroke. Politics, Literature.
1701-1751 P. Doddridge. Divinity.
1707-1751 Benjamin Robins. Mathematics.
1692-1752 Bishop Butler. Divinity.
1660-1753 Hans Sloane. Natural History.
1684-1753 G. Berkeley. Metaphysics, Ethics.
1686-1754 Thomas Carte. History of England.
1707-1754 H. Fielding. "Tom Jones," &c.
1720-1756 W. Collins. Odes.
1704-1757 D. Hartley. "Observations on Man."
1696-1758 Allan Ramsay. "The Gentle Shepherd."
1703-1758 Jon. Edwards. Theology.
1700-1758 John Dyer. Poems.
1676-1761 B. Hoadley. Polemics.
1678-1761 T. Sherlock. Divinity.
1689-1761 S. Richardson. "Clarissa," "Pamela," &c.
1710-1761 Thomas Simpson. Mathematics.
1690-1762 M. W. Montague. Letters.
1692-1762 James Bradley. Astronomy.
1714-1763 W. Shenstone. Pastorals, &c.
1763 *d.* Nathaniel Hooke. History of Rome.
1703-1764 R. Dodsley. Drama.
1681-1765 Edward Young. "Night Thoughts," &c.
1703-1767 John Swinton. History, Antiquities.
1687-1768 Robert Simson. Geometry.
1713-1768 Lawrence Sterne. "Tristram Shandy."
1698-1770 J. Jortin. Divinity, Criticism.
1721-1770 Mark Akenside. "Pleasures of Imagination."
1752-1770 T. Chatterton. Poems.
1716-1771 Thomas Gray. Odes, Elegies.
1720-1771 Tobias Smollett. Novels, History.
1690-1772 James Stirling. Mathematics.
1718-1772 John Canton. Experimental Philosophy.
1694-1773 Chesterfield. Letters.
1731-1774 Oliver Goldsmith. "Traveller," "Vicar of Wakefield."
1750-1774 R. Ferguson. Poems.
1776 *d.* James Granger. Biog. Hist. of England.
1711-1776 David Hume. Hist. of England, Essays.
1709-1778 Lord Littleton. History, Poems, Divinity.
1709-1779 W. Warburton. Theology, Criticism.
1716-1779 David Garrick. Drama.
1709-1780 J. Harris. Philology.
1723-1780 W. Blackstone. "Laws of England."
1696-1782 Lord Kaimes. "Elements of Criticism."
1782 *d.* John Blair. Chronology.
1701-1782 Wm. Emerson. Mathematics.
1706-1783 H. Brooke. "Fool of Quality."
1709-1784 Sam. Johnson. Lives of Poets Dictionary, &c.
1717-1785 Matthew Stewart. Mathematics.
1712-1786 Jonas Hanway. Travels in the East.
1704-1787 Soame Jenyns. Theology.
1710-1787 R. Lowth. Divinity, Philology.
1712-1789 R. Glover. "Leonidas."
1723-1790 Adam Smith, "Wealth of Nations," &c.
1728-1790 Thomas Warton. History of English Poetry, Poems.
1706-1790 Benjamin Franklin. Electricity, Philosophy.
1703-1791 J. Wesley. Divinity.
1723-1791 R. Price. Metaphysics, Divinity.
1723-1792 Joshua Reynolds. Art.

Chronology.

A. D.
1721-1793 W. Robertson. "History of Charles V.," &c.
1728-1793 John Hunter. Physiology.
1730-1794 James Bruce. Travels.
1733-1794 George Colman. Comedies.
1737-1794 Edward Gibbon. "Decline and Fall of the Roman Empire."
1747-1794 Sir William Jones. Oriental Literature.
1716-1795 E. Balguy. Divinity.
1740-1795 J. Boswell. Biography.
1710-1795 Thomas Reid. Metaphysics.
1738-1796 J. Macpherson. "Ossian's Poems."
1759-1796 Robert Burns. Poems.
1725-1797 W. Mason. Poems, Biography.
1717-1797 H. Walpole. "Historic Doubts," "Royal and Noble Authors."
1730-1797 Edmd. Burke. "Treatise on the Sublime."
1744-1797 J. Milner. Ecclesiastical History.
1736-1798 Edward Waring. Mathematics.
1718-1800 Hugh Blair. Sermons.
1731-1800 William Cowper. Poems.

1737-1801 G. L. Staunton. Chinese Code.
1730-1802 J. Moore. "Views of Society and Manners."
1732-1802 Eras. Darwin. "Botanic Garden."
1748-1802 Joseph Strutt. Chronology, Antiquities.
1735-1803 James Beattie. "The Minstrel," Metaphysics.
1724-1804 W. Gilpin. Biography, Divinity.
1733-1804 Jos. Priestley. Chemistry, Metaphysics.
1727-1805 Arthur Murphy. Dramas, Literature.
1733-1805 John Robison. "Mechanical Philosophy."
1743-1805 Wm. Paley. Theology, Ethics.
1733-1806 S. Horsley. Theology.
1749-1806 C. J. Fox. History.
1724-1808 J. Home. "Douglas."
1735-1808 J. Whitaker. "History of Manchester."
1759-1808 Richard Porson. Philology.
1760-1808 Thomas Beddoes. Medicine.
1779-1808 J. Macdiarmid. Biography.
1732-1811 Nevil Maskelyne. Astronomy.
1732-1811 R. Cumberland. Dramas.
1775-1811 J. Leyden. "Scenes of Infancy."
1736-1812 J. Horne Tooke. Philology.
1726-1814 Charles Burney. History of Music.
1751-1816 R. B. Sheridan. Comedies.
1738-1819 J. Wolcot (Peter Pindar). Comic Poems.
1749-1819 John Playfair. Mathematics, Nat. Philos.
1741-1820 Arthur Young. Agriculture.
1743-1820 Sir Joseph Banks. Natural History.
1778-1820 Thomas Brown. "Philosophy of the Human Mind."
1738-1822 Sir W. Herschel. Astronomy.
1769-1822 E. D. Clarke. Travels.
1792-1822 P. B. Shelley. Poems.
1761-1823 Matthew Baillie. Anatomy, Medicine.
1764-1823 Ann Radcliffe. Novels.
1766-1823 R. Bloomfield. "Farmer's Boy."
1737-1823 C. Hutton. Mathematics.
1772-1823 D. Ricardo. Political Economy.
1731-1824 Baron Maseres. Mathematics.
1788-1824 Byron. Poems.
1782-1825 R. C. Maturin. Dramas.
1743-1825 A. Rees. Cyclopædia.
1746-1825 Dr Parr. Philology.
1773-1825 P. Elmsley. Philology.
1770-1827 George Canning. Political Miscellanies.
1773-1827 R. Woodhouse. Mathematics.
1759-1828 Sir J. E. Smith. Botany.
1747-1828 W. Coxe. "History of the House of Austria," and Travels.

A. D.
1753-1828 Dugald Stewart. Mental Philosophy.
1766-1828 W. H. Wollaston. Nat. Philos. and Chemistry.
1778-1829 Sir Humphry Davy. "Chemical and Philosophical Researches."
1778-1830 W. Hazlitt. "Spirit of the Age," Criticism.
1745-1831 H. Mackenzie. "Man of Feeling."
1763-1831 J. Abernethy. Physiology and Surgery.
1764-1831 Robert Hall. Sermons.
1751-1831 W. Roscoe. Hist. of Lorenzo de Medici and Leo X.
1754-1832 Geo. Crabbe. "Tales of the Hall," Poems.
1832 *d.* C. C. Colton. "Lacon."
1766-1832 Sir John Leslie. Nat. Phil. and Doctrines of Heat.
1765-1832 Sir James Mackintosh. Ethics, Hist., Politics.
1749-1832 Jer. Bentham. Political Economy.
1771-1832 Sir W. Scott. "Waverley Novels," Poems.
1760-1833 W. Wilberforce. "Prac. View of Christianity."
1774-1833 Hannah More. Tales and Sketches.
1791-1834 Ed. Irving. Sermons.
1770-1834 S. T. Coleridge. Poetry, Philosophy.
1775-1834 Charles Lamb. "Elia."
1798-1835 W. Motherwell. Poems.
1766-1835 T. R. Malthus. "Essay on Population."
1794-1835 Felicia Hemans. Poems.
1762-1835 W. Cobbett. "Register," Grammar, &c.
1772-1835 T. M'Crie. "Life of Knox."
1782-1835 James Hogg. "Queen's Wake."
1747-1836 John Gillies. "History of Greece."
1777-1836 Sir W. Gell. Topography, Antiquities.
1756-1836 W. Godwin. Novels, &c., "Political Justice."
1774-1836 James Mill. "Elements of Political Economy," History of India.
1762-1836 George Colman. Comedies.
1765-1836 W. Taylor. "Hist. of German Poetry."
1801-1837 R. Macnish. "Anatomy of Drunkenness."
1762-1837 Sir S. E. Brydges. "*Censura Literaria.*"
1838 L. E. Landon. Poems.
1768-1839 W. Smith. Geology, British Strata.
1757-1839 Herbert Marsh. Biblical Criticism.
1757-1839 Archd. Alison. "Essay on Taste," Sermons.
1779-1839 John Galt. Novels.
1752-1840 Mme. d'Arblay. Novels.
1773-1840 Lord Holland. Spanish Literature, Lives of Lope de Vega and Guillen de Castro.
1788-1841 Theodore E. Hook. Novels.
1774-1842 Sir Charles Bell. "Anatomy of Expression," On the Nerves.
1790-1842 Thomas Arnold. "History of Rome."
1779-1842 W. E. Channing. Theology and Literature.
1786-1842 Allan Cunningham. Poetry, Biography.
1775-1843 Robert Southey. Poetry, History of Brazil.
1770-1843 John Foster. Essays, Lectures, &c.
1781-1843 J. C. Loudon. Botany, Landscape Gardening.
1776-1844 Thos. Campbell. Lyrics, "Pleasures of Hope."
1781-1844 John Abercrombie. "Intellectual Powers," Medicine.
1767-1844 John Dalton. Chemistry and Meteorology.
1774-1844 Francis Baily. Doct. of Annuities, Astronomy.
1771-1845 Sydney Smith. "Plymley's Letters," Criticism, Politics.
1798-1845 Thomas Hood. Poems.
1779-1846 Hugh Murray. Geography.
1794-1847 R. Liston. Surgery.
1780-1847 Thomas Chalmers. Theology and Political Economy.
1786-1847 Sharon Turner. History.
1766-1848 Isaac Disraeli. "Curiosities of Literature."
1790-1848 F. Marryat. Novels.

A. D.	
1784-1848	W. Tennant. "Anster Fair."
1799-1848	Sir N. Harris Nicolas. "Chronology of History."
1764-1848	Sir John Barrow. Travels in China, Reviews.
1779-1849	Horace Smith. "Rejected Addresses."
1774-1849	Edward Copleston. "Inquiry into Necessity and Predestination."
1767-1849	Maria Edgeworth. Tales, Education.
1790-1849	Pat. F. Tytler. History of Scotland.
1808-1849	Edgar Allan Poe, *Am.* Tales and Poems.
1773-1850	Francis Jeffrey. Essays, Criticism.
1762-1850	W. Lisle Bowles. Sonnets.
1770-1850	William Wordsworth. Poems.
1776-1850	Jane Porter. Novels.
1759-1850	W. Kirby. Entomology.
1798-1851	Mrs Shelley. Novels, Poems.
1771-1851	John Lingard. History.
1774-1851	J. Pye Smith. Theology.
1762-1851	Joanna Baillie. Poems, Plays.
1798-1851	D. M. Moir. Poems, Essays.
1789-1851	J. Fenimore Cooper, *Am.* Novels.
1780-1852	Moses Stuart, *Am.* Theology.
1780-1852	Thomas Moore. Poems.
1852 *d.*	W. Macgillivray. Natural History.
1782-1852	Daniel Webster, *Am.* Speeches.
1779-1852	H. F. Clinton. "Fasti Hellenici."
1773-1852	Thomas Thomson. Chemistry.
1789-1852	G. A. Mantell. Geology.
1783-1852	Samuel Lee. Oriental Languages.
1811-1852	A. N. W. Pugin. "Glossary of Ecclesiastical Ornament."
1804-1853	Jon. Pereira. Materia Medica.
1779-1853	Ralph Wardlaw. Theology.
1784-1853	Amelia Opie. Tales.
1777-1854	John Wilson. Poems, Criticism, Tales.
1771-1854	James Montgomery. Poems.
1794-1854	Thomas Noon Talfourd. Dramas.
1774-1854	R. Jameson. Mineralogy.

CHRONOMETER, any instrument for measuring time, as dials, clocks, &c. The term, however, is commonly applied in a restricted sense to a kind of clock so contrived as to measure a small portion of time with great exactness. See CLOCK and WATCH-WORK.

CHRONOMETER is also the name of an instrument invented by Loulie, a French musician, for the purpose of measuring musical time by means of a pendulum. The form of the instrument is described in Malcolm's *Treatise of Music*, p. 407.

The *Metronome*, an instrument of the same kind, was introduced in Austria about the year 1814. It consists of a box containing a pendulum, which has its point of suspension between the extremities of the rod; and attached to the rod there is a sliding weight, by means of which the vibrations may be regulated to any number of beats in a fixed time. The pendulum is set in motion by a simple piece of mechanism, which is wound up like a clock.

CHRUDIM, a town of Bohemia, capital of a cognominal circle, on the right bank of the Chrudimka, an affluent of the Elbe, 58 miles E.S.E. of Prague. The town, which is surrounded by walls, is well built, and has a fine Gothic collegiate church and five others, a Capuchin monastery, high school, and manufactories of calicoes and leather. The horse-markets of Chrudim are much frequented. Pop. 6107.

CHRYSALIS, or AURELIA, the particular form assumed by butterflies, moths, and some other insects, before they arrive at their winged or perfect state. These terms are derived from the golden colour of certain species; though others are green, black, brown, &c. See ENTOMOLOGY, chap. IV.

CHRYSES, the priest of Apollo, and father of Chryseis. When Lyrnessus was taken, and the spoil divided among the conquerors, Chryseis fell to the share of Agamemnon. Chryses went to the Grecian camp to solicit his daughter's restoration; and when his prayers proved fruitless, he implored the aid of Apollo, who visited the Greeks with a plague, and obliged them to restore Chryseïs.

CHRYSIPPUS, a Stoic philosopher, born at Soli in Cilicia. He was a disciple of Cleanthes, successor of Zeno, and wrote many books, several of which related to logic. None of the philosophers dogmatized in stronger terms of the fatal necessity of everything, or declaimed more pompously of the liberty of man, than the Stoics, particularly Chrysippus, who was held of so much importance among them as to give rise to the proverbial remark, that "if Chrysippus had not existed, the Porch could not have been." Yet the Stoics complained, as Cicero relates, that he had collected many arguments in favour of the sceptical hypothesis, which he could not answer himself, and had thus furnished Carneades, their antagonist, with weapons against them. An apophthegm of this philosopher does him honour. Being told that some person spoke ill of him, he said—"It is no matter, I will live so that he shall not be credited."

This was also the name of several ancient physicians; and likewise of a celebrated ecclesiastical writer, about A.D. 450, whose only remaining work, besides some fragments, is a treatise entitled *Homilia de Sancta Deipara*. (Cave, *Hist. Lit.*, vol. i.)

CHRYSOBERYL, a silicious gem, of a pale yellowish-green colour. See MINERALOGY.

CHRYSOLITE (*peridot*, Haüy; *olivin*, Hausmann). When chrysolite is found in a crystallized state, and of considerable dimensions, it is a very beautiful mineral, and presents a fine grass-green colour, with a vitreous fracture, and perfect transparency. Such specimens are very rare, and the locality is quite unknown, but supposed to be Upper Egypt. It occurs also in minute but perfect crystals, along with other gems, in alluvial deposits at Expaillie. It is most commonly found in grains in trap-rocks, sometimes in large spheroidal masses, of an oil-green colour, in a state of granular concretions. It likewise enters into the composition of meteoric stones, and occurs imbedded in the native iron discovered by Pallas in Siberia, and also in the same substance which has subsequently been found at Attacama. Chrysolite is the softest of all gems, being scratched by quartz, and yielding readily to the file. Its specific gravity is 3·4; and, according to Vauquelin, it contains, of silica 38·, magnesia 50·5, and iron 9·5.

CHRYSOLORAS, MANUEL, a learned Greek, who was instrumental in spreading Greek literature in the West. He was born at Constantinople, of a distinguished family, which had removed with Constantine to Byzantium. While still very young, he was sent by the emperor John Palæologus to implore the aid of the Christian princes against the Turks. After an absence of some years, Chrysoloras returned to Constantinople; but at the invitation of the magistrates of Florence he became professor of Greek language in that city about the year 1393, and taught three years. From Florence he passed to Milan; and from Milan to Pavia, at the request of Gian Galeazzo, duke of Milan. On the death of Galeazzo in 1402 he retired to Venice, where he lived several years. He subsequently went to Rome, upon the invitation of Aretino, who had been his disciple, and was then secretary to Gregory XII. In 1408 he was sent to Paris

with an important mission from Manuel Palæologus, the Greek emperor. In 1413 he accompanied cardinals Chalanco and Zabarella on a mission from Pope Martin V. to the emperor Sigismund, to appoint a place of meeting for a general council; and was preparing to go to Constance when he was suddenly cut off, on the 15th of April 1415, in the forty-seventh year of his age. Only two of his works have been printed, viz., his *Erotemata*, or grammatical questions, and *Epistolæ III., de comparatione veteris et novæ Romæ;* but numerous others exist in MS.

CHRYSOPRASE, a name derived from the Greek, and denoting a superior kind of prase. It occurs at Rosemutz in Silesia, and also at New Fane, Vermont, North America. It is of an apple-green colour, more or less intense. It is translucent, with a fine-grained splintery fracture, nearly even, and occurs massive, in contemporaneous veins, traversing rocks of serpentine. Chrysoprase is nearly allied to calcedony; and derives its beautiful colour from an admixture of the oxide of nickel, as ascertained by the analysis of Klaproth.

CHRYSOSTOM, St John (Χρυσόστομος, golden-mouthed), the most famous of the Greek fathers, was born of a noble family at Antioch the capital of Syria, A.D. 347. At the school of Libanius the sophist he gave early indications of his mental powers, and would have been the successor of his heathen master, had he not been stolen away to a life of piety (like Augustin, Gregory of Nazianzen, and Theodoret), by the influence of a pious mother. Immediately after his baptism by Meletius the bishop of Antioch, he gave up all his forensic prospects, and buried himself in an adjacent desert, where for six years he spent a life of ascetic self-denial and study. His infirmities, however, compelled him to return to the world; and the authority of Meletius gained his services to the church. On his arrival he was ordained deacon, and afterwards presbyter at Antioch; and on the death of Nectarius he was appointed archbishop of Constantinople by Eutropius, the favourite minister of the emperor Arcadius. On the archiepiscopal throne Chrysostom still persevered in the practice of monastic simplicity. The ample revenues which his predecessors had consumed in pomp and luxury, he diligently applied to the establishment of hospitals; and the multitudes who were supported by his charity preferred the eloquent discourses of their benefactor to the amusements of the theatre or of the circus. His homilies, which are still preserved, furnish ample apology for the partiality of the people, exhibiting the free command of an elegant and copious language, an inexhaustible fund of metaphors and similitudes, giving variety and grace to the most familiar topics, with an almost dramatic exposure of the folly and turpitude of vice. His zeal as a bishop, and eloquence as a preacher, however, gained him enemies both in the church and at the court. The ecclesiastics who were parted at his command from the lay-sisters whom they kept ostensibly as servants; the thirteen bishops whom he deposed for simony and licentiousness at a single visitation; the idle monks who thronged the avenues to the court, and found themselves the public object of his scorn,—all conspired against the powerful author of their wrongs. Their resentment was inflamed by a powerful party, embracing the magistrates, the ministers, the favourite eunuchs, the ladies of the court, and Eudoxia the empress herself, against whom the preacher thundered daily from the pulpit of St Sophia. A favourable pretext for gratifying their revenge was discovered in the shelter which Chrysostom had given to four Nitrian monks, known as the tall brothers, who, on being excommunicated by their bishop, had fled to Constantinople; and a ready tool was found in Theophilus, bishop of the rival city of Alexandria, who had driven them from their dioceses, and had long circulated in the East the charge of Origenism against Chrysostom. By his instrumentality a synod was called to try or rather condemn the archbishop; but fearing the violence of the mob in the metropolis, who idolized him for the fearlessness with which he exposed the vices of their superiors, it held its sessions in the suburbs of Chalcedon, named the *Oak*, where Rufinus had erected a stately church aud monastery. A bishop and a deacon were sent to accuse the archbishop, and presented to him a list of charges, in which pride, inhospitality, and Origenism were brought forward to procure the votes of those who hated him for his austerity, or were prejudiced against him as a suspected heretic. Four successive summonses were signified to Chrysostom, but he indignantly refused to appear until four of his notorious enemies were removed from the council. Without entering into any examination of the charges brought before them, the synod condemned him on the ground of contumacy; and, hinting that his audacity merited the punishment of treason, called on the emperor to ratify and enforce their decision. He was immediately arrested and hurried to Nicæa in Bithynia. As soon as the news of his banishment spread through the city, the astonishment of the people was quickly exchanged for a spirit of irresistible fury. In crowds they besieged the palace, and had already begun to take vengeance on the foreign monks and sailors who had come from Chalcedon to the metropolis, when, at the entreaty of Eudoxia, the emperor consented to his recal. His return was graced with all the pomp of a triumphal entry, but in two months after he was again in exile. His fiery zeal could not blind him to the vices of the court; and heedless of personal danger he thundered against the profane honours that were addressed almost within the precincts of St Sophia to the statue of the empress. The haughty spirit of Eudoxia was inflamed by the report of a discourse commencing with the words,—"Herodias is again furious; Herodias again dances; she once more demands the head of John;" and though the report was false, it sealed the doom of the archbishop. A new council was summoned, more numerous and more subservient to the wishes of Theophilus; and troops of barbarians were quartered in the city to overawe the people. Without examining it, the council confirmed the former sentence, and condemned him afresh for having resumed his functions without their permission. He was hurried away to the desolate town of Cucusus, among the ridges of Mount Taurus, with a secret hope, perhaps, that he might be a victim to the Isaurians on the march, or to the more implacable fury of the monks. He arrived at his destination in safety; and the sympathies of the people, which had roused them to fire the cathedral and senate-house on the day of his exile, followed him to his obscure retreat. His influence, however, became more powerfully felt in the metropolis than before. In his solitude he had ample leisure for forming schemes of missionary enterprise; and by his correspondence with the different churches, he at once baffled his enemies, and gave greater energy to his friends. This roused the emperor to visit him with a severer punishment. An order was despatched for his instant removal to the extreme desert of Pityus; and his guards so faithfully obeyed their cruel instructions that, before he reached the sea-coast of the Euxine, he expired at Comana in Pontus, in the sixtieth year of his age. His exile gave rise to a schism in the church, and the Johannists (as they were called) did not return to communion with the archbishop of Constantinople till the relics of the saint were, 30 years after, brought back to the Eastern metropolis with great pomp, and the emperor publicly implored forgiveness from Heaven for the guilt of his ancestors. The festival of St Chrysostom is kept in the Greek Church, Nov. 13, and in the Latin Church, Jan. 27.

His works are exceedingly voluminous, and consist chiefly of homilies, commentaries, smaller treatises, epistles, and liturgies. Their excellence is powerfully shown in the history of the times, for the illustration of which they afford highly valuable materials. The best edition is that of Bernard de Montfaucon in 13 vols. fol., 1718-1738; but numerous MSS.

still remain unedited. Some of his homilies and commentaries are translated in the *Library of the Fathers*, published at Oxford. As authorities for the facts of his life, the most valuable are the ecclesiastical histories of Socrates, Sozomen, and Theodoret; and amongst the moderns Erasmus, Cave, Lardner, and Tillemont, with the more recent church history of Neander, and his monogram on the Life and Times of Chrysostom, translated by J. C. Stapleton.

CHUB, a river fish, of the genus Cyprinus. See index to ICHTHYOLOGY; and ANGLING, vol. iii. p. 161.

CHUBB, THOMAS, (1679-1747,) a noted deist, was born at East Harnham, near Salisbury, where he was apprenticed to a glover, and afterwards became a tallow chandler. His parents were poor, and unable to afford him a liberal education; but, in the midst of his other avocations, he contrived to make considerable progress in scientific study. His favourite subject, however, was theology; and from discussing the question in a debating society which he himself had instituted, he soon became publicly engaged in the trinitarian controversy, then warmly agitated between Clarke and Waterland. He embodied his opinions in a dissertation, which was afterwards published under the title of *The Supremacy of the Father asserted.* Besides this, he published a quarto volume of tracts, and some minor practical and controversial works.

CHUDLEIGH, a market-town of England, county of Devon, and hundred of Exminster, near the Teign, 9 miles S.S.W. of Exeter, and 182 miles from London. Pop. (1851) 2401. The town is pleasantly situated on an acclivity, and consists chiefly of a single street. It has a church, 2 chapels, and a grammar-school with 3 exhibitions to Cambridge. Market-day Saturday. The greater part of the town was destroyed by fire in 1808. The district is famous for its cider. In the vicinity are Ugbrook Park the seat of Lord Clifford, and Chudleigh rock, a great mass of limestone, with a remarkable cavern.

CHUMBUL, a river of Hindustan, which rises in the centre of the province of Malwah, within 15 miles of the Nerbuddah. From thence its course is due N., until it passes the city of Kotah; after which, being augmented by many smaller streams, it turns more to the E., and falls into the Jumna 20 miles from Etaweh, in Lat. 26. 30., Long. 79. 19. The course of this river is computed at 570 miles, described in a form nearly semicircular; and the breadth of its channel at the ford of Kyteree, near Dhoolpoor, is three-quarters of a mile. This river is supposed by Major Rennell to be the Sambus of Arrian. It is now the boundary between the Rajpoot territories and those of Sindia to the south.

CHUMPANEER, in Hindustan, a hill fort situated on an isolated rock rising 2500 feet above the plains of Gujerat, one of the most level provinces of Hindustan. To the northward of the mountain are the remains of an ancient city, the ruins of which extend several miles on each side, and are at present covered with an impenetrable jungle, the abode of tigers and Bheels, a fierce race of predatory mountaineers. The town is inclosed by a stone wall of good workmanship, within a small space of an oblong figure, which is three-fourths of a mile long, and three furlongs broad. The mountain is strengthened by two forts; the upper deemed impregnable by the natives, and containing a Hindu temple; while the defences of the lower part are extensive, and the whole of difficult approach. In 1812 the town of Chumpaneer contained four hundred houses, of which about only one-half were inhabited, principally by emigrants from other parts of Gujerat. It is supposed to have been the capital of an ancient principality long before the Mohammedan conquest; and it was taken about the end of the fifteenth century, by Mahmoud VII. of Guzerat, after a siege or blockade of twelve years. In 1534, it was taken by the Mogul emperor Humayon. In 1582, it is described as a place of considerable strength, surrounded by extensive ruins, Hindu as well as Mohammedan. On the dismemberment of the empire of Delhi, in the latter part of the eighteenth century, it was seized by the Mahrattas, who always considered it as a strong place, and had a good garrison in it. It was taken from Sindia by the British in 1802, but was restored to him in the following year. It is 55 miles E. by N. from Cambay. Long. 73. 30. E., Lat. 22. 31. N.

CHUNAM, a kind of calcareous cement or stucco used in India to cover houses. It contains various ingredients.

CHUNAR or CHUNARGHUR, a town and fortress of Hindustan, in the British district of Mirzapore fort, situated on the south bank of the Ganges. The fort is built on the top of a solid rock, which rises abruptly from the plain, and projects into the river. It is inclosed all around by a stone wall and small towers, and is a place of great strength; but its chief defence against escalade is a number of large round stones, which are piled round the rampart, ready to be hurled down on any rash assailant. It has a small citadel, and extensive magazines. This fortress has been sometimes used as a state prison; but the rays of the sun reflected from the rock render it very hot and unhealthy. The town of Chunar consists of a straggling collection of native huts and European dwellings. Its population has been returned at 11,058. There is here an English church which belongs to the Church Missionary Society, built in good style, and embellished with a Gothic steeple. The batteries completely command the navigation of the river, so that no vessel can pass without inspection. Chunarghur is a very ancient fortress, and there is no record of its original foundation. The first time it is mentioned in Mohammedan history is in the year 1491, when it was in possession of Sing Joanpore. When garrisoned by Baber in 1529, it appears to have been a place of importance, though its vicinity was infested by the elephant, tiger, and rhinoceros. In 1530 it was the residence of Shere Khan, the Afghan who expelled Humayon the son of Baber from Hindustan. In 1575 it was recovered by the emperor Akbar, after a siege of six months. In 1763 it was seized by the nabob of Oude; and it was then attacked by the English, under general Carnac, who were repulsed by the garrison rolling down large stones on the storming party; but the rampart being breached in the S.W. quarter, the garrison surrendered. Five years later, it was formally surrendered by treaty to the East India Company. The hills, which approach very near the town, contain quarries of excellent freestone, which is in great demand at Benares and other towns down the river. Distance from Calcutta, N.W. 437 miles. N. Lat. 25. 5. E. Long. 83.

CHUPMESSAHITES, a sect of Mohammedans who believe that Jesus Christ is God, the true Messiah and Redeemer of the world, but render him no public or declared worship.

CHUPRAH, a large town of Hindustan, in the province of Bahar, and chief town of the district of Sarun, situated on the north bank of the Ganges. It was first entered in 1757 by the British, in pursuit of a French detachment under Mr Law, which had entered into the service of the nabob of Oude. Though the town has but one street passable for wheeled vehicles, it is said to contain a large number of handsome native houses. The place is well situated for commerce, enjoying intercourse by means of the river with all the towns between it and Calcutta. It is 32 miles W.N.W. from Patna. Long. 84. 46. E. Lat. 25. 46. N.

CHUQUISACA, the capital city of Bolivia, in the department of Chuquisaca, is situated on a plain, surrounded by a chain of eminences which shelter it from the winds, at an elevation of 9331 feet above the level of the sea. The climate is mild and healthy, the temperature throughout the year presenting no great variation; but in winter heavy storms are not unfrequent, and the rains continue a con-

siderable time. The vegetation of the surrounding district is rich and luxuriant, and accordingly it is looked upon as one of the gardens of Bolivia which supply the necessaries of life to those inhabiting higher and less prolific regions. Chuquisaca formerly was named La Plata from its contiguity to silver mines. It was founded in 1539 by one of Pizarro's captains. In 1551 it was erected into a bishopric, and in 1608 was raised to an archbishopric. The best houses are only one story high; but they are roomy, and in general have gardens planted with European fruit-trees. The public buildings of this city include a university, a large and handsome cathedral, a parochial church, five monastic establishments; and besides these there are several splendid churches, a conventual hospital, and three nunneries. Pop. about 25,000. See Bolivia.

CHUR, French Coire, the capital of the Swiss canton of Grisons, situated in a valley traversed by the Plessur, an affluent of the Rhine, which it joins about one mile below the town. Pop. (1851) 6183. It is a walled town with narrow and crooked streets, but it possesses a considerable transit trade, being situated on the high road over the Splügen and Bernardin passes, by which the manufactures of St Gall, Glarus, and Zürich are transported to Italy. About one-third of its inhabitants are engaged in that traffic. It is the seat of a bishop, and has, besides a cathedral, 2 churches, 2 convents, an episcopal palace, town hall, and public library. Manufactures, zinc-plates and cutlery.

CHURCH (κύριος a lord, hence τὸ κυριακόν, *the Lord's house*—whence also *kyrke*) has several significations, according to the different subjects to which it is applied.

First, it denotes the collective body of Christians, or all those who acknowledge Christ as the Saviour of mankind; and hence denominated by ancient writers the Catholic or Universal Church. Sometimes the word is used in a sense still more extensive, including the Church Militant, or the assembly of the faithful on earth; the Church Triumphant, which is that of the faithful already in glory; to which the Catholics add the Church Patient, or that of the faithful in purgatory.

Church is also applied to a particular congregation of Christians who associate together and participate in the institutions of Christ, with their proper pastors and ministers. In this sense we read of the church of Antioch, the church of Alexandria, the church of Thessalonica, &c.

Church likewise denotes a particular sect of Christians, distinguished by particular doctrines and ceremonies; as the Roman Catholic Church, the Greek Church, the Reformed Church, the Church of England, the Church of Scotland.

The Latin or Western Church comprehends all the churches of Italy, France, Spain, Africa, the north, and all other countries whither the Romans carried their language. Great Britain, part of the Netherlands, part of Germany, and part of the north, have been separated from this church ever since the time of the Reformation, and constitute the Reformed Church, or what the Roman Catholics denominate the Western Schism.

The Greek or Eastern Church comprehends the churches of all the countries anciently subject to the Greek or Eastern empire, and through which their language was carried; that is, all the space extending from Greece to Mesopotamia and Persia, and thence into Egypt. This church has been divided from the Latin Church ever since the time of the emperor Phocas.

The Gallican Church denotes the Church of France under the government and direction of their respective bishops and pastors. This church has always enjoyed certain franchises and immunities, not as grants from popes, but as derived from her origin or foundation, and which she has taken care to maintain. These liberties depend upon two maxims; the first of which is, that the pope has no authority or right to command or order anything, either in general or in particular, in which the temporalities and civil rights of the kingdom are concerned; and the second, that notwithstanding the pope's supremacy is acknowledged in cases purely spiritual, yet in France his power is limited and regulated by the decrees and canons of certain ancient councils received in that realm.

Church is also used to signify the body of ecclesiastics, or the clergy, in contradistinction to the laity.

Church is used for the place where a particular congregation or society of Christians assemble for the celebration of divine service. In this sense churches are variously denominated, according to their rank, degree, discipline, and the like; as the metropolitan church, the patriarchal church, cathedral church, parochial church, collegiate church, &c.

In ecclesiastical writers we meet with Grand Church, used to signify the chief church of a place. Thus, in the Greek liturgy, the church of St Sophia at Constantinople, the see of the patriarch, founded by Constantine, and consecrated under Justinian, is denominated the Grand Church.

The first church publicly built by the Christians is supposed by some to have been that of St Saviour at Rome, founded by Constantine; while others contend that several churches abroad, called by the name of St Peter Vivus, were built in honour of that apostle during his lifetime.

High Church was a denomination originally given to those otherwise called Nonjurors, who refused to acknowledge the title of William III. Prince of Orange to the crown of Great Britain, on the plea that James II., though excluded, was still their rightful sovereign. This appellation was given them because they entertained high notions of the dignity and power of the church, and the extent of its prerogatives and jurisdiction. And those, on the contrary, who disapproved of the succession and obstinacy of the Nonjurors, were called Low Churchmen, as being distinguished by their moderation towards dissenters, and less ardent in extending the limits of church authority. The denomination of High Churchmen is now more generally applied to all who form lofty and ambitious conceptions of the authority and jurisdiction of the church, and who would raise it to an absolute independence of all civil power.

Church-Wardens (*ecclesiæ guardiani*) in the English ecclesiastical polity, are the guardians or keepers of the church, and the representatives of the parish. Churchwardens are appointed by the minister, or by the parish, and sometimes by both together, to superintend the church, its property and concerns, and the behaviour of the parishioners.

CHURCHILL, John, Duke of Marlborough, was born at Ashe in Devonshire, June 24, 1650. He was second son of Sir Winston Churchill, a stanch royalist, who for his services during the civil war was rewarded with considerable preferment at court. Thither young Churchill followed his father before he had acquired even a common education; but this deficiency proved no barrier in the way of an intimacy which soon sprung up between him and the Duke of York, afterwards James II. In 1666 he was made an ensign of the guards during the first Dutch war; and afterwards served at Tangier in the war against the Moors. In 1672 Churchill joined the Duke of Monmouth, who commanded a body of auxiliaries in the French service, and soon afterwards he was made captain in the duke's own regiment. At the siege of Nimeguen, which happened during that campaign, he distinguished himself so much that he gained the admiration of Marshal Turenne, who bestowed on him the name of "the handsome Englishman." In 1673 he was present at the siege of Maestricht, and afterwards received a public acknowledgment from the king of France for his services on that occasion. The Duke of Monmouth too, who had the direction of the attack, acknowledged to Charles II. that he owed his life to Churchill's bravery. In 1681 he married Sarah, daughter of Richard Jennings,

Esq. of Sandrich, Hertfordshire, a lady who like himself had spent her early life at court, and whose genius and temper exercised a very remarkable influence on his character and fortunes. Soon after this, through the patronage of the Duke of York, he obtained the baronetcy of Eyemouth, and a colonelcy in the third troop of guards. On the accession of King James he was created Baron Churchill of Sandrich, in the county of Hertford, and made brigadier-general of his Majesty's army in the west; where, when the Duke of Monmouth attempted to surprise the king's army while the Earl of Feversham and the greater part of the officers were in bed, he kept the enemy in play till the king's forces had time to form, and thereby saved the whole army. At the time of the revolution he hesitated for a while between the two contending parties, offering his services to the one, while he accepted command under the other; but at length he joined the Prince of Orange. He was graciously received in the prince's camp; and for his services in augmenting and remodelling the army was invested with the rank and title of lieutenant-general. In 1689 he was sworn a member of the privy-council, and one of the gentlemen of the king's bed-chamber; and immediately after he was raised to the dignity of Earl of Marlborough, in the county of Wilts. He assisted at the coronation of their majesties; and was soon afterwards appointed commander-in-chief of the English forces sent over to Holland, where he first laid the foundation of that fame which was afterwards spread over all Europe. In 1690 he was appointed general of the forces sent to Ireland, and captured the garrisons of Cork and Kinsale. In the following year he was sent by King William to Flanders on a preparatory expedition, for the purpose of organizing the army before the arrival of the king. In 1692 he was dismissed from all his employments, and not long afterwards committed to the Tower, on an accusation of high treason. This aspersion on his character seems to have been without foundation. Marlborough was soon restored to favour, and, in 1698, appointed governor to the Earl of Gloucester; upon which occasion King William paid him this extraordinary compliment:—"My lord, make him but what you are, and my nephew will be all I wish to see him." The same day he was again sworn of the privy-council; and in July following he was declared one of the lords justices of England, for the administration of the government, an office with which he was three times successively invested in the king's absence. In 1701 he was appointed general of infantry, commander-in-chief of the English forces, and ambassador extraordinary and plenipotentiary at the Hague. Upon the accession of Queen Anne to the throne, he was elected into the order of the garter, declared captain-general of all her Majesty's forces, and sent as ambassador extraordinary and plenipotentiary to Holland. His warlike exploits, and the vicissitudes of his political career have been sufficiently detailed under BRITAIN; we shall therefore only mention here the rewards and honours conferred upon him for these brilliant achievements. After his first campaign he was created Marquis of Blandford and Duke of Marlborough, with a pension of L.5000 out of the post-office, to devolve for ever upon those enjoying the title of Duke of Marlborough. In 1703 he met Charles III., afterwards emperor, proceeding to Spain, by whom he was presented with a sword set with diamonds. In 1704, having forced the enemy's lines at Schellenberg, he was honoured with a letter of thanks from the emperor Leopold, written with his own hand. After the battle of Blenheim he received congratulatory letters from most of the potentates in Europe, particularly from the states-general, and from the emperor, who desired him to accept of the dignity of a prince of the empire. With permission of his sovereign, accordingly, he was created Prince of Mildenheim, in the province of Suabia. When the campaign was ended, he visited the court of Prussia, where he succeeded in suspending the disputes with the Dutch about King William's estate; and by his address on the occasion gained the acknowledgment from the whole confederacy that the duke had done the greatest service possible to the common cause. Upon his return to England, the queen, to perpetuate his memory, granted the interest of the crown in the honour and manor of Woodstock and hundred of Wotton to him and his heirs for ever. In 1705 he made a tour to Vienna, upon the invitation of the emperor Joseph, who received him in the most gracious manner, and made him a grant of the lordship of Mildenheim. After the campaign of 1708, the speaker of the House of Commons was sent to Brussels on purpose to compliment him; and on his return to England he received a second compliment in the House of Lords. After the change of the ministry in 1710, his interest daily declined; and in the beginning of 1712 he was removed from all his offices. Finding his disgrace sealed (if it was not actually procured) by the estrangement which then existed between the Duchess of Marlborough and the queen, he spent a considerable part of his time abroad—visiting his principality of Mildenheim, and several towns in Germany—and arrived in England only on the day of the queen's death. Receiving a cordial welcome from the nobility and foreign ministers, he attended George I. in his public entry into London; and was appointed captain-general, colonel of the first regiment of foot guards, one of the commissioners for the government of Chelsea hospital, and master-general of the ordnance. These dignities he retained till his death, which took place at Windsor Lodge, June 16, 1722; and though 73 years old and weakened by two previous paralytic strokes, he retained his mental faculties in full vigour to the last. Upon his demise, all parties united in doing honour to his merit; and his corpse was interred, on the 9th of August following, in Westminster Abbey.

One of the most generous testimonies to the abilities and greatness of Marlborough is from the pen of Bolingbroke, who, though one of the keenest of his political opponents, is known to have said to a parasite who ridiculed the avarice of Marlborough—"He was so very great a man, that I had forgotten he had that vice." Speaking in his *Letters on History* of the consternation raised among the allies by the death of King William, and of the joy which that event gave to the French, Bolingbroke observes, that "a short time showed how vain the fears of some and the hopes of others were. By his death the Duke of Marlborough was raised to the head of the army, and indeed of the confederacy; where he, a new, a private man, a subject, acquired, by merit and by management, a more deciding influence than high birth, confirmed authority, and even the crown of Great Britain, had given to King William. Not only all the parts of that vast machine, the Grand Alliance, were kept more compact and entire, but a more rapid and vigorous motion was given to the whole; and instead of languishing out disastrous campaigns, we saw every scene of the war full of action. All those wherein he appeared, and many of those wherein he was not then an actor, but abettor, however, of their action, were crowned with the most triumphant success. I take, with pleasure, this opportunity of doing justice to that great man, whose faults I knew, whose virtues I admired; and whose memory, as the greatest general and as the greatest minister that our country, or perhaps any other, has produced, I honour."

So far as his military ability is concerned, posterity has not hesitated to accept the verdict. Without inventing for himself a new system of strategy, or at all improving the military science of the day, he was never defeated in a battle, and never unsuccessful in a siege. He was the animating spirit of the Grand Alliance; and by his personal address at the foreign courts, as well as his skill in the field, he proved the bulwark of European liberties. His conduct at the era of the revolution, however, has been regarded as a

Churchill. stigma to his character; and to this has been added the charge of deliberate treason in privately communicating to the French intelligence of a secret expedition against Brest. In the words of Mr Macaulay—"His former treason, thoroughly furnished with all that makes infamy exquisite, placed him under the disadvantage which attends every artist from the time that he produces a masterpiece. Yet his second great stroke may excite wonder, even in those who appreciate all the merit of the first. Lest his admirers should be able to say that, at the time of the revolution, he had betrayed his king for any other than selfish motives, he proceeded to betray his country. He sent intelligence to the French court of a secret expedition intended to attack Brest. The consequence was, that the expedition failed, and that 800 British soldiers lost their lives by the abandoned villany of a British general. Yet this man has been canonized by so many eminent writers, that, to speak of him as he deserves, scarcely seems decent."

The following anecdotes may be noticed as somewhat characteristic:—One of the first things which he did, when very young, was to purchase a box to put his money in; an indication of the economical, not to say avaricious, temper which accompanied him through life. Dr Joseph Warton relates, that on the evening of an important battle the duke was heard to chide his servant for having been so extravagant as to light four candles in his tent when Prince Eugene came to confer with him. Richardson the painter has recorded a pleasing instance of the duke's equanimity, for which, indeed, he was always remarkable. "The Duke of Marlborough," says the writer, "riding out once with Commissary Marriot near the commissary's house in the country, it began to rain, and the duke called for his cloak; Marriot having his put on by his servant immediately. The duke's servant not bringing the cloak, he called for it again, but the man was still puzzling about the straps and buckles. At last, as it now rained very hard, the duke called again, and asked him 'what he was about that he did not bring his cloak?' 'You must stay,' grumbled the fellow, 'if it rains cats and dogs, till I can get at it.' The duke only turned to Marriot and said, 'I would not be of that fellow's temper;' reminding us of the saying of Seneca, *Quid est quare ego servi mei hilarius responsum, et contumaciorem vultum, flagellis et compedibus expiem?*"

See *Memoirs and Correspondence of the Duke of Marlborough*, by Archdeacon Coxe, in 3 vols. 4to, and Alison's *Life of Marlborough*, 2 vols. 8vo.

CHURCHILL, *Charles* (1731-1764), a celebrated satirist, was born at Westminster, where his father was curate and lecturer of St John's. He was educated at Westminster school; but made so little progress in his studies that when he went to Oxford he was rejected on account of his deficiency in the classics,—a circumstance which probably explains the frequent invectives which we find in his works against that university. On his return he again applied to his studies in Westminster school; and after studying theology for some time in retirement at Sunderland, he was ordained priest by Sherlock, bishop of London, and obtained a curacy at Cadbury in Somersetshire. It is said that, while in this situation, he endeavoured to augment his income by keeping a cider-cellar, and thus laid the foundation of his dissoluteness in after life; but this story seems to be without foundation, and is denied by the editor of his works. From Cadbury he removed to Wales; and thence, on the death of his father, to Westminster, where he was not unfavourably known for his talents and deportment. In spite, however, of his efforts to improve his income by teaching in a boarding-school, his debts soon outstripped his means, and he was only saved from incarceration by the interposition of Dr Lloyd, a master in Westminster school. His intimacy at this time with Robert Lloyd, a dissolute poetaster, the son of his benefactor, exerted an unhappy influence on his character. The first of Churchill's poems for which he could find a publisher was the *Rosciad*, a rude satire on the theatrical notabilities of the time; but it was not till a second edition was called for that he ventured to affix his name to the work. His next performance was his *Apology to the Critical Reviewers*, which contains a vigorous reply to the attacks made on his former production. While his writings were thus furnishing general amusement, his private life was viewed with unmitigated disgust. He abandoned his wife, resigned his clerical dignities, and openly devoted himself to a life of pleasure. To palliate his convivial excesses, he wrote a poem called *Night*, in which he justified his conduct by pleading that he never disguised it. His next poem, entitled the *Ghost*, is aimed at Dr Johnson, who had expressed an unfavourable opinion of Churchill's previous works, and is satirized under the name of Pomposo. A political squib, entitled *Prophecy of Famine*, was more successful than either of these works. It was written in the spirit of the *North Briton*, and principally to gratify Mr Wilkes, who augured well of its success on the ground that it was at once personal, poetical, and political. His succeeding pieces were carelessly written, and far less successful. *Gotham*, *Independence*, *The Times*, &c., were written rather from a desire to profit by his fame than to advance it. Churchill died of a miliary fever at Boulogne, whither he had gone on a visit to his friend Wilkes. (See *Genuine Memoirs of Mr Churchill*, 12mo, 1765.) His collected poems were published in 2 vols. 8vo, 1779.

Churchyard ‖ Chusan.

CHURCHYARD, a piece of ground adjoining to a church, and set apart for the interment of the dead. In the Church of Rome such grounds are consecrated with great solemnity; and if afterwards profaned, as by the burial of an infidel, a heretic, or an unbaptized or excommunicated person, the ceremony of *reconciliation* is performed with all the solemnity of the original consecration.

CHURCHYARD, *Thomas*, a poet who flourished in the reigns of Henry VIII., Edward VI., Mary, and Elizabeth. He was born at Shrewsbury; and inherited a small patrimony, which was soon exhausted in a fruitless attendance on the court. He found his only recompense in having gained the favour of Lord Surrey, who retained him as a domestic, and encouraged his first poetical attempts. On his patron's death he joined the army; and in the engagements at which he was present he was frequently wounded, and twice made prisoner. He published several pieces, which were afterwards collected into one volume under the title of *Churchyard's Chips*; and also the tragedy of *Thomas Moubray, Duke of Norfolk*. He died in 1604.

CHURN (Saxon *cierne*), a machine for separating the oily parts of milk or cream from the caseous and serous parts, to make butter. (See DAIRY.) The common churn is a vessel in the shape of the frustrum of a cone, in which the milk is agitated by means of a perforated circular board attached to a long rod, which is worked up and down through an orifice in the lid of the vessel; or several such boards are arranged around a horizontal spindle, one end of which is made to pass through the side of the vessel, and attached to a handle. In some churns the agitation of the milk is increased by a double apparatus acting in contrary directions. The construction of churns however varies greatly.

CHUSAN, the principal of an immense group of smaller islands off the eastern coast of China, in Lat. 30. N. Long. 122. E. It lies N.W. and S.E., and has a circumference of $51\frac{1}{4}$ miles—the extreme length being 20, the extreme breadth 10, and the minimum breadth 6 miles. This island is beautifully diversified with hill and dale, and is well cultivated. Of the numerous small streams which run from the mountains and cross the plains to the sea, the most considerable is the Tungkeang, which falls into the harbour of Tinghae. On most of the hills there is a moderate coating

of earth, which by industry has been rendered very productive. Nineteen-twentieths of the inhabitants are engaged in agriculture. Wherever it is possible to rear rice, the cultivation of every other product is abandoned; yet the quantity produced is not sufficient for the wants of the inhabitants. Millet, wheat, sweet potatoes, yams, taros, &c., are also grown. The tea plant is found almost everywhere, but is treated with little or no care. Chusan annually exports about 30,000 dols. worth. The cotton plant is largely cultivated near the sea. The capital, Tinghae, stands about half a mile from the beach, and is surrounded by a wall nearly 3 miles in circuit. The ditch outside the wall is interrupted on the N.W. side by a spur from a neighbouring hill, which projects into the town, and forms an easy access to an attacking force on that side The town is traversed by canals, and the harbour, which has from 4 to 8 fathoms water, is landlocked by several islands. Temple or Joss-house Hill, which commands the town and harbour, is 122 feet high close to the beach, and on its east side there is a canal. The population of the town and suburbs of Tinghae, which at the commencement of 1843 was about 27,500, had increased in 1846 to above 35,000. The population of the entire island was estimated at 200,000. Chusan has but few manufactures; of these the chief are coarse cotton stuffs and agricultural implements. There are salt works on the coast; and the fisheries employ a number of the inhabitants. In Tinghae a considerable business is carried on in carving and varnishing. The principal exports are fish, coarse black tea, cotton, vegetable tallow, sweet potatoes, and some wheat. Chusan was taken by the British forces in 1840 and 1841, and retained till 1846 as a guarantee for the fulfilment of the stipulations of the treaty.

CHUTTERPOOR, a city of Hindustan, in the province of Bundelcund. It is a very ancient town, having been established by rajah Chuttersal, the founder of the short-lived independence of Bundelcund, who occasionally made it his residence. It was in consequence a very flourishing city, and an important commercial mart, being a great entrepôt of trade between Benares and the Deccan, and at a very short distance from the diamond mines of Pannah. The town is still a thriving place, but maintains its prosperity less by its transit trade than by its manufactures. The principal articles of fabrication are paper and coarse cutlery. The territory, of which this town is the chief place, contains an area of 1240 square miles, with a population of 120,000. The revenue is stated at L.30,000 per annum; and a military force of 100 cavalry and 1000 infantry is maintained by the chief. As Pertaub Singh, the present rajah, has no male issue, the territory, upon his decease, would have lapsed to the paramount power: in acknowledgment, however, of the fidelity of the present rajah and his predecessor, and of the beneficial administration of Pertaub Singh, the British government has recognized a successor to the present rajah in the person of his grand-nephew Juggut Singh, whom Pertaub wishes to adopt. Distance from Agra 180 miles; from Calcutta 600. Lat. 24. 55.; Long. 79. 39.

CHYLE (χυλός, *juice*), the nutritious fluid separated from the chyme in the process of digestion. See Anatomy, vol. ii. p. 782.

CHYTLA, in *Grecian Antiquity*, a mixture of water and oil, used in libations to the dead; and also to rub into the skin after bathing.

CIBBER, Colley, a dramatic writer, and poet-laureate to George II., was the son of Caius Gabriel Cibber, a distinguished German sculptor, and was born in London in 1671. At the age of eleven he was sent to the free school of Grantham in Lincolnshire, where he was educated, and whence he returned to London in 1687. In the following year he joined the army of the Prince of Orange as a volunteer; but in 1689 he left the service and betook himself to the stage, where at first he met with very indifferent success, acting originally for a salary of ten and afterwards of fifteen shillings a-week. In course of time he gradually rose in his profession, till in 1711 he became joint patentee in the management of Drury Lane, and distinguished himself especially by his impersonations of old men and fops. On the death of Eusden the poet-laureate in 1730, Cibber was appointed to succeed him in that office. On this occasion he retired from the stage; to which however he was tempted to return from time to time by an offer of fifty guineas a night. In 1757, shortly after he had completed his 86th year, he was found dead in his bed on the morning of December 12th. Cibber's principal comedies are entitled "Love's last Shift," "Love makes a Man," "She would and She would not," "The Nonjuror" (founded on the Tartuffe of Molière), and "The Careless Husband," which in spirit and finish is superior to all the others. His "Apology" for his life is interesting and humorous, and throws much light on contemporary social history. It has often been reprinted.

CIBORIUM, in *Antiquity*, a drinking-cup, so called from the κιβώριον or seed-vessel of the Egyptian bean, which in Egypt was applied to that use. (Hor., *Od.* ii. 7.)

Ciborium also denotes a kind of architectural structure composed of an arched vault or dome, carried or supported on four columns. In Roman Catholic countries these are erected over shrines and altars. The word is likewise applied less properly to the pyx or box in which the host is preserved.

CICACOLE, a town of Hindustan, British province of Ganjam, presidency of Madras, with a military cantonment, on the north bank of the river Naglandee. Pop. about 50,000. The district of which it is the chief place formerly constituted one of the five Northern Circars, designated the Circar of Cicacole; but the tract is now comprised within the province of Ganjam. Distance of town from Vizagapatam, N.E. 58 miles; from Madras, N.E. 435. Lat. 18. 18.; Long. 83. 58.

CICATRIX (*Latin*), the scar left by a wound or ulcer when healed.

CICERO, Marcus Tullius, the celebrated Roman orator, was born in the year of Rome 647, or about 105 years before Christ. His father Marcus Tullius, who was of the equestrian order, took great care of his education, which was directed particularly with a view to the bar. On his first appearance in public, young Tully declaimed with such vehemence against Sylla's party, that it became expedient for him to retire into Greece, where he attended the Athenian orators and philosophers, and greatly improved both in eloquence and knowledge. Here he met with his school-fellow Titus Pomponius, who, from his love of Athens, and having spent a great part of his days in that city, obtained the surname of *Atticus;* and here they revived and confirmed that noted friendship which subsisted between them through life with unshaken constancy and affection. From Athens Tully passed into Asia, and after an excursion of two years returned to Italy much improved by his travels.

Cicero had now established himself at Rome, where, after one year more spent at the bar, he obtained the dignity of questor. Among the causes which he pleaded before his questorship, was that of the famous comedian Roscius, whom singular excellence in his art had recommended to the familiarity and friendship of the greatest men in Rome. The questors were the general receivers or treasurers of the republic, and were sent annually into the provinces assigned them by lot. The island of Sicily happened to fall to Cicero's share, including that part of it,—for it was considerable enough to be divided into two provinces,—which was called Lilybæum. The office of questor he received, not as a gift, but as a trust; and he acquitted him-

self so well in discharge of it, that he gained the love and admiration of all the Sicilians. Before he left Sicily, he made the tour of the island, in order to visit every thing curious, especially the city of Syracuse, at which place he pointed out the tomb of Archimedes to the magistrates, who were showing him the curiosities of the place; but, to his surprise, he found that they knew nothing either of the tomb or of him whose ashes it contained.

We have no account of the precise time of Cicero's marriage with Terentia; but it is supposed to have been celebrated immediately after his return from his travels to Italy, when he was about thirty. Being now disengaged from his questorship in Sicily, by which first step in the legal gradation and ascent of public honours he had gained an immediate right to the senate, and an actual admission into it during life, he again settled in Rome, where he employed himself constantly in defending the persons and properties of its citizens, and indeed became a general patron of causes. Five years had scarcely elapsed since Cicero's election to the questorship (this being the proper interval prescribed by law before he could hold the next office), when he was, in his thirty-seventh year, elected ædile by the unanimous suffrages of the tribes, and in preference to all his competitors. After Cicero's election to the ædileship, but before his entrance upon office, he undertook the famous prosecution of Verres, the late prætor of Sicily, who was charged with many flagrant acts of injustice, rapine, and cruelty, during his triennial government of that island. This was one of the most memorable transactions of his life, one for which he was greatly and justly celebrated by antiquity, and for which he will, in all ages, be admired and esteemed by the friends of mankind. The result was, that, by his diligence and address, he so confounded Hortensius, though the reigning orator at the bar, and usually styled the king of the forum, that his majesty had nothing to say for his client. Verres, despairing of all defence, submitted immediately, without waiting the sentence, to a voluntary exile, in which condition he lived many years, forgotten and deserted by all his friends. He is said to have been relieved in this miserable situation by the generosity of Cicero; but at length he was proscribed and murdered by Mark Antony, for the sake of those fine statues and Corinthian vessels of which he had plundered the Sicilians.

After the usual interval of two years from the time of his being chosen ædile, Cicero offered himself as a candidate for the prætorship; and, in three different assemblies convened for the choice of prætors, two of which were dissolved without effect, he was every time declared the first prætor by the suffrages of the centuries. He was now in the full career of his fortunes, and in sight, as it were, of the consulship, the grand object of his ambition; and therefore, when his prætorship terminated, he refused to accept any foreign province, the usual reward of that magistracy, and the chief fruit which the generality proposed from it. He had no particular love for money, and no genius for war; so that those governments had no charms for him. The glory which he pursued was to shine in the eyes of the city as the guardian of its laws; to teach the magistrates how to execute, and the citizens how to obey them.

Being now in his forty-third year, the proper age required by law, he declared himself a candidate for the consulship, along with six competitors, L. Sulpicius Galba, L. Sergius Catilina, C. Antonius, L. Cassius Longinus, Q. Cornificius, and C. Licinius Sacerdos. The first two were patricians; the next two plebeians, yet noble; the last two the sons of fathers who had first imported the public honours into their families; Cicero was the only *new man*, as he was called, among them, or person of the equestrian rank. These were the competitors; and in the competition the practice of bribing was carried on openly and shamefully by Antony and Catiline. However, as the election approached, Cicero's interest appeared to be superior to that of all the candidates; for the nobles themselves, though always envious of and desirous to depress him, yet, considering the dangers which threatened the city from many quarters and seemed ready to burst out into a flame, they began to think him the only man qualified to preserve the republic, and to quash the cabals of the desperate, by the vigour and prudence of his administration. The method of choosing consuls was not by an open vote, but by a kind of ballot, or little tickets of wood distributed to the citizens, with the names of the several candidates inscribed upon each. But in Cicero's case the people were not content with this secret and silent way. Before they came to any scrutiny, they loudly and universally proclaimed Cicero the first consul; so that, as he himself says, "he was not chosen by the votes of particular citizens, but by the common suffrage of the city; not declared by the voice of the crier, but by that of the whole Roman people."

Cicero had no sooner entered upon his office than he had occasion to exert himself against P. Servilius Rullus, one of the new tribunes, who had been alarming the senate with the promulgation of an agrarian law; the purpose of which was to create a decemvirate, or ten commissioners, with absolute power for five years over all the revenues of the republic, to distribute them at pleasure to the citizens, and to exercise other functions equally incompatible with the existence of society. These laws used to be greedily received by the populace, and were therefore proposed by factious magistrates as often as they had any point to carry with the multitude against the public good; so that Cicero's first business was to quiet the apprehensions of the city, and to baffle, if possible, the intrigues of the tribune. Accordingly, in an artful and elegant speech from the rostra, he gave such a turn to the inclination of the people, that they rejected this law with as much eagerness as they had ever received one. But the affair which constituted the great glory of his consulship, and which has transmitted his name with such lustre to posterity, was the skill he showed, and the unwearied pains he took, in suppressing the conspiracy which had been formed by Catiline and his accomplices for the subversion of the commonwealth. For this great service he was honoured with the glorious title of *Pater Patriæ*, or Father of his Country, a title which he retained for a long time afterwards.

Cicero's administration was now at an end; but he had no sooner quitted his office than he began to feel the effects of that envy which is the certain fruit of illustrious merit. He was now, therefore, the common mark, not only of all the factious, against whom he had declared perpetual war, but of another party not less dangerous, the envious, whose united malice never left him from this moment till they had driven him out of the very city which he had so lately preserved. Cicero, upon the expiration of his consulship, took care to send a particular account of his whole administration to Pompey, then occupied with the Mithridatic war in Asia; in hopes no doubt of preventing any wrong impressions there from the calumnies of his enemies, and of drawing from that commander some public declaration in favour of what had been done. But Pompey being informed by Metellus and Cæsar of the ill humour which was rising up against Cicero in Rome, answered him with great coldness, and instead of paying him any compliment, took no notice at all of what had passed in the affair of Catiline; an omission in regard to which Cicero expostulates with him in a letter which is still extant.

About this time Cicero bought a house of Marcus Cras-

sus, on the Palatine Hill, adjoining to that in which he had always lived with his father, and which he is supposed to have given up to his brother Quintius. The house cost him a very large sum, and seems to have been one of the noblest in Rome. The purchase of so expensive a house led to some censure of his vanity, especially as it was effected with borrowed money; a circumstance which he himself does not dissemble, but observes jocosely, with reference to it, that "he was now plunged so deeply in debt, as to be ready for a plot, only that the conspirators would not trust him."

The most remarkable event that happened in this year, which was the forty-fifth of Cicero's life, was the pollution of the mysteries of the Bona Dea by Publius Clodius, a crime which, by an unhappy train of consequences, involved Cicero in a great and unexpected calamity. Clodius had an intrigue with Cæsar's wife Pompeia, who, according to annual custom, was now celebrating in her house those awful sacrifices of the goddess, to which no male creature was ever admitted, and where everything masculine was so scrupulously excluded, that even pictures of that sort were covered during the ceremony. It flattered Clodius's imagination greatly to gain access to his mistress in the midst of her holy ministry; and with this view he dressed himself in a woman's habit, that by the benefit of his smooth face, and the introduction of one of the female servants, he might pass without discovery; but by some mistake between him and his guide, he lost his way when he came within the house, and fell unluckily among the other female servants. Here he was detected by his voice, and the servants alarmed the whole company by their shrieks, to the great amazement of the matrons, who threw a veil over their sacred mysteries, while Clodius found means to escape. The story was presently spread abroad, and raised a general scandal and horror throughout the city. The whole defence which Clodius made when, by order of the senate, he was brought to trial, was to prove himself absent at the time when the offence was committed; for which purpose he produced two men to swear that he was then at Interamna, distant about two or three days' journey from the city. But Cicero being called upon to give his testimony, deposed that Clodius had been with him that very morning at his house in Rome. Irritated by this, Clodius formed a scheme of revenge. This was to get himself chosen tribune, and in that office to drive Cicero out of the city, by the publication of a law, which, by some stratagem or other, he hoped to obtrude upon the people. But as all patricians were incapable of the tribunate by its original institution, so his first step was to make himself a plebeian, by the pretence of an adoption into a plebeian house, which could not yet be done without the suffrage of the people. The first triumvirate had now been formed, being in reality nothing else but a traitorous conspiracy of three of the most powerful citizens of Rome, to extort from their country by violence what they could not obtain by law. Pompey's chief motive was to get his acts confirmed by Cæsar in his consulship, which was now approaching; Cæsar, by giving way to Pompey's glory, thought to advance his own; while Crassus hoped to gain that ascendency by the authority of Pompey and Cæsar which he could not sustain alone. Cicero might have made what terms he pleased with the triumvirate, and even been admitted a partner of their power, or a fourth in their league; but he would not enter into any engagements with the three, whose union he and all friends of the republic abhorred. Clodius, in the mean time, had been pushing on the business of his adoption, which at last he effected, and began soon afterwards to threaten Cicero with all the terrors of his tribunate, to which he was now advanced without any opposition. Both Cæsar and Pompey secretly favoured his scheme; not that they intended to ruin Cicero, but only to keep him under the lash; and if they could not draw him into their measures, or induce him at least to remain quiet, to let Clodius loose upon him. Cæsar, in particular, wanted to distress him so far as to force him to a dependence on himself; and hence, while he was privately encouraging Clodius to pursue him, he was proposing expedients to Cicero for his security. But though his fortunes seemed now to be in a tottering condition, and his enemies daily gained ground upon him, yet he was unwilling to owe an obligation for his safety to any man, far less to Cæsar, whose designs he had always suspected, and whose schemes he never approved. This stiffness in Cicero so exasperated Cæsar, that he resolved immediately to assist Clodius with his whole power to oppress him; while Pompey was all the while giving him the strongest assurances that there was no danger, and that he would sooner be killed himself than suffer him to be hurt.

Clodius, in the mean time, was obliging the people with several new laws, contrived chiefly for their advantage; in the hope, no doubt, that he might thereby introduce with a better grace the ground-plot of the plan for the banishment of Cicero. In short, having caused a law to be enacted, importing, that whoever had condemned a Roman citizen unheard should be banished, he soon afterwards impeached Cicero upon the enactment. It was in vain that the great orator went up and down the city soliciting his cause in the habit of a suppliant, and attended by many of the first young noblemen whom he had taught the rules of eloquence; those powers of speaking which had so often been successful in defending the cause of others, seemed totally to forsake him in pleading his own. He was banished by the votes of the people four hundred miles from Italy; his houses were ordered to be demolished, and his goods set up to sale. It cannot be denied that, in this great calamity, he did not behave himself with that firmness which might have reasonably been expected in one who had borne so glorious a part in the republic, conscious of his integrity, and suffering in the cause of his country; and his letters are for the most part filled with such lamentable expressions of grief and despair, that his friends, and even his wife, were forced sometimes to admonish him to rouse his courage, and to remember his former character. Atticus was constantly putting him in mind of this, and sent him notice of a report which had been brought to Rome by one of Cassius's freed-men, that his affliction had disordered his senses. He was now indeed attacked in his weakest part, the only place in which he was vulnerable. To have been as great in affliction as he was in prosperity, would have been to exhibit a perfection not given to man; yet his very weakness flowed from a source which rendered him the more amiable in all the other relations of his life; and the same tenderness of disposition which made him love his friends, his children, and his country, more passionately than other men, caused him to feel the loss of them more sensibly. When he had been gone a little more than two months, a motion was made in the senate by one of the tribunes, who was his friend, to recal him, and repeal the laws of Clodius, to which the whole house readily agreed. Many obstructions, as may be easily imagined, were given to it by the Clodian faction; but this made the senate only more resolute to effect the object proposed. They passed a vote, therefore, that no other business should be done till Cicero's return had been carried; which it at last was, and in so splendid and triumphant a manner, that he had reason, he says, to fear lest people should imagine that he himself had contrived his late flight for the sake of so glorious a restoration.

Cicero, now in his fiftieth year, was restored to his former dignity, and soon afterwards to his former fortunes,

satisfaction being made to him for the ruin of his estates and houses, which last were rebuilt by himself with more magnificence than before. But about this time he had domestic grievances which touched him very nearly, and which, as he signifies obscurely to Atticus, were of too delicate a nature to be expressed in a letter. They arose chiefly from the petulant humour of his wife, which began to give him frequent occasions of chagrin; and, by a series of repeated provocations, confirmed in him the settled disgust which at last ended in a divorce.

In the fifty-sixth year of his age he was appointed proconsul of Cilicia, and his administration there gained him great honour. About this time the expectation of a breach between Cæsar and Pompey engaged the general attention. Crassus had been destroyed with his army some years before, in the war with the Parthians; and Julia, the daughter of Cæsar, whom Pompey had married, and who, while she lived, formed the cement of their union, had also died in childbed. Cæsar had put an end to the Gallic war, and reduced the whole province under the Roman yoke; but though his commission was near expiring, he seemed to have no thoughts of giving up his command and returning to the condition of a private subject. He pretended that he could not possibly be safe if he parted with his army, especially while Pompey held the province of Spain, the government of which had been continued to him for five years. This tendency towards a breach Cicero learned from his friends, as he was returning from his province of Cilicia. But as he foresaw the consequences of a war more clearly and fully than any of them, so his first resolution was to apply all his endeavours and authority to the mediation of a peace; though, in the event of a breach, he secretly determined to follow the fortunes of Pompey. He clearly foresaw, and indeed declared without scruple to his friends, that which side soever proved victorious, the war must necessarily end in a tyranny. The only difference, he said, was, that if their enemies conquered, they should be proscribed; if their friends, they would be slaves.

He had no sooner arrived in the city, however, than he fell, as he tells us, into the very flame of civil discord, and found the war in effect proclaimed; for the senate had just voted a decree that Cæsar should disband his army by a certain day, or be declared a public enemy; and his sudden march towards Rome had effectually confirmed it. In the midst of all this hurry and confusion, Cæsar was extremely solicitous about Cicero; not so much to gain him, for that was not to be expected, as to prevail with him to remain neutral. He wrote to him several times to this effect, and employed all their common friends to press him with letters on the subject, but in vain; for Cicero was impatient to join Pompey. In the mean time these letters give us a most sensible proof of the high esteem and credit in which Cicero was held at this time in Rome; when, in a contest for empire, which force alone was to decide, the chiefs on both sides were so solicitous to gain a man to their party who had no peculiar skill in arms nor talents for war. Pursuing, however, the result of all his deliberations, he at length embarked to join Pompey, who had been obliged to quit Italy some time before, and was then at Dyrrachium; and he arrived safely in the camp with his son, his brother, and his nephew, thus committing the fortunes of his whole family to the issue of the cause. After the battle of Pharsalia, in which Pompey was defeated, Cicero returned into Italy, and was afterwards received into great favour by Cæsar, who had now been declared dictator the second time, with Mark Antony as his master of horse. We may easily imagine, what indeed we find from his letters, that he was not a little disconcerted at the thoughts of an interview with Cæsar, and the indignity of presenting himself before a conqueror against whom he had been in arms; for although, upon many accounts, he had reason to expect a kind reception from Cæsar, yet he hardly thought his life, he says, worth begging, since what was given by a master might always be taken away again at pleasure. But at their meeting he had no occasion to say or do any thing below his dignity; for Cæsar no sooner saw him than he alighted, ran to embrace him, and walked with him alone, conversing very familiarly, for several furlongs.

Cicero, now in his sixty-first year, was at length forced to part with his wife Terentia, whose humour and conduct had long been disagreeable to him. She was a woman of an imperious and turbulent spirit; and though he had borne her perverseness in the vigour of health, and the prosperous state of his fortunes, yet, in declining life, and soured by a continual succession of mortifications from abroad, the want of ease and quiet at home became no longer tolerable to him. But he was immediately oppressed by a new and most cruel affliction, the death of his beloved daughter Tullia, who died in childbed soon after her divorce from her third husband Dolabella. She was about thirty-two years old at the time of her death; and, by the few hints which are left of her character, she appears to have been an excellent and admirable woman. She was most affectionately and piously attentive to her father, and, to the usual graces of her sex, added the more solid accomplishments of knowledge and polite letters, which qualified her to be the companion and delight of his age, and made her justly esteemed not only as one of the best, but the most learned, of the Roman ladies. His affliction for the death of this daughter was so great, that to shun all company as much as he could, he removed to Atticus's house, where he lived chiefly in his library, turning over every book he could meet with on the subject of moderating grief. But finding his residence here too public, and being exposed to more society than he was able to bear, he retired to Astura, one of his seats near Antium; a little island on the Latian shore, at the mouth of a river of the same name, and covered with wood and groves cut into shady walks, forming a scene altogether the fittest to indulge melancholy, and to afford a free vent to affliction. "Here," says he to Atticus, "I live without the speech of man. Every morning early I hide myself in the thickest of the wood, and never come out till the evening. Next to yourself, nothing is so dear to me as this solitude; and my whole conversation is with my books." Indeed his whole time was employed in little else than reading and writing, during Cæsar's administration, which he could never cheerfully submit to; and it was within this period that he drew up one of the gravest of those philosophical pieces which are still extant in his works.

Upon the death of Cæsar, Octavius, his nephew and heir, coming into Italy, was presented to Cicero by Hirtius and Pansa, with the strongest professions on the part of the young man that he would be governed entirely by his direction. Indeed Cicero thought it necessary to cherish and encourage Octavius, if for nothing else, to keep him at a distance from Antony; but he could not yet be persuaded to enter heartily into his affairs. He suspected his youth and want of experience, and that he had not strength enough to deal with Antony; and, above all, that he had no good disposition towards the conspirators. He thought it impossible he should ever be a friend to them; and indeed he was persuaded, that if ever he obtained the ascendency, his uncle's acts would be more violently enforced, and his death more cruelly revenged, than even by Antony himself. Accordingly, when Cicero at last consented to unite himself to Octavius's interests, it was with no other view than to arm him with a power sufficient to con-

trol Antony, yet so checked and limited, that he should not be able to oppress the republic.

In the midst of all this political bustle he still prosecuted his studies with his usual application; and, besides some philosophical pieces, now finished his book of Offices, or the Duties of Man, for the use of his son. However, he paid constant attention to public affairs, and missed no opportunities, but on the contrary did every thing that human prudence could suggest, for the restoration of the republic; indeed all the vigour with which the last effort was made in its behalf, was entirely owing to his counsels and authority. This appears from the memorable Philippics which from time to time he published against Antony, as well as from other monuments of antiquity. But all was in vain; for although Antony's army was entirely defeated at the siege of Modena, and many people were in consequence led to imagine that the war was at an end, and the liberty of Rome established, yet the death of the consuls Pansa and Hirtius in that action gave a fatal blow to all Cicero's schemes, and proved the immediate cause of the ruin of the republic.

Octavius having humbled the senate to his mind, marched towards Gaul to meet Antony and Lepidus, who had already passed the Alps, and brought their armies into Italy, in order to have a personal interview with him, which, in fact, had been privately concerted for settling the terms of a triple league, and dividing the power and provinces of Italy among themselves. The place appointed for this interview was a small island about two miles from Bononia, formed by the river Rhenus, which runs near that city. Here they met, and spent three days in close conference, adjusting the plan of their accommodation; and the last thing they settled was the list of a proscription of their common or individual enemies. This, as the writers tell us, occasioned much difficulty and warm contests among them, till each in his turn consented to sacrifice some of his best friends to the revenge and resentment of his colleagues. Cicero was at his Tusculan villa when he first received the news of the proscription, and of his being included in it at the instigation and to satisfy the vengeance of Antony. It was the design of the triumvirate to keep it a secret, if possible, till the very moment of execution, in order to surprise those whom they had destined to destruction, before they were aware of their danger, or had time to effect their escape. But some of Cicero's friends found means to give him early notice of this infamous compact, upon which he set forward to the sea-coast, with the design of transporting himself beyond reach of his enemies. There, finding a vessel ready, he immediately embarked; but the winds being adverse, and the sea uneasy to him, after he had sailed about two leagues along the coast, he was obliged to land, and spend the night on shore. By the importunity of his servants, however, he was forced on board again; but he soon afterwards landed at a country-seat of his, a mile from the shore, weary of life, and declaring he was resolved to die in that country which he had so often saved. Here he slept soundly for some time, till his servants once more forced him away in a litter towards the ship, having heard that he was pursued by Antony's assassins. They had scarcely departed when the assassins arrived at his house, and, perceiving that he had fled, immediately pursued and overtook him in a wood near the shore. Their leader was one Popilius Lenas, a tribune of the army, whose life Cicero had formerly defended and saved. As soon as the soldiers appeared, the servants prepared to defend their master's life at the hazard of their own; but Cicero commanded them to set him down and make no resistance. The assassins soon cut off his head and his hands, with which they returned to Rome as the most agreeable present to their savage and remorseless employer. Antony, who was then at Rome, received them with extreme joy, rewarded the murderers with a large sum of money, and ordered the head to be fixed upon the rostra between the two hands,—a sad spectacle to the city, and which drew tears from every eye.

If we take an impartial survey of Cicero's conduct and principles, avowed in his own epistolary correspondence, and trace him through all the labyrinths of his contradictory letters, we shall perhaps find more to blame than to admire; and discover that the desire of advancing his fortunes, and making himself a name, were, from his outset in life, the chief objects he had in view. The good of his country, and the dictates of a steady unyielding virtue, were not, as in Brutus and Cato, the constant springs of his actions. The misfortunes which befel him after his consulship developed his character, and showed him in his true colours: from that time to his death, pusillanimity, irresolution, and unworthy repining, tainted his judgment, and perplexed every step he attempted to take. He flattered Pompey and cringed to Cæsar, while in his private letters he abused both alternately and impartially. He acknowledges, in a letter to his friend Atticus, that, although he was at present determined to support the cause of Rome and liberty, and to bear misfortune like a philosopher, there was one thing which would gain him over to the triumvirs, and that was their procuring for him the vacant augurship; so pitiful was the bribe to which he would have sacrificed his honour, his opinions, and the commonwealth.

Cicero's death happened on the 7th of December, in the sixty-fourth year of his age, about ten days after the settlement of the first triumvirate. As an orator he is thus characterized by a popular writer: " In all his orations his art is conspicuous. He begins commonly with a regular exordium, and with much address prepossesses the hearers, and studies to gain their affections. His method is clear, and his arguments are arranged with exact propriety. In a superior clearness of method, he has an advantage over Demosthenes. Every thing appears in its proper place. He never tries to move till he has attempted to convince; and in moving, particularly the softer passions, he is highly successful. No one ever knew the force of words better than Cicero. He rolls them along with the greatest beauty and magnificence; and in the structure of his sentences is eminently curious and exact. He is always full and flowing, never abrupt. He amplifies every thing; yet though his manner is generally diffuse, it is often happily varied and accommodated to the subject. When an important public object roused his mind, and demanded indignation and force, he departs considerably from that loose and declamatory manner to which he at other times is addicted, and becomes very forcible and vehement. This great orator, however, is not without his defects. In most of his orations there is too much art, even carried to a degree of ostentation. He seems often desirous of obtaining admiration rather than of operating conviction. He is sometimes, therefore, showy rather than solid, and diffuse where he ought to have been urgent. His sentences are always round and sonorous. They cannot be accused of monotony, since they possess variety of cadence; but from too great a fondness for magnificence, he is on some occasions deficient in strength. Though the services which he had performed to his country were very considerable, yet he is too much his own panegyrist. Ancient manners, which imposed fewer restraints on the side of decorum, may in some degree excuse, but cannot entirely justify, his vanity."

There have been many editions of all Cicero's pieces, and many also of his whole works. Their multiplicity is so great that we can only refer those who may wish for

information in regard to them, to the works which have been published on the bibliography of the classics, particularly Dibdin's fourth edition. We may, however, mention shortly some of the most useful editions. These are, the edition of his treatises on Oratory, printed *in usum Delphini*, in 2 vols. 4to, in 1687; of his Letters, by Grævius, published in 1677, in 2 vols. 8vo; of his Orations, also by Grævius, published in 1699, in 6 vols. 8vo; and of his Philosophical Works, by Rath, published in 1808, in 6 vols. 8vo. One of the best editions of his whole works is that of Olivet, published at Paris in 1742, in 9 vols. 4to. The beautiful edition published at Glasgow in 1749, in 20 vols. 12mo, is a reprint of that of Olivet. Among the other editions of note, may be mentioned that of Manutianus, which is the *editio princeps*, Mediol. fol. 1498, 4 vols.; that of Paulus Manutius, which is deservedly held in high estimation, Venet. 1540–41, 10 vols.; that of R. Stephanus, Paris, 1543, 8 vols.; that of Elzevir, beautiful and correct, exhibiting the improved text of Gruter, Lugd. Bat. 1642, 10 vols.; those of Ernesti, Lipsiæ, 1737, Hal. Sax. 1758–74, one in 5 vols. and the last in 8; the beautiful and correct edition of Lallemand in 14 vols. 12mo, Paris, 1768; the magnificent, but as yet uncompleted, edition begun at Naples in 1777; and the Bipont edition, which professes to be formed on the basis of the most popular ones, without the introduction of either conjecture or novelty, 1780, 13 vols. Later than any of these is the edition of Orelli, Turic. 1826–1837, valuable not only on account of the accuracy of its text, but as containing the recovered portions or fragments of the celebrated treatise on government (*De Republica*), for which the world is indebted to the patient labour and sagacity of Signor Angelo Mai, librarian of the Vatican, formerly of the Ambrosian library at Milan. In a palimpsest volume, containing various treatises of St Augustin, this learned and ingenious person found that the original writing, of much greater antiquity, had consisted of the long-lost books of Cicero *De Republica*, of which nothing had been known in modern times except the few fragments which had been preserved in the writings of Macrobius, Lactantius, Augustin, Nonnius, and others. From these rescribed pages, a very considerable part of the first and second books of this interesting treatise was found so perfect as to be almost completely recovered by Signor Mai; and this he was enabled to publish in 1821, with copious notes and illustrations, with an accurate notice of all the chasms occurring from the loss of original leaves, and with such a restoration of the four remaining books as could be made from the less perfect fragments of the manuscript, and from the remains collected by Ligonius and other critics. This is perhaps the most valuable contribution which has been made to classical literature in modern times; and it is sufficient to immortalize the learned, sagacious, and indefatigable scholar to whom we are indebted for it; consisting, as it does, of no inconsiderable portion of that treatise which the contemporaries of the Roman orator and statesman all agreed in regarding as his masterpiece.

CICISBEO, an Italian term, synonymous with *cavalièr servente*, and used to signify a dangler about ladies. Formerly no married woman of fashion was to be seen in public without her cicisbeo, whose duty it was to attend upon her everywhere, and in short to act the part of the most devoted admirer. This practice is now fast declining. Though the office of cicisbeo has been the subject of frequent invective, it has not wanted its advocates and admirers. Among others, Baretti, in his "Account of the Manners and Customs of Italy," has endeavoured to vindicate it with much ingenuity—ascribing it to a spirit of gallantry derived from the age of chivalry, and much heightened and refined by the revival of the Platonic philosophy in Italy about the thirteenth century, and by the verses of Petrarch and his numerous imitators.

CICLUT, or CICLUCH, a strong frontier town of Dalmatia, situated on the river Narentha, in Long. 18. 22. E., Lat. 43. 29. N., and surrounded by walls built in the ancient manner.

CICOGNARA, LEOPOLD, COUNT. This eminent writer was born of a noble family at Ferrara in 1767, and distinguished himself in physical and mathematical science at Pavia, where he completed his academical career. In 1795 we find him settled at Modena, where he was employed by the government; and for some time he was its representative at Turin; but he resigned this post in 1808 on being appointed president of the academy of the fine arts at Venice. He was now in his true element, and published very important works connected with the fine arts. His treatise on the Beautiful appeared soon after his removal to Venice; and from 1816 to 1818 he published his great work "Storia della Scultura dal suo Risorgimento in Italia al Secolo di Napoleone," in 3 vols. folio. This excellent work gives a luminous view of the progress of modern sculpture, carrying down its history to our own times, and thus supplying the portions since the time of Winckelmann and D'Agincourt. He also produced a treatise on copper-engraving, "Memorie per servire alla Storia della Calcografia;" and the two magnificient folio volumes "On the Most Conspicuous Edifices of Venice" owe much of their value to his pen, though in this work he had the assistance of Selva and Diedo. His systematic catalogue of his own rich library, in two 8vo volumes, shows the immense collection he had formed of works illustrative of every branch of the fine arts, and the use he had made of them. In short, he may be regarded as one of the most learned and assiduous writers that ever handled such subjects. He also possessed considerable poetic powers, as appears by his first publication, "Le Ore del Giorno," published at Palermo in 1790; the beautiful and correct edition of Lallemand, in 14 vols. 12mo, Paris, 1768; and the magnificent but as yet uncompleted edition begun at Naples 1777. Cicognara died at Venice on the 5th March 1834. (T. S. T.)

CICUTA, hemlock, the juice of which was the famous κώνειον of the Athenians, used in the execution of criminals. Thus, too, perished Socrates, B.C. 399. (Plat. *Phæd.*)

CID, The, (from the Arabic *El Seid*, the Lord,) a name given to Rodrigo Diaz de Bivar, the national hero of Spain. See POETRY.

CIDARIS, a Persian word signifying a diadem or tiara, and used to denote the mitre of the high priest of the Jews. The rabbin admit no difference between the high priest's head-dress and that of other priests, except that the one was flat and in the form of a turban, while that worn by ordinary priests was somewhat peaked.

CIDER or CYDER, a vinous liquor made from the expressed and fermented juice of the apple. In England, the counties of Devon and Hereford are noted as the cider counties; but good cider is also produced in the counties of Gloucester, Monmouth, Worcester, Dorset, Somerset, and Cornwall. Normandy has long been known for the excellence of its cider; and considerable quantities are manufactured in other districts of France, and also in Belgium, Germany, and in North America.

In this country the manufacture of cider is almost entirely in the hands of the common farmer, so that little or nothing has been done either to improve the machinery, or bring science to bear on the processes which are followed. Hence much of the cider is of inferior quality, and much waste ensues in the manufacture. The apples for cider should only be gathered when fully ripe, as it is only then that they contain their full proportion of saccharine matter. As the apples are gathered they are laid in heaps, and are allowed to lie thus from 15 to 30 days in order to become fully ripe or mellow. They are then thrown (in this country) into a circular stone trough, round which a heavy circular stone is turned by means of one or two horses. When the apples

are thoroughly reduced to a pulp, the pulp is carried in pails to the screw-press and poured into square pieces of hair-cloth, the edges of the hair-cloth being so folded over the pulp as to prevent any escaping. The pulp is then subjected to pressure in the press when the juice escapes, leaving a solid cake. The juice is now transferred to casks, where it rapidly undergoes a process of fermentation, without requiring any addition; and in three or four days the process is completed, when it is drawn off into casks. The best cider is almost always that in which the process of fermentation has been most slowly conducted. When the fermentation has been rapid the cider is apt to run to acidity.

In France several manufacturers of cider have lately employed improved apparatus for mashing their apples, somewhat similar to that used for mashing the beet-root in the manufacture of sugar; and have also given special attention to the management of the process of fermentation. The quality of the cider is said to have been thereby greatly improved. The cake after its first pressure is sometimes broken up with water and subjected to a second pressure, and the juice it then yields furnishes, on fermentation, an inferior cider, which must be soon used, as it will not keep. Cider is not fit to be drunk till about three months after it is made. Good cider yields about 6 per cent. of alcohol on distillation, and thus contains nearly the same amount of alcohol as the ordinary bitter Indian ales; but the inferior kinds used by the labourers in Devon and Hereford do not contain above half that proportion. Cider appears to be a refreshing and healthful drink; and the natives of the counties in which it forms the ordinary drink are remarked to be nearly exempt from stone and from gravel complaints.

CIEZA or ZIEZA, a town of Spain, on the left bank of the Segura, province of Murcia, and 24 miles N.W. from the town of that name. Pop. about 6500. It has manufactures of coarse linens. On the opposite side of the river there are remains of a Roman town, supposed to be *Carteia*.

CIGAR. See TOBACCO.

CIGOLI, LODOVICO CARDI DA, a Florentine painter of the third epoch of that school, was born in 1559. He may be considered as the artist who taught the Florentine school the value of a finer chiaroscuro than it then possessed. His style was formed on that of Coreggio, though he failed in giving his pictures the mellow lucidness of that mighty master of colouring. Cigoli drew well, and had a good knowledge of perspective, in which he was instructed by Buontalenti, while he was the scholar of Santi di Tito. His finest pictures are in the churches of Florence and in the ducal gallery. The *Martyrdom of St Stephen* in the nunnery of Monte Domini, and his *St Albert* in S. Maria Maggiore; and above all his *St Peter healing the lame man* in the Vatican, are among his noblest productions. This last Sacchi considers next to Raphael's *Transfiguration*, and the *St Jerome* of Domenichino. Cigoli died in 1613. (T.S.T.)

CIGNANI, CARLO, an Italian painter, born at Bologna in 1628. He was the disciple of Albano. Pope Clement XI. nominated him prince of the academy of Bologna, and loaded him with favours. Cignani died at Forli in 1719. His cupola of La Madonna del Fuoco at Forli, representing Paradise, is an admirable work. His principal pictures are at Rome, Bologna, and Forli.

CILIA (Lat. *cilium*, an eye-lash), in *Anatomy*, the name given to minute hair-like organs found in various animals on the surfaces of certain tissues, and requiring the aid of lenses to discover their form. They were first observed on the bodies of infusorial animals, and appear to be their organs of motion. They are most conspicuous on the Ciliograde Medusaria, and on the gills of various mollusca. On the external surface of infusoria they were first noticed by Leeuwenhoek; but they have since been found not only in the invertebrata and cold-blooded vertebrata, but Parkinje and Valentin have demonstrated cilia to exist on the moist tissues of the higher types of animals—and they not only exist on the external surfaces of animals inhabiting water, but also in the alimentary system, the organs of respiration, and those of reproduction. Their office seems to be to produce motion in the fluids on such surfaces. Their form is generally that of elongated cones, but sometimes they are flattened filaments varying in length even in the same animal, from $\frac{1}{500}$th to $\frac{1}{10,000}$th of an inch. They are usually colourless and transparent, sometimes slightly coloured, and exist in a state of perpetual motion, but which is seldom rapid. See ZOOLOGY.

CILICIA, an ancient division of Asia Minor, bounded W. by Pamphylia, N. by the range of Mount Taurus, which separates it from Pisidia, Lycaonia, and Cappadocia, E. by Mount Amanus, which separates it from Syria, S. by the Mediterranean. The western portion of Cilicia, from its broken and hilly character, was called *Trachæa* or rough, while the eastern portion, which consists for the most part of continuous plains, was called *Campestris* or level. The former division was famed for its breed of horses, and for the noble cedars which grew in great abundance on its mountain slopes; the latter was well watered and highly cultivated, producing largely the various kinds of cereals, besides dates and other fruits. Reckoning from Coracessium to Rhossus, Cilicia has a sea-board of about 420 miles. The direct distance, however, between these two places is only about half that measurement.

Cilicia was the fourth satrapy in the arrangement of Darius, and its annual tribute consisted of 500 talents of silver and 360 of its famous horses.

In Cilicia Trachæa the only river of any importance is the Calycadnus (Gok-Su), which rises in Taurus, and flowing from W. to E., falls into the sea near Cape Zephyrium. Three rivers of considerable magnitude drain the levels of Cilicia Campestris, the Cydnus, the Sarus, and the Pyramus. The waters of the first of these have long been noted for their coldness, which in ancient times nearly proved fatal to Alexander the Great, and more recently caused the death of Frederick Barbarossa. The Sarus (the modern Sihun), rising in Cappadocia, falls into the sea after a very irregular course of about 200 miles chiefly in a S.W. direction. The Pyramus, or Jyhoon, the largest of the Cilician rivers, consists of two main streams, which rising in Cataonia, unite at Marash and flow into the sea in a direction almost parallel with the course of the Sarus. Between the mouths of these rivers is the famous Aleian plain, renowned in Grecian mythology as the scene of Bellerophon's wanderings. The mouth of the Pyramus became in course of time so silted up that the river shifted the lower part of its course, and now falls into the sea by an outlet 22 miles E. of the ancient mouth. The most important towns of Cilicia Trachæa were Coracessium, now Alaya, a strong natural fortress; Selinus, afterwards called Trajanopolis, from the name of Emperor Trajan, who died there; and Seleucia, of which the ruins only now remain. In Cilicia Campestris the most noteworthy cities were Tarsi or Tarsus, now Tersoos, the birthplace of the Apostle Paul, and a famous school of philosophy; Issus, where Alexander defeated Darius, B.C. 333; and Soli, afterwards called Pompeiopolis from Pompey the Great, the birthplace of Chrysippus the Stoic philosopher and the poets Philemon and Aratus.

According to the old Greek myths, the Cilicians (who were originally called Hypachæi) took their name from Cilix, the son of the Phœnician Agenor. They were originally governed by native kings, who successfully resisted the attempts of Crœsus and others to subdue them, and remained independent till the rise of the Persian empire. Even after their incorporation with that power they continued to be governed by their own princes. When Xerxes was organizing a fleet for the invasion of Greece, Cilicia contributed 100 galleys, which were placed under

the command of Syennesis, whose bravery is eulogized by Æschylus (*Pers.* 320).

If tradition may be believed, the Greeks began at a very remote period to settle in Cilicia. Historical evidence of their presence in the country, however, is wanting till the days of Alexander the Great. The natives gradually retired before them, and took refuge in the mountainous regions of the Trachæa, where they maintained themselves till the time of Cicero. After the downfal of Persia, Cilicia passed into the family of the Seleucidæ, by whom it was retained till Pompey reduced the Campestris to a Roman province. The mountaineers were not finally subdued till B.C. 52, in which year the proconsul Cicero took their stronghold Pindenessus—an exploit for which he was rewarded with a triumph on his return to Rome. After this the Trachæa continued to be governed by native princes till the reign of Vespasian, when it was reduced to a Roman province. The character of the Cilicians never stood very high among the ancients. By the Greeks and Romans, the Cilicians, Carians, and Cappadocians were classed together as the three bad Ks.

CILICIUM, in Hebrew antiquity, a sort of habit made of Cilician goat's hair, used by the Jews in times of mourning. It is the sackcloth of the Septuagint and Hebrew versions.

CIMABUE, GIOVANNI, one of the regenerators of the art of painting, was born at Florence in 1240. The early historians of art differ in the accounts they give of his education. Vasari maintains that his instructors were some Greeks who had been engaged to restore the ancient paintings in a Florentine church; while Lanzi denies this statement, and asserts that art was at this time better understood in Italy than in Greece. At the time that Cimabue appeared, the arts and sciences had fallen into neglect in consequence of the civil wars which had long desolated the peninsula. So highly valued were his efforts for the restoration of painting, that on one occasion an altar-piece, which he completed for a church in his native city, was inaugurated with a triumphal procession by his grateful countrymen. Some of Cimabue's works are still preserved in Florence, but his masterpieces are believed to be the frescoes in the church of St Francesco at Assisi. (For a critical estimate of Cimabue's works, and their influence on subsequent art, see article PAINTING.) In addition to the benefits which he conferred on painting by his contributions to it, Cimabue rendered most important service to it indirectly by discovering and fostering the genius of Giotto, the greatest of all his pupils. Cimabue died in 1300.

CIMAROSA, DOMENICO, a celebrated composer of music, was born at Aversa, in the kingdom of Naples, in 1754, and died at Venice on the 11th of January 1801. A priest, named Porzio, taught him the elements of music; and he learned singing under Aprile, and composition under Fenaroli in the Conservatory of Loretto. In 1773 he began to compose operas for the Italian theatres, and was eminently successful, even although he had to contend at Naples with the popular Paesiello. In 1787 he was engaged by the court of St Petersburg, where he composed several operas, a mass, and a cantata, besides about 500 detached pieces. His health suffering from the climate, he left Russia in 1792, and went to Vienna. There he composed, in 1792, his best opera, *Il Matrimonio Segreto*—full of beauty and originality. He returned to Naples in 1793. The style of this great artist is distinguished by facility, elegance, and simplicity. His fecundity was prodigious. His works consist of 69 operas, a mass, two requiems, one dixit, several litanies, a Te Deum, four oratorios, and three cantatas, besides the 500 detached pieces above mentioned. In his opera *Il fanatico per gli antichi Romani*, composed in 1775 for the Teatro dei Fiorentini at Naples, he was the first to introduce vocal trios and quartetts in the course of the action. (G.F.G.)

CIMBRI, an ancient Celtic nation, inhabiting the northern parts of Germany. They are said to have been descended from the Asiatic Cimmerians, and to have taken the name of Cimbri when they changed their old habitations. When they first became remarkable, they inhabited chiefly the peninsula now called Jutland, and by the ancients *Chersonesus Cimbrica.* About 113 years B.C. they left their peninsula, with their wives and children, and joining the Teutones, a neighbouring nation, took their journey southward in quest of a better country. They first fell upon the Boii, a Gallic nation, situated near the Hercynian forest; but here they were repulsed, and obliged to move nearer the Roman provinces. The republic, being then alarmed at the approach of such multitudes of barbarians, sent an army against them, under the consul Papirius Carbo. On the approach of the Roman army, the Cimbri made proposals of peace, which the consul pretended to accept; but having thrown them into a disadvantageous situation, he treacherously attacked their camp. His perfidy was rewarded as it deserved; the Cimbri flew to arms, and not only repulsed the Romans, but, attacking them in their turn, utterly defeated them, and obliged the shattered remains of their forces to conceal themselves in the neighbouring forests. After this victory, the Cimbri entered Transalpine Gaul, which they quickly covered with slaughter and desolation. Here they continued five or six years, when another Roman army, under the consul Silanus, marched against them; but this general met with no better success than Carbo had done. His army was routed at the first onset, and all *Gallia Narbonensis* was in consequence exposed to the ravages of these barbarians.

About 105 years B.C. the Cimbri began to threaten the Roman empire itself with destruction; and the Gauls marched from all parts, with a design to join them in the invasion of Italy. The Roman army was commanded by the proconsul Cæpio and the consul Mallius; but as these two commanders could not agree, they were advised to separate and divide their forces. This advice proved ruinous to the whole army. The Cimbri immediately fell upon a strong detachment of the consular army, commanded by M. Aurelius Scaurus, which they cut off to a man and made Scaurus himself prisoner. Mallius greatly intimidated by this defeat desired a reconciliation with Cæpio, but was haughtily refused. He moved nearer the consul, however, with his army, in order that the enemy might not be defeated without his having a share in the action. The Cimbri, imagining by this movement that the commanders had made up their quarrel, sent ambassadors to Mallius with proposals of peace; and as they could not avoid passing through Cæpio's camp, he ordered them to be brought before him; but finding they were empowered to treat only with Mallius, he could scarcely be restrained from putting them to death. His troops, however, forced him to confer with Mallius about the proposals sent by the barbarians; but as Cæpio proceeded to the consul's tent against his will, so he opposed him in everything, contradicted him with great obstinacy, and insulted him in the grossest manner. The deputies, on their return, acquainted their countrymen that the misunderstanding between the Roman commanders still subsisted; upon which the Cimbri attacked the camp of Cæpio, and the Gauls that of Mallius, both of which were forced, and the Romans slaughtered without mercy. Eighty thousand citizens and allies of Rome, with forty thousand servants and sutlers, perished on that fatal day. In short, of the two Roman armies, only ten men, with the two generals, escaped, to carry the news of this dreadful defeat. The conquerors destroyed all the spoil, pursuant to a vow they had made before the battle. The gold and silver they threw into the Rhone, then drowned the horses they had taken, and put to death all the prisoners.

The Romans were thrown into the utmost consternation

on the news of so terrible an overthrow. They saw themselves threatened with a deluge of Cimbri and Gauls, numerous enough to overrun the whole country; but they did not on that account despair. A new army was raised with incredible expedition, no citizen who was able to bear arms being exempted. On this occasion, also, fencing-masters were first introduced into the Roman camp; by which means the soldiers were soon rendered in a manner invincible. Marius, who enjoyed at that time a high reputation on account of his victories in Africa, was chosen commander, and waited for the enemy in Transalpine Gaul; but they had resolved to enter Italy by two different routes; the Cimbri over the eastern, and the Teutones and other allies over the western Alps. The Roman general, therefore, marched to oppose the latter, and defeated the Ambrones and Teutones with great slaughter. The Cimbri, in the meantime, entered Italy, and struck the whole country with terror. Catullus and Sylla attempted to oppose them; but their soldiers were so intimidated by the fierce countenances and terrible appearance of these barbarians, that nothing could prevent their flying before them. Rome was now totally defenceless; and had the Cimbri only marched briskly forward, they would undoubtedly have become masters of the city; but not having heard of the defeat of their allies by Marius, they waited in expectation of being joined by the Ambrones and Teutones, till the senate had time to recal him to the defence of his country. By their order he joined his army to that of Catullus and Sylla, and upon this junction he was declared commander-in-chief. The Roman army consisted of 52,300 men. The cavalry of the Cimbri were no more than 15,000, but their foot seemed innumerable; for, being drawn up in a square, they are said to have covered thirty furlongs. The Cimbri attacked the Romans with the utmost fury; but being unaccustomed to endure the heats of Italy, they soon began to lose their strength, and were easily overcome. They had put it out of their power to fly; for, that they might keep their ranks the better, they had, like true barbarians, tied themselves together with cords fastened to their belts, so that the Romans made a terrible havoc of them. The battle, therefore, was soon over, and the whole day employed in the most unsparing butchery. A hundred and twenty thousand were killed on the field of battle, and sixty thousand taken prisoners. The victorious Romans then marched to the enemy's camp, where they had a new battle to fight with the women, whom they found even more fierce than their husbands. From their carts and waggons, which formed a kind of fortification, they discharged showers of darts and arrows on friends and foes without distinction; and, finding themselves about to be overpowered, they first suffocated their children in their arms, and then put an end to their own lives. The greater part of them hanged themselves on trees. One was found hanging at a cart with two of her children at her heels. Many of the men, for want of trees and stakes, tied strings in running knots about their necks, and fastened them to the tails of their horses, and the horns and feet of their oxen, in order to strangle themselves in that way; and thus the whole multitude was destroyed.

The country of the Cimbri, which, after this terrible catastrophe, was left a mere desert, was again peopled by the Scythians, who, being driven by Pompey out of the space included between the Euxine and the Caspian Sea, marched towards the north and west of Europe, subduing all the nations they met with in their way. They conquered Russia, Saxony, Westphalia, and other countries as far as Finland, Norway, and Sweden. It is pretended that Woden, or Odin, their leader, traversed so many countries and endeavoured to subdue them only with a view to excite the people against the Romans; and that the spirit of animosity which he had excited operated so powerfully after his death, that the northern nations combined to attack the empire, and never ceased their incursions until it was totally subverted.

CIMMERII, a nomad people of antiquity who dwelt near the Palus Mæotis, in the Tauric Chersonese, and in Asiatic Sarmatia. They are said to have desolated Asia Minor prior to the time of Homer; and in their second invasion they penetrated as far westward as Æolis and Ionia, captured Sardis the capital of Lydia B.C. 635, in the reign of Ardys, and continued in possession till they were driven out of Asia by Alyattes, the grandson of that sovereign. (Herod. i. iv.; Strab. i.)

This was also the name of a mythical people, represented by Homer as inhabiting a remote region of mist and darkness; but they are localized by later writers near Lake Avernus, and also in the Tauric Chersonesus, and in Spain. Their country was fabled to be so gloomy, that, to indicate great obscurity, the expression "Cimmerian darkness" became proverbial; and Homer, according to Plutarch, drew his images of hell and Pluto from the gloomy and dismal region inhabited by the Cimmerii.

CIMOLIA TERRA (Cimolite), a species of clay much esteemed by the ancients as a cataplasm in erysipelas and other inflammations. They also used it as fuller's earth, for cleansing cloth. The ancients obtained the Cimolia Terra in several islands of the Archipelago, but particularly from Cimolus (now Argentiera or Kimoli), whence it derived its name. It is still plentiful in those islands; and the Turks, who believe in the virtues ascribed to it by the ancients, mould it into small cakes, which are stamped with the seal of the Grand Signior. Cimolite is of a soft crumbly texture; has a white or pearly-gray hue; adheres firmly to the tongue; and when thrown into water, moulders to a fine powder. These are the characters of the ancient *terra cimolia*. It yielded to Klaproth of silica 62, alumina 23, oxide of iron 1·25, and water 12; sp. gr. 2. It is believed to be formed by the decomposition of trachite.

CIMON, son of Miltiades. See ATTICA, pp. 201-2. The life of Cimon has been written by Plutarch and by Cornelius Nepos.

CIMON of Cleonæ, a famous painter who flourished about B.C. 460, the inventor of *catagrapha*, or drawing in perspective. (Plin. viii. 8.) See CATAGRAPHA.

CINALOA, or SINALOA. See MEXICO.

CINCHONA, PERUVIAN or JESUITS' BARK, is the dried bark of several species of the genus Cinchona, belonging to the Linnean class and order Pentandria Digynia, and to the natural order Cinchonaceæ. (See BOTANY, vol. v., p. 196.) This bark has for a couple of centuries retained its reputation as a nearly infallible remedy or specific in the cure of agues or intermittent fevers. It is not known how the native Peruvians first acquired the knowledge of the virtues of this bark, though many stories are told to account for it; such as, that a native was cured of an ague by drinking from a pool into which a cinchona tree had fallen, to the water of which it had imparted its virtues, &c. But if certain natives had so discovered its virtues, the knowledge of this must not have spread far, as even a century after its reputation was established in Europe, Humboldt and Bonpland found the natives around Loxa, whence the best supplies were derived, still ignorant of its value in agues. Its virtues were first made known in Europe in the year 1640 in consequence of its having cured of an intermittent fever the wife of the viceroy of Peru, the Conde del Chinchon; and from this circumstance the bark was afterwards known as the bark of Chinchon, Cortex Chinchonæ, variously corrupted, according to the pronunciation, into *Chinchina*, *Kinkina*, *Quinquina*. Shortly after its introduction into Spain, the Jesuits had the bark sent to them by their brethren in Peru, and keeping the secret of its source to themselves spread it over Europe. In consequence of its being alone procurable through the Jesuits, it received the name of Jesuits' bark.

Cinchona.

On its first introduction into Europe it was vehemently opposed by the medical profession, till its cause was espoused by Dr Roland Sturm of Antwerp in 1659. An Englishman of the name of Talbot having discovered its source a few years later, and succeeded in curing with it the Dauphin of France, the Prince of Condé, and many persons of rank—sold his secret to the French government for a knighthood, L.1600, an annuity of L.80, and a monopoly of the trade for ten years. Its price at this time reached the enormous sum of L.5 sterling per ounce.

For more than a century after the discovery of its virtues the jealousy of the Spaniards foiled all attempts to investigate the botanical history of the cinchona barks; and even at the present day, notwithstanding the investigations of La Condamine, Jussieu, Ruiz and Pavon, Humboldt and Bonpland, Poppig, and even the latest naturalist who has visited these regions, Weddell, much remains to be ascertained regarding the species of trees which yield the several varieties of bark. Weddell has done more than others to determine accurately the exact species which yield several of the varieties of bark; and has, in addition to the external characters of the barks, given in his elaborate work drawings of the appearance of fine sections of the several barks under the microscope. The subject has been still further investigated in this country by John Eliot Howard, Esq.; and it is to be hoped that in a few years the whole of the different varieties of bark will be able to be referred to their proper species. Chemistry now lends a powerful aid to all such investigations; for as the essential and powerful remedial agent in these barks is found to reside in an alkaloidal substance, which in the most valued barks is termed quinine, the less valued barks are found to contain less of this and a greater proportion of a less valued alkaloid, cinchonine; or the quinine is quite superseded by another similar principle called aricine.

The cinchona trees are met with in the elevated valleys of the Andes, in Colombia, Peru, and Bolivia, from the 11th degree of N., to the 20th degree of S. latitude, and from 1200 to 10,000 feet above the level of the sea. The bark is collected from May to November. The trees are usually cut down and peeled; and the fresh shoots which spring from the roots are ready for cutting after six or eight years. The Indians, however, to save themselves trouble, often peel the bark from the tree while still standing, and so destroy the tree for ever. The thinner bark from the small branches curls up in drying, and forms quills: the thicker bark from the larger branches and stems remains in flat pieces.

The curative properties of Peruvian bark depend on the presence in the bark of peculiar alkaloidal substances, which vary in quality and kind in the different varieties of barks. The most valued of these is quinine; and hence in modern medicine this substance, combined with sulphuric acid, when it forms the sulphate of quinine, has almost entirely superseded the use of the bark itself in the cure of agues and other diseases. Other alkaloidal principles, similar but scarcely so powerful in action, exist in the cinchona barks, as cinchonine, aricine, cinchovatine, quinidine, &c. All these have more or less powerful febrifuge properties; and the first especially might with propriety be substituted for the more expensive quinine in hospital and dispensary practice, and in the army and navy. So much have these chemical preparations of the bark superseded the use of the crude bark itself, that the latter is now very rarely used in medical prescriptions; while these alkaloidal principles, from their small bulk, from their not overloading the stomach with a great mass of inert matter, and from their unvarying uniformity of strength, may be given in doses and in cases where the crude bulky powder could not be used. Almost every disease which shows a tendency to recur in regular fits or paroxysms is alleviated or removed by the use of Peruvian bark, or of its alkaloids quinine and cinchonine. Hence the value of these not only in agues (intermittent fevers), but in neuralgia, tic douloureux, hooping-cough, &c. Quinine and cinchonine are also powerful tonics, and are given with the best effects in recovery from debilitating fevers and diseases, in gangrene, &c. (J. S—K.)

Cincinnati.

CINCINNATI, a city in the state of Ohio, North America, capital of the county of Hamilton, on the north side of the Ohio river, 113 miles S.W. of Columbus; Lat. 39. 5. 54. N., Long. 84. 27. W. It was founded in 1789 by emigrants from New England and New Jersey, and incorporated in 1819. Pop. in 1800, 750; in 1830, 24,831; in 1840, 46,338; in 1850, 115,436. This is the largest inland city of the United States, and in point of population ranks sixth. It stands near the eastern extremity of a pleasant valley about 12 miles in circumference, surrounded by hills, and divided into two nearly equal parts by the Ohio. The ground on which the city is built consists of two plains, one about 60 feet above the other. Except along the margin of the river, the city is regularly laid out, the streets crossing each other at right angles, many of them adorned with fine edifices, and beautifully shaded with trees. It contains about 80 churches, many of them elegant buildings, 3 colleges, 4 medical schools, a law school, a female college, several female seminaries, 6 classical and numerous public schools; besides various libraries, and literary, philosophical, and charitable institutions. Among the public buildings are several public halls, the county and city courts, mercantile exchange, observatory, museum, 4 theatres, gas and water works, &c. The manufactures of Cincinnati are very varied, embracing almost every branch of industrial employment. There are numerous distilleries, breweries, tanneries, soap-works, foundries, iron-works, provision-curing establishments, &c. The total number of the manufacturing and industrial establishments in the city was about 3400, employing about 32,850 persons. Cincinnati is very favourably situated for commerce, being on the banks of the Ohio, and having railroads and canals extending in every direction. The Miami canal and the Ohio division of the Wabash and Erie canal connect the Ohio with Lake Erie, a distance of 251 miles. The Little Miami railroad and its branch-lines to Cleveland (255 miles); the Cincinnati Hamilton and Dayton, and its branch-lines to Sandusky (218 miles); and a number of others, completed or in progress, render Cincinnati the chief centre of the railroad system of the Western States. It has direct railway communication with every lake-port from Chicago to Niagara; with Albany, Boston, New York, Philadelphia, and Baltimore; and will soon be connected with Charleston, Savannah, Mobile, New Orleans, and St Louis. It has also telegraphic communication with every large city from Maine to Florida, and from the Atlantic to beyond the Mississippi. The river trade is carried only chiefly in steam-boats with New Orleans, Pittsburg, St Louis, and other ports. The arrivals of steam-boats during the year ended 31st August 1852, amounted to 3675, of which 219 were from New Orleans, 574 from Pittsburg, and 218 from St Louis. The departures during that year were 3611; of which 326 were for New Orleans, 498 for Pittsburg, and 241 for St Louis. The shipping owned within the district in 1850 was 17,181 tons, of which 16,906 were propelled by steam. A detailed account of the trade and commerce of Cincinnati in 1852 will be found in *Hunt's Merchants' Magazine* for November 1852. The city is governed by a mayor, recorder, and three councillors for each of the seven wards into which the city is divided. It has a separate judiciary, and also a commercial court, specially instituted to try causes arising between merchants. There are 8 daily newspapers in Cincinnati, all of which issue weekly editions, and 1 a tri-weekly edition, 22 weekly papers, 1 semi-monthly, and 14 monthly periodicals. Near the city are two beautiful suburban villages, Mount Auburn and Walnut Hills; the latter being the seat of Lane Seminary, a theological institution

Cincinnatus ‖ Cinnamon.

under the New School Presbyterians. Four miles N.W. of the city are 2 fine cemeteries, the one occupying about 100, and the other 40 acres. In the vicinity of Cincinnati the cultivation of the vine is extensively carried on, for which the soil and climate are well adapted.—(See *Gazetteer of United States*, 1853; De Bow's *Resources of the South and West*, 1853; *Hunt's Magazine*, &c.)

CINCINNATUS, Lucius Quintius, a celebrated Roman, reduced to poverty (according to the legend) by having to pay a heavy bail on account of the flight of his son Cæso. He is said to have been ploughing his farm on the banks of the Tiber when called to fill the consulship, and was twice chosen (B.C. 458 and 439) under the same circumstances to be dictator. During his first dictatorship, which he resigned at the end of 16 days, he defeated the Æqui, and afterwards the Volsci, and procured the honourable recal of his son from banishment. In his second dictatorship he was chiefly occupied with thwarting the machinations of Spurius Mælius. See Roman History.

CINEAS, a Thessalian, the minister and friend of Pyrrhus king of Epirus. He was sent to Rome after the battle of Heraclea to sue for a peace, but was foiled in his mission through the eloquence of Appius Cæcus. He told Pyrrhus that the Roman senate was a venerable assembly of kings; and that to fight with them was to fight against another Hydra. He was a man of consummate address, and possessed a memory so retentive that the day after his arrival at Rome he could call every senator and knight by name. His last diplomatic mission was to Sicily, B.C. 278; and with his death the fortunes of Pyrrhus began to decline.

CINERITIOUS, resembling ashes in colour or consistence; and hence this epithet has sometimes been applied to the cortical part of the brain.

CINNABAR, the native red sulphuret of mercury, the most prolific ore of that metal. *Factitious* cinnabar, or vermilion, is made by heating 100 parts of mercury with 16 of sulphur in an iron vessel, and subliming the compound. The sublimate, when reduced to powder, is of a beautiful scarlet colour. It is the *minium* of antiquity. See Chemistry.

CINNAMON. The cinnamon of commerce is chiefly produced in the island of Ceylon in the East Indies, from the *Laurus Cinnamomi* of botanists, the *Kooroondoo-gaha* of the Singhalese, a plant which appears to have flourished in that island from the earliest period. We learn from Scriptural history (Exodus xxx. 23) that this spice was employed by the Hebrews in their religious ceremonies; and there can be little doubt that their supplies were derived from the Arabian merchants who traded between the Red Sea and the East.

When the commerce between the western and eastern world was opened by way of the Cape of Good Hope, cinnamon formed a valuable item in the precious commodities received from the regions of the sun in exchange for calamancoes, metal work, and silver coin. The Portuguese had their attention drawn to this spice at an early period; and there can be no doubt that their chief and perhaps sole reason for forming a settlement in Ceylon was to secure a monopoly of the trade in this article, since Colombo, their first fort, and afterwards the European capital of the island, possessed no other claim for their choice than its proximity to the cinnamon lands of that island.

The Singhalese never attempted to cultivate this shrub, but were content to leave it in its indigenous state, and draw their supplies of the spice from the jungles of the sea-board and the forests of the interior. No sooner, however, had the Portuguese established a footing in the island on the west coast, and erected a stone fort at Colombo, than they commenced the exploration of the adjacent country where they had learnt the bulk of the cinnamon grew. It was found in greatest abundance as far as Negombo on the N., and to Morotto on the S. of Colombo, and scattered more thinly over a great portion of the western and southern coasts.

Cinnamon.

The little taste evinced by the Portuguese for agricultural pursuits, added to the continual state of warfare in which they found themselves involved with the native sovereigns of the island, proved a serious obstacle to the cultivation of this spice, which, indeed, appears to have received no care until the Dutch took possession of Ceylon, when they soon turned their attention to the subject. By clearing the cinnamon tracts from jungle and weeds, and draining the ground, they succeeded in producing a finer quality of bark; and by means of honorary distinctions and immunities from taxation granted to the *Chalias* or *Cinnamon Caste*, induced them to prepare the spice for the market in a far superior manner.

The cinnamon lands, or gardens as they are termed, were thus formed by the Dutch at Kaderani, Welliserre, Ekelle, Marandahn, and Moorotto, and are still existing at those places. They were very unequal in size and productiveness, and together covered an extent of 12,000 acres. The cultivation and trade in this article were preserved in the hands of the government by the most severe enactments; the offence of injuring a plant, or cutting the smallest fragment of the bark, was punishable with death; and the entire management and control of the gardens vested in the office of the "*Mahabadde*" or Chalia caste, whose duties and privileges were made the subject of a long code of laws.

The cinnamon trade of Ceylon was greatly extended under the Dutch government; and we read that, in the middle of the eighteenth century, as many as 1500 bales were required for the Indian government, 200 bales for Persia, 400 bales for the Coromandel coast, and 8000 bales for Europe; which, at 88 lb. the bale, gives a total of 900,000 lb. The only mart for the sale of this and other spices in Europe at that period was Amsterdam. The following table of cinnamon sold at the Dutch capital from 1692 to 1792 will be a safe guide to the consumption of Europe during that period:—

	Quantity Sold.	Average Price per lb.
1692	375,000	4s. 1¾d.
1702	300,000	3 9
1722	425,000	4 3½
1742	350,000	3 9¼
1762	350,000	9 10
1782	200,000	17 4
1792	250,000	14 7

The right of trading in cinnamon after the capture of the island by the British, was left in possession of the East India Company, who received annually from the local government a quantity ranging between 4000 and 4500 bales of 100 lb. each, at a stipulated price. This contract was terminated in 1821, after which the spice continued to be shipped to England by the Ceylon government, and there sold on their account to the extent generally of 4500 bales, which yielded a nett income of about L.97,000.

In the year 1833, the monopoly in this spice, so long enjoyed by the crown, was abandoned, and the culture and trade thrown open to the public; a duty of 3s. 6d. per lb. being levied on the export of the spice. The government stock of cinnamon in the island was disposed of by public sales held monthly, as well as future crops from their gardens, until 1840, when they commenced the sale of those properties by monthly auctions, realizing for their price sums varying between L.5 and 7s. the acre. Since the gardens came into the possession of private capitalists, great improvements in the cultivation and preparation of the spice have taken place. Manuring, pruning, and draining have been successfully resorted to on an extensive scale, and the yield of cinnamon per acre has, in some cases, been brought up from 50 lb. to 500 lb.

In 1837 the first imports of cinnamon from Java into Europe took place; and, influenced by this new rival, the government reduced the export duty on the best cinnamon

to 2s. 6d. per lb. The inferior sorts had been two years previously reduced to that amount.

In 1841 the duty was lowered to 2s., and in 1843 to 1s. on all qualities. Subsequent reductions were made, first to 8d. then to 4d. per lb., and at present it is exported free of all duty. These continued concessions to the trade do not appear to have had so favourable an effect upon the consumption of the spice in Europe and America, (to which localities the demand has been confined during the present century), as might have been looked for. The sales of cinnamon in London during the nine years previous to the opening of the Ceylon trade, averaged 4138 bales annually; during the nine years succeeding that period, the deliveries of spice averaged about 5000 bales yearly. During the seven years ending 1852, the shipments from Ceylon averaged 5100 bales. From 1829 to 1833, the value of cinnamon in London ranged between 10s. and 5s. the lb. From 1834 to 1843, the London price fluctuated from 9s. 3d. to 3s. 9d. Since that period the highest price paid has been 6s., and the value at present ranges between 2s. 6d. and 1s.

In 1837, the Dutch government imported their first parcel of cinnamon from Java, amounting to 3951 lb. In 1839 the import was 16,312 lb. In 1842 it reached 124,696 lb., and in 1845 its highest point of 180,000 lb.; since which it has sensibly fallen off. Its early value varied from 6½d. to 5s. 6d. per lb., but it has since declined to prices ranging from 3d. to 3s. 4d.

A more decided rival to cinnamon has been the cassia of the Malabar coast and China, which has become an important article of our trade since 1817. In that year the imports into London amounted to 1745 chests, worth L.10 to L.13 per cwt. It has since been imported to the extent of 36,000 chests, but the value has declined to L.5 and L.3 per cwt. The countries to which this is chiefly exported are Russia, Prussia, Spain, and the Levant.

Cinnamon is chiefly employed in the manufacture of chocolate, confectionary, liqueurs, and medicines, and was at one time largely used in religious ceremonies on the continent of Europe, and for fumigations. For both of these latter purposes, however, cassia has been largely substituted, the low price at which it has been produced having been far below the cost of cinnamon when free from export duty.

The cinnamon of Ceylon, as now imported, is produced from three distinct sources; from the late government gardens; from private or inferior plantations; and lastly, from the forests of the interior. The average yield from these sources for the last four years of the monopoly was:—government gardens, 1453 bales per annum; from uncultivated plantations, 1135 bales; from forests, 1456 bales. The yield of these under the free-trade system may be stated at 3300 bales from the gardens; 1700 bales from the private lands; whilst the forests are rarely searched for spice at the present low prices. The finest cinnamon, both in flavour and appearance, comes from the government gardens, and the worst from the forests, where it is found thick in quill, of a dark colour, and of a bitter, acrid flavour. The best is that which is of a bright clear colour, of a soft, sweet, aromatic taste, not gritty in the mouth, and which is not thicker than stout paper. A pipe or quill of fine cinnamon should be smooth, clear brown, without blemish, and contain three or four layers of bark within it.

Cinnamon thrives best in a light sandy soil of some depth, free from stagnant water. A hot damp atmosphere, such as prevails along the sea-board of Ceylon, is highly favourable to the proper development of the plant; and without these desiderata it is impossible to produce a spice of good quality. It is the absence of these which has rendered the cinnamon recently cultivated in Java so far inferior to the Ceylon article.

The cinnamon plant, if left in its natural state, becomes a tree of considerable size, and in this state it is usually met with in the Ceylon forests. These trees are also to be seen in South America, although Spain ships larger supplies of Ceylon spice to that continent. The trees and large bushes bear blossoms, and the seeds, shaped like a small acorn, yield an agreeable oil, which used to be highly valued by the Singhalese, and kept for burning in the lamps of the royal palace of their kings.

Plants are reared from the seed, and placed in well cleared land, on the first setting in of the periodical rains, in clusters of five, of which about nine hundred cover an acre. These young plants require shading from the sun, and daily watering during the first two dry seasons; after which they will thrive unaided, and yield a small crop in the fourth year; arriving at maturity, if well tended, in the twelfth year; after which there does not appear to be any limit to their duration. The cinnamon bushes left by the Portuguese two centuries since still continue to bear abundantly.

The crops are taken off twice in the year at the setting in of the monsoon rains. The first or great harvest is usually secured between the first week in June and the middle of August. The second or small harvest is taken in during November and December. If a cinnamon garden be properly tended, there will not be a weed visible upon it. Drainage is highly necessary, and a little shade from lofty trees at wide intervals is desirable, to protect the plants during the hot dry months.

The operation of stripping the bark from the straight cinnamon sticks is performed by none but those of the *Chalia* caste, who are very expert at the work. Good "peelers," as these men are called, will prepare, with the aid of their family, from 80 to 100 lb. of spice in a month; for which they are paid at the rate of 3d. or 4d. the lb., according to quality. The bark being sorted or made into quills or pipes, forty inches in length, containing three or four layers inside, and being first slowly dried in the shade, is afterwards exposed for three days to the sun. At the end of two months the spice may be packed in gunny, a coarse native sacking, and shipped. It is made up in bales of 100 lb. each, having generally the native name of the garden in which it was produced marked on the outside of the bales.

The ordinary yield of the old government gardens is about 30 lb. of spice per acre; a few of the finest will produce nearly 100 lb., and by the aid of high cultivation, as much as 500 lb. Good cinnamon land is worth L.10 an acre; though it may be planted and brought into full production for about L.7.

An essential oil of great aroma is obtained by distillation from the broken and imperfect bark. When properly made, and produced from a good quality of spice, this oil is worth 3s. an ounce in the London market; but the great bulk is inferior, and sells at about 8d. It is used in perfumery, pharmacy, and confectionary, as a substitute for the powdered spice.—(*Parliamentary Reports;* Rybiero's *Ceylon; Ceylon Magazine.*) (J. C—R.)

CINTRA, a town of Portugal, province of Estremadura, 14 miles N.W. of Lisbon, with about 4000 inhabitants. It stands at the foot of a stupendous rocky mountain, and is remarkable for the picturesque beauty of its situation and the salubrity of its climate, which render it a favourite resort of the wealthier inhabitants of Lisbon. On one of the adjacent summits stands the Penha convent; and on another are the ruins of a Moorish castle. It has also an ancient royal palace. The convention, by which the French were allowed to leave Portugal without molestation, was signed at Cintra, August 22, 1808.

CINQUE PORTS (*i. e.*, the five ports), five havens on the south-eastern coast of England, opposite France, and thus called by way of eminence, on account of their importance as safeguards against invasion. These comprise Hast-

ings, Romney, Hythe, Dover, and Sandwich; to which were afterwards added the two ancient towns of Winchelsea and Rye. These places were anciently deemed of so much importance in the defence of the kingdom against invasion, that they received royal grants of particular privileges, on condition of providing during war a certain number of ships at their own expense. They are governed by a warden with the title of Lord Warden of the Cinque Ports, and each had the privilege formerly of returning to parliament two members under the title of Barons of the Cinque Ports; but since 1831 this privilege has been confined to Hastings, Dover, and Sandwich. We are told by Camden that William the Conqueror appointed the first warden of the Cinque Ports; but their charters are traced to the time of Edward the Confessor. The salary of the Lord Warden is L.3000 a-year. (See Chitty's *Commercial Law*, vol. ii. p. 12.)

CINYRA, in *Jewish Antiquity*, a musical instrument of the lyre kind. This and the Hebrew *kinnor*, which is generally translated *cithara* or *lyra*, are probably the same. It was usually made of wood. Josephus says that the *cinyra* of the temple had ten strings, and was played with a plectrum; and in another place he mentions some made of a mixed metal called *electrum*. (*Antiq.* vii. 12-3.)

CIOTAT, LA, a maritime town of France, department of Bouches-du-Rhône, arrondissement and 16 miles S.E. of Marseilles, on the west side of a bay of the Mediterranean. It is surrounded by old walls, and is regularly and well built. The port, protected by a mole and defended by a fort, is commodious and secure, and has a lighthouse with a lantern 82 feet above the level of the sea. It has a considerable trade in wine, oil, and dried fruits. Pop. 4200.

CIPHER, or Cypher (from the Arabic *sifr*, devoid of, empty), one of the Arabic characters used in computation, and formed thus, 0.

Cipher is also a kind of enigmatic character composed of several letters interwoven; as the initial letters of a person's name. Anciently, merchants and tradesmen not being allowed to bear family arms, in lieu thereof bore their ciphers, or initials of their names, artfully interwoven about a cross. These frequently occur on tombs and other monuments.

Cipher also denotes certain characters used in writing secret despatches, so that their contents shall be understood by none but those between whom the characters are agreed on.

The *scytala* of the Spartans has been regarded as a species of cipher. The scytalæ were two wooden cylinders exactly alike, one of which was kept by the ephori, the other by the general of the army sent on any expedition against the enemy. Whenever any secret orders were to be sent to the general, a narrow slip of parchment was wound close round the scytala, and on this the instructions were written. When taken off the cylinder only broken or single letters appeared; but their connection was at once restored by the general on applying the parchment to the scytala in his possession. Polybius says that Æneas Tacticus had collected together twenty different manners of writing, so as not to be understood by any but those in the secret; and that these methods were partly invented by himself, and partly in use before his time. Trithemius, Baptista Porta, Vigenère, and P. Niceron, have written expressly on the subject of ciphers.

The art of writing in cipher has given rise to another art—that of deciphering or unravelling the meaning of such writing. The rules of deciphering are different in different languages. By observing the following, any one may read a common cipher written in English.

1 Observe the letters or characters that most frequently occur, and set them down for the six vowels, including *y*, and of these the most frequent will generally be *e*, and the least frequent *u*.

2. The vowels that most frequently come together are *ea* and *ou*.

3. The consonant most common at the end of words is *s*, and the next frequent is *r* or *t*.

4. When two similar characters come together, they are most likely to be the consonants *f*, *l*, or *s*, or the vowels *e* or *o*.

5. The letter that precedes or follows two similar characters is either a vowel, or *l*, *m*, *n*, or *r*.

6. In deciphering, begin with the words that consist of a single letter, which will be either, *a*, *I*, *o*, or *&*.

7. Then take the words of two letters, one of which will be a vowel. Of these words the most frequent are, *an*, *to*, *be*, *by*, *of*, *on*, *or*, *no*, *so*, *as*, *at*, *if*, *in*, *is*, *it*, *he*, *me*, *my*, *us*, *we*, *am*.

8. In words of three letters, there are most commonly two consonants. Of these words the most frequent are, *the*, *and*, *not*, *but*, *yet*, *for*, *tho'*, *how*, *why*, *all*, *you*, *she*, *his*, *her*, *our*, *who*, *may*, *can*, *did*, *was*, *are*, *has*, *had*, *let*, *one*, *two*, *six*, *ten*, &c. Some of these, and words of two letters, will be found in every sentence.

9. The most common words of four letters are, *this*, *that*, *then*, *thus*, *with*, *when*, *from*, *here*, *some*, *most*, *none*, *they*, *them*, *whom*, *mine*, *your*, *self*, *must*, *will*, *have*, *been*, *were*, *four*, *five*, *nine*, &c.

10. The most usual words of five letters are, *their*, *these*, *those*, *which*, *where*, *while*, *since*, *there*, *shall*, *might*, *could*, *would*, *ought*, *three*, *seven*, *eight*, &c.

11. Words of two or more syllables frequently begin with double consonants, or with a preposition; that is, a vowel joined with one or more consonants. The most common double consonants are, *bl*, *br*, *dr*, *fl*, *fr*, *gl*, *gr*, *ph*, *pl*, *pr*, *sh*, *sb*, *sp*, *st*, *th*, *tr*, *wh*, *wr*, &c.; and the most common prepositions are, *com*, *con*, *de*, *dis*, *ex*, *im*, *in*, *int*, *mis*, *per*, *pre*, *pro*, *re*, *sub*, *sup*, *un*, &c.

12. The double consonants most frequent at the end of long words are, *ck*, *ld*, *lf*, *mn*, *nd*, *ng*, *rl*, *rm*, *rn*, *rp*, *rt*, *sm*, *st*, *xt*, &c.; and the most common terminations are, *ed*, *en*, *er*, *es*, *et*, *ing*, *ly*, *son*, *sion*, *tion*, *able*, *ence*, *ent*, *ment*, *full*, *less*, *ness*, &c.

By applying these rules, any common cipher written in English may be deciphered; and, *mutatis mutandis*, a cipher written in any language may be evolved by an application of the principle on which these rules are constructed.

CIPPUS, in *Antiquity*, a low column, with an inscription, erected on the high road or elsewhere, to show the way to travellers, to serve as a boundary, or to mark a grave. It was sometimes highly ornamented, as seen in the specimens in the British Museum.

CIPOLIN (Ital., *cipolla*, an onion), a green Italian marble with irregular concentric white zones.

CIPRIANI, Giovanni Battista, well known for his numerous designs engraved by Bartolozzi, was born at Florence in 1727. He settled in England, and there he died in 1785. He was one of the original members of the Royal Academy of Design.

CIRCARS, Northern, an extensive province of Hindustan, lying on the western side of the Bay of Bengal. It is a narrow slip of territory, extending from 15. 2. to the 20th degree of N. Lat., but is little more than one degree in breadth. The sea bounds it on the E. along a coast 470 miles in length, from the port of Mootapilly to the town of Maloud in Orissa, on the borders of the Chilca Lake. From about 50 to 70 miles inland it is divided from the province of Hyderabad by a range of small detached hills, extending to the banks of the Godavery; and it is separated from Gundwana to the N. of that river by the great ridge of the Eastern Ghauts, impassable except in some few depressions for horse or wheel-carriages. From Goomsur the same unbroken chain curves to the eastward, reducing the breadth of the province at this point

to a narrow tract of about 18 miles. Towards the south the small river Gondlacama, which empties itself at Mootapilly, separates this territory from the district of Ongole.

The area of the Circars is 30,060 square miles, of which it is estimated that only one-fifth is in cultivation or fallow, twice that portion in pasture, and the remainder occupied by woods, water, towns, barren hills, and a sandy waste three miles in breadth, which borders the whole extent of the coast. The country for about 35 miles inland is a level plain, with only two remarkable interruptions in its greatest length along the shore. Beyond this about 15 miles farther inland, and parallel to it, the country is much more elevated, being agreeably variegated with hills easy of access, and remarkably fertile. Beyond these tracts of plain and hilly ground, to the north of the Godavery, a still higher region extends close to the great ridge of mountains which stretch far inland.

The grand divisions of this province are properly five. Of these the first is Guntoor, the most southerly division, bounded on the north by the river Kistnah, which, after running a curve of 600 miles from the Balaghaut hills, near the coast of Malabar, separates this province on the north from the second division, namely, Masulipatam. Rajahmundry is the third division, succeeded in a northerly direction first by Vizagapatam and lastly by Ganjam. These divisions, which are of comparatively modern date, were introduced by the British to supersede the original distribution of the territory into the five Circars of Cicacole, Rajahmundry, Ellore, Condapilly, and Guntoor.

The climate of the Northern Circars, though it has a general resemblance to that of Hindustan north of the Kistnah, is well distinguished by local peculiarities arising from its maritime situation, and the extent and position of the inland hills. The S.W. monsoon usually sets in about the middle of June with a westerly wind, and continues with moderate showers until the latter end of August, which is the period of the small grain harvest. In October it is succeeded by a variable season, ushering in the N.E. monsoon, with cooler weather and greater abundance of rain. This continues to the middle of November, when it generally ceases, and is succeeded by a strong north-easterly wind, tempered by the mild influence of the sea over which it blows. The harvest for rice and bajree, which are the great productions of the country north of the Godavery, finishes about the middle of this latter season, early in January; and in like manner the vernal equinox terminates the harvest south of that river for the different species of maize as well as of other grains and pease. Then commences the hot season, which is always moderate towards the northern extremity of the Circars, near Ganjam, owing to the constant breezes from the sea. On the south the hot season is moderated for two months by sea-breezes from the south blowing along the shore; but afterwards, until the period of the rains, the wind blowing over a parched loose soil of great extent, and especially over the almost dry and sandy bed of the Kistnah, becomes so heated that it raises the thermometer for an entire week to 105, and frequently to 110 degrees. In the hilly regions the air is in a highly noxious state; and throughout the different seasons of the year the hill fever, which is prevalent, is frequently fatal to strangers. It is generally ascribed to the state of the atmosphere, contaminated with the exhalations of a fertile soil, pent up in valleys, or impeded in its circulation by the luxuriant growth of plants, or by the trees with which the villages are surrounded. All these provinces along the coast have a sandy soil, which improves gradually towards the hills; but seldom produces more than one crop annually, except in localities enjoying an abundant supply of water. The country is well irrigated by running streams, many of which are divided artificially into canals, and conducted into tanks and reservoirs; thus being rendered subservient to cultivation. Within the last few years the government have appropriated considerable sums to the purpose of extending the system of irrigation by means of the waters of the Godavery and the Kistnah. Through the advantages which in this respect it enjoys, the province abounds in all the different sorts of grain which have been already mentioned: it is properly the granary of the Carnatic during the N.E. monsoon. Fruits, roots, and greens are scarce, or reared with difficulty, to the south of the Godavery; nor towards the north are they so excellent as in some other provinces. Sugar, cotton, and tobacco are largely cultivated. Salt is manufactured on the coast, and in such abundance as greatly to exceed the home demand. The forests of Rajahmundry, from the commencement of the hills, along the banks of the Godavery, yield an inexhaustible supply of the best and largest teak timbers; and if proper use were made of this advantage, an article would be procured of great importance to commerce. The cocoa and the palmyra, or, in the more northerly provinces, the tree which produces the gum-arabic, are the materials from which are constructed those unwieldy vessels with two masts, called doonies, averaging from 60 to 300 tons each. The domestic animals found in this province are chiefly sheep and the larger species of horned cattle. The neighbouring sea and its numerous inlets abound with almost every species of Indian fish, together with some that are common to Europe, such as mullet, sole, and the pomphlet, a small fish resembling a turbot.

Cotton is the staple produce, and from it are fabricated cloths of different degrees of fineness. The muslins of Masulipatam, and other places within the Circars, formerly in high esteem both at home and abroad, have been nearly superseded by the irresistible competition of British fabrics. The coarser plain cloths, which are made to the north and south of the Godavery, and coloured with chay root (which is the madder of the East, and grows in most perfection in the pure sands annually overflowed by the Kistnah,) are in great demand. Woollen carpets are manufactured at Ellore, and silks at Burrampore. But these are rather objects of curiosity than of any great general advantage; as is also the art of painting or inlaying ivory and black wood in the cabinet work at Vizagapatam. Ship-building is carried on extensively in the ports of Coringa and Narsapore, the two principal mouths of the Godavery. Here ships of 500 tons are built, and about 50,000 tons of small craft are employed in the coasting trade.

The native inhabitants of the Northern Circars, with the exception of some thousand Mohammedans found chiefly in the principals towns, are wholly Hindus. They are composed of the two nations of Telinga and Orissa, formerly divided from each other by the Godavery, but, since their union under the same government, amalgamated to some extent with each other, as well as with some of the neighbouring tribes. They have each their peculiar dialect, apparently of the Sanscrit language, as well as their peculiar rites, customs, and national traits. The four great castes or divisions of the people are common in both countries, but with less deviations from original institutions in Orissa, where Brahminical abstinence from animal food is very general among all the higher tribes. The Brahmins continue to enjoy their pre-eminence and consideration among the other classes. The Rachewars, Rowars, and Velmas, of which denominations the principal Zemindars are composed, affect the warlike character and manners of Rajpoots. The Rachewars are of the ancient race of the Orissa sovereigns, who were forced to fly before the conquering arms of the Mohammedans from the plains to the highland woods. The Rowars, or Worians, being petty chieftains of the military tribe, were enabled, after the Mohammedan conquest, to acquire an independent jurisdiction in the moun-

Circassia. tainous tract to the west of Cicacole. The Velmas are of Telinga origin; and being driven from the Carnatic in the year 1662 by the Mohammedans, they established themselves on the borders of the Kistnah. The remainder are husbandmen, cow-herds, weavers, artificers, all of the Sudra or last great caste. The retail dealers form a third class. The entire population of the Circars, according to the last census, was 4,284,187.

It was not till the year 1471 that the Mohammedans carried their arms to the Northern Circars. In 1541 they conquered Condapilly; and nine years afterwards they extended their conquests over all Guntoor, and the districts of Masulipatam. But the conquerors appear to have acquired only a very imperfect possession of the country, as it was again conquered from the Hindu princes of Orissa about the year 1571, during the reign of Ibrahim Kootub, Shah of Hyderabad or Golcondah. In 1687 these provinces, with the empire of Hyderabad, were added to the extensive empire of Aurungzebe. But this monarch was too busily employed in conquering the larger provinces of the Deccan, and curbing the Mahratta power, to bestow due care on his conquest. Nizam ul Moolk, appointed viceroy of the Deccan, and who in that character exercised the sovereign power which subsequently he usurped, reformed the administration of the revenues and the civil and military establishment. He was succeeded by his third son Salabut Jung, who, being indebted for his elevation to the French East India Company, granted them in return for their services the district of Condavir or Guntoor, and soon afterwards the other Circars. In 1759, by the conquest of that great commanding bulwark, the fortress of Masulipatam, the dominion of the maritime provinces on either side, from the river Gondegama to the Chilca Lake, was necessarily transferred from the French to the British. But they left them under the administration of the Nizam, with the exception of the town and fortress of Masulipatam, which were retained by the English East India Company. In 1765 Lord Clive obtained from the Mogul a grant of four of the Circars, which in the following year was confirmed by a treaty entered into with Nizam Ali, who had by this time superseded Salabut Jung in his authority. The remaining Circar of Guntoor devolved to the East India Company in 1788. (E. T.)

CIRCASSIA. The name of Circassia is given to all that western part of the Caucasian territory which is situated on the Black Sea, and bounded by the lands of the Cossacks, the Caucasians, the Lesghians, the Georgians, the Imeretians, and Mingrelians. This district, however, includes not only Circassia proper, but also the great and little Kabardah, Abasia, and the land of the Ossetes. The Circassians inhabit only that part of the country which is bounded by the Black Sea, and the rivers Sotsha, Laba, and the lower Kouba. The territory of Circassia towards the S.W. is exceedingly mountainous, and includes within its limits the Elburz, the Mainevari, and several of the loftiest parts of the Caucasian range. Towards the N.W. the mountains gradually decline in elevation; and the range of the Black Mountains between the Black Sea and the Kouba consists of a number of rounded hills, very moderate in height. Towards the N. and the N.E., a great number of small rivers descend rapidly from the mountains, and form in their course many pleasant and fertile valleys. On the coast of the Black Sea, along the river Kouba, and even in many of the interior parts of the country, several Russian forts have been erected in order to maintain the power of the Czar in these regions. The climate in the north-western part of Circassia is very insalubrious; as the water of the rivers, which are generally broad and shallow, frequently becomes stagnant in hot weather, and produces fatal fevers. In the more elevated portions of the country situated to the S.E., where the atmosphere is colder, the climate is much more favourable to health.

The Circassians, or Tschirkessians, are termed by themselves Adighé, or the noble. In the patriarchal simplicity of their manners, the mental qualities with which they are endowed, the beauty of form and regularity of feature by which they are distinguished, they surpass most of the other tribes of the Caucasus. They have long been celebrated for their warlike and intrepid character, their independence, their hospitality to strangers, and that love of country which they have manifested in their determined resistance to an almost overwhelming power during the period of a long and desolating war. They exhibit in their manners a strange mixture of chivalrous sentiment and of savage customs. The government under which they live is a peculiar form of the feudal system. The free Circassians are divided into three distinct ranks, the princes or *pschi*, the nobles or *uork*, (Tartar *usden*), and the peasants or *hokotl*. Like the inhabitants of the other regions of the Caucasus, they are also divided into numerous families, tribes, or clans, some of which are very powerful, and carry on war against each other with great animosity. The slaves, of whom a large proportion are prisoners of war, are generally employed in the cultivation of the soil, or in the domestic service of some of the principal chiefs.

The will of the people is acknowledged to be the supreme source of authority; and every free Circassian has a right to express his opinion in those assemblies of his tribe in which the questions of peace and war, almost the only subjects which engage their attention, are brought under deliberation. The princes and nobles, the leaders of the people in war, and their rulers in peace, are only the administrators of a power which is delegated to them. Having no written laws, the administration of justice is regulated solely by custom and tradition; and in those tribes professing Mohammedanism, by the precepts of the Koran. The most aged and respected inhabitants of the various *aouls* or villages frequently sit in judgment, and their decisions are received without a murmur by the contending parties. The Circassian princes and nobles are professedly Mohammedans; but in their religious services many of the ceremonies of their former heathen and Christian worship are still preserved. The great body of the people have remained faithful to the worship of their ancient gods, Shible, the god of thunder, of war, and of justice, Tleps, the god of fire, and Seosseres, the god of water and of winds. Although the Circassians possess minds capable of the highest cultivation, the arts and sciences, with the exception of poetry and music, are completely neglected. They possess no written language. The wisdom of their sages, the knowledge they have acquired, and the memory of their warlike deeds, are preserved in verses, which are repeated from mouth to mouth and descend from father to son.

The education of the young Circassian is confined to riding, fencing, shooting, hunting, and such exercises as are calculated to strengthen his frame, and prepare him for a life of active warfare. The only intellectual duty of the *atalik* or instructor, with whom the young men live until they have completed their education, is that of teaching them to express their thoughts shortly, quickly, and appropriately. One of their marriage ceremonies is very strange. The young man who has been approved by the parents, and has paid the stipulated price in money, horses, oxen, or sheep, for his bride, is expected to come with his friends fully armed, and to carry her off by force from her father's house. Every free Circassian has unlimited right over the lives of his wife and children. Although polygamy is allowed by the laws of the Koran, the custom of the country forbids it, and the Circassians are generally faithful to the marriage bond. The respect for superior age is carried to such an extent, that the young brother rises from his seat when the elder enters an apartment, and is silent when he speaks. Like all the other inhabitants of the Caucasus, the

Circassians are distinguished for two very opposite qualities. the most generous hospitality, and implacable vindictiveness, Hospitality to the stranger is considered one of the most sacred duties. Whatever be his rank in life, all the members of the family rise to receive him on his entrance, and conduct him to the principal seat in the apartment. The host is considered responsible with his own life for the security of his guest, upon whom, even although his deadliest enemy, he would inflict no injury while under the protection of his roof. The chief who has received a stranger, also grants him an escort of horse to conduct him in safety on his journey, and confides him to the protection of those nobles with whom he may be on friendly terms. The law of vengeance is no less binding on the Circassian. The individual who has slain any member of a family is pursued with implacable vengeance by the relatives, until his crime be expiated by death. The murderer may, indeed, secure his safety by the payment of a certain sum of money, or by carrying off from the house of his enemy a newly-born child, bringing it up as his own, and restoring it when its education is finished. In either case, the family of the slain individual may discontinue the pursuit of vengeance without any stain upon its honour. The man closely followed by his enemy, who, on reaching the dwelling of a woman, has merely touched her hand, is safe from all further pursuit so long as he remains under the protection of her roof. The opinions of the Circassians regarding theft resemble those of the ancient Spartans. The commission of the crime is not considered so disgraceful as its discovery; and the punishment of being compelled publicly to restore the stolen property to its original possessor, amid the derision of his tribe, is much dreaded by the Circassian who would glory in a successful theft. The greatest stain upon the Circassian character is the custom of selling their children. The Circassian father willingly parts with his daughters, many of whom are bought by Turkish merchants for the harems of eastern monarchs. No degradation is implied in this transaction, and the young women themselves are generally willing partners in it. However contrary this custom may be to the ideas of Christian nations, it is certain that none of the more revolting features of American slavery are practically connected with it. Herds of cattle and sheep constitute the chief riches of the inhabitants. The princes and nobles, from whom the members of the various tribes hold the land which they cultivate, are the proprietors of the soil. Although the Circassians are desirous of devoting their attention to commerce, the warlike attitude which they are compelled, by the presence of the Russians, to maintain, has hitherto prevented them from cultivating any of the arts of peace.

The early periods of Circassian history are exceedingly obscure. Several Greek colonies appear to have been established at a remote period upon the coasts of the Black Sea, which were inhabited by savage tribes noted for their piratical expeditions. By these colonies commercial activity and regular government were to some extent introduced into that wild and uncultivated region. To them the Romans afterwards succeeded, who maintained their authority during the period of their power and prosperity. In the twelfth and thirteenth centuries, the princes of Georgia were successful in reducing Circassia to the condition of a province of that kingdom. Thamar, one of the Georgian princes, is said by some to have been the first to introduce Christianity among the inhabitants, while by others it is maintained that the Christian faith was the prevailing religion from the fifth century. The Circassians having succeeded in the fifteenth century in throwing off the Georgian yoke, many of them settled on the coasts of the sea of Azof, where, coming in contact with the Tartars, they were subdued by the khans of the Crimea. In the middle of the sixteenth century, the Russian Czar, Ivan I., having married a Circassian princess, assisted the people to throw off the Tartar yoke, and became master of a considerable portion of the country. But the Russian monarchs do not appear to have regarded its conquest as a matter of much importance, until the time of Peter the Great. That powerful monarch perceiving how much the possession of the Caucasus would contribute to his political and commercial influence in western and central Asia, made an unsuccessful attempt to reduce it permanently under his dominion. Catherine II. pursued a similar line of policy. Georgia having been harassed by the successive invasions of the Persians and Turks, the prince of that country at last threw himself under the protection of the Russians, and became tributary to their power. The river Kouba being afterwards fixed as the southern boundary of the Muscovite empire, the Russians became ambitious of extending their dominion uninterruptedly to the extreme limits of Georgia The Circassians, meanwhile, surrounded by Mohammedan nations, visited frequently by Turkish merchants, and gained over by the impressive eloquence of a fanatical devotee, the sheik Mansur, had embraced the faith of Islam, and acknowledged the Sultan as chief of their religion In the wars which now took place between the Russians and the Turks, the latter used every exertion, by exciting the fanatical feelings of the Circassians against the infidels, to induce them to harass the Russians by frequent incursions into their territory. After having experienced the various fortunes of war, the Turks were worsted, and compelled by the treaty of Adrianople in 1829 to cede a considerable portion of their territory to the Czar. Assuming a right of political sovereignty which they had never possessed, Circassia was included in this cession. The Circassians refusing to acknowledge the right of the Sultan (whom they had never recognised as their sovereign) thus to dispose of their country, were now exposed to the hostility of the Russians, who determined to become masters of the territory on the coasts of the Black Sea, and indeed of the whole Caucasian region, by force of arms. This was the origin of that remorseless war which has been carried on with so much animosity under various leaders to the present day, and has cost the Russians an incredible amount of blood and treasure, and which is still apparently as far from ultimate settlement as it was at its commencement. See CAUCASUS.

CIRCE, a mythical sorceress, daughter of Sol and Perseis, celebrated for her skill in magic and her knowledge of poisonous herbs. She was sister to Æetes king of Colchis, and to Pasiphäe the wife of Minos. She married a Sarmatian prince of Colchis, whom she murdered to obtain the kingdom. She was expelled by her subjects, and carried by her father to an island called Ææa, upon the coast of Italy. Ulysses, on his return from the Trojan war, visited her coast; and all his companions, who ran headlong into pleasure and voluptuousness, were changed by Circe's potions into swine. Ulysses, who was fortified against all enchantments by a herb called *moly* which he had received from Mercury, went to Circe and demanded, sword in hand, the restoration of his companions to their former state. She not only complied, but welcomed the hero with marks of signal favour. In this voluptuous retreat Ulysses had by Circe one son called Telegonus, or according to Hesiod, two named Agrius and Latinus. For one whole year Ulysses forgot his glory in Circe's arms. At his departure the nymph advised him to descend to hell, and to consult the seer Tiresias concerning the fates that attended him. Circe also metamorphosed her rival Scylla, and Picus king of the Ausonians.

CIRCEII, a town of Latium, at the foot of Mons Circeius, and a short distance from the sea. It was originally colonized by the Romans in the reign of Tarquin the Proud, who deemed the position of the city favourable for commerce and for repressing the inroads of the Volsci. From its foundation till the date of the Latin War, B.C. 340, it seems to have been at one time subject to the Romans, at another to have espoused the cause of the Volsci, and sometimes to have been independent of either power. After the Latin War it was recolonized by the Romans; but it continued gradually to decline till the emperors Tiberius and Domitian, attracted to it by the pleasantness of its situation and the excellence of its oysters, erected villas in the neighbourhood. The ruins of the old city of Circeii are still distinctly visible on the Monte della Cittadella, about two miles from the sea.

CIRCENSIAN GAMES, a general term under which was comprehended all combats exhibited in the Roman circus, in imitation of the Olympic games in Greece. Most of the feasts of the Romans were accompanied with Cir-

censian games; and the magistrates and other officers of the republic frequently presented the people with these exhibitions in order to procure their favour. The great games (*Ludi Romani* or *Magni*) were held during several days from the 4th to the 12th of September. See CIRCUS.

CIRCLE, in *Geometry*, a plane figure comprehended by a single curved line called its circumference, every part of which is equally distant from a point called the centre. Consequently all straight lines drawn from the centre to the circumference are equal to each other.

CIRCLES *of the Sphere* are such as cut the mundane sphere, and have their periphery either on its movable surface, as the meridians; or in another immovable, conterminous, and equidistant surface, as the ecliptic, equator, and its parallels.

CIRCLES *of Altitude* or *almucantars*, are circles parallel to the horizon, having their common pole in the zenith, and diminishing as they approach the zenith.

Diurnal CIRCLES are immovable circles, supposed to be described by the several stars, and other points of the heavens, in their diurnal rotation round the earth, or rather, in the rotation of the earth round its axis. The diurnal circles are all unequal; the equator is the largest.

Horary CIRCLES, in *Dialling*, are the lines which show the hours on dials; though these be not drawn circular, but nearly straight.

CIRCLES *of Latitude*, or *Secondaries of the Ecliptic*, are great circles parallel to the plane of the ecliptic, passing through its poles, and through every star and planet. They are so called because they serve to measure the latitude of the stars, which is nothing but an arc of one of these circles intercepted between the star and the ecliptic.

CIRCLES *of Longitude* are several lesser circles, parallel to the ecliptic; still diminishing as they recede from it. On the arcs of these circles the longitude of the stars is reckoned.

CIRCLE *of Perpetual Apparition*, one of the lesser circles, parallel to the equator, described by any point of the sphere touching the northern point of the horizon, and carried about with the diurnal motion. All the stars included within this circle are always visible above the horizon.

CIRCLE *of Perpetual Occultation*, another lesser circle at a like distance from the equator, containing all those stars which never appear in our hemisphere. The stars situated between these circles alternately rise and set at certain times.

Polar CIRCLES are immovable circles, parallel to the equator, and at a distance from the poles equal to the greatest declination of the ecliptic. That next the north pole is called the Arctic, and that next the south pole the Antarctic.

Druidical CIRCLES, a name given to certain ancient inclosures formed by rude stones circularly arranged; as that of Stonehenge near Salisbury. These, it is now generally supposed, were temples, and also places of solemn assemblage for councils or elections, and seats of judgment.

CIRCLES of the Empire, the provinces or principalities of the German empire, which had a right to be present at the diets.

CIRCUIT, in *Law*, signifies the periodical progress of a legal tribunal for the sake of carrying out the administration of the law in the several provinces of a country. It has long been applied to the journey or progress which the judges have been in the habit of making twice every year, through the several counties of England, to hold courts and administer justice, where recourse could not be had to the king's court at Westminster. The country, including Wales, is now divided into eight circuits, viz., the Home, the Norfolk, the Midland, the Oxford, the Western, the Northern, the North Wales, and the South Wales circuit. For a short period the insolvency commissioners made circuits three times a-year, but in 1847 the duties of the circuits were transferred to the new county courts.

In Scotland the judges of the supreme criminal court, or High Court of Justiciary, form also three separate circuit courts, consisting of two judges each; and the kingdom, with the exception of the Lothians, is divided into corresponding districts, called the Northern, Western, and Southern Circuits. In certain burghs of each circuit two courts are held in the year, in spring and autumn, called Circuit Courts. One more is now held at Glasgow during the Christmas recess.

Ireland is divided into the North-East and the North-West Circuits, the Home Circuit, and those of Leinster, Connaught, and Munster.

CIRCULAR, in the form of a circle; circumscribed by a circle; spherical, &c. &c. It is also applied to a letter or paper, of which a copy is sent to several persons on some common business.

CIRCULAR *Instruments*, a general name for those astronomical and nautical instruments used for measuring angles, in which the graduation extends round the whole circumference, or to 360°.

CIRCULAR *Numbers* are those whose powers terminate in the roots themselves; as 5 and 6, whose squares are 25 and 36.

CIRCULAR *Sailing* is the method of sailing by the arc of a great circle. See NAVIGATION.

CIRCUM, a Latin prefix of many English words, signifying *around* or *about*. It corresponds to the Greek *peri* or *amphi*, as in *perimeter*, *amphitheatre*.

CIRCUMCELLIONES, or CIRCELLIONES, a furious and sanguinary set of fanatics in the fourth century, composed of peasants and rustics, who espoused the cause of the Donatists against the emperor Constantine, and went about with women as abandoned as themselves, filling the province of Africa with slaughter, rapine, and burnings, and inflicting on the persons of the adverse party the most atrocious cruelties. They were called *circumcelliones* because they hovered, vagrant like, about the cottages (*cellæ*) of the peasants, having no fixed residence of their own; and styled themselves *agonistici* or combatants, pretending that they were combating the devil. These wretches were utterly regardless of their lives, and when there was occasion they would face death with the greatest alacrity. They first appeared amid those terrible commotions that ensued when Constantine, A.D. 316, ordered the temples of the Donatists in Africa to be taken from them, banished the seditious bishops, and put others to death. Some have accused the Donatists of encouraging them in their enormities; but it does not appear on any good evidence that the bishops, or at least the more sensible of them, approved or instigated their proceedings. Constantine endeavoured in vain to repress their outrages; and the storm continued to increase till it seemed to threaten a civil war. The laws against the Donatists were repealed, A.D. 321. But the Circumcelliones were not subdued—for in the succeeding reign, when Constans attempted to heal this deplorable schism, and Donatus opposed a reconciliation, they still contended furiously in support of the party whose cause they had espoused. In the time also of Gratian, when that emperor deprived the Donatists of their temples, the Circumcelliones acted as the soldiery of the Donatists, and undoubtedly prevented the vigorous execution of the laws enacted against them, as proved by the subsequent prosperity of the Donatist community in Africa.—(Mosheim's *Ecclesiastical History*—Reid's edition.)

CIRCUMCISION, the act of cutting off the prepuce or foreskin; a Jewish and Mohammedan rite.

Circumcision was the seal of a covenant between God and Abraham. It was in the year of the world 2178 that Abraham, by divine appointment, circumcised himself and all the males of his family; from which time it became an hereditary practice among his descendants.

The ceremony, however, was not confined to the Jews, although it originated with them. Herodotus and Philo Judæus observe, that it obtained also among the Egyptians and Ethiopians. Herodotus says that the custom was very

ancient among each people; so that it was impossible to determine which of them borrowed it from the other. The same historian relates, that the inhabitants of Colchis also practised circumcision; and hence he concludes that they were originally Egyptians. He adds, that the Phœnicians and Syrians were likewise circumcised; that they borrowed the practice from the Egyptians; and, lastly, that a little before the time when he wrote, circumcision had passed from Colchis to the people living near Thermodon and Parthenius. (Herodot., ii. 104.)

Marsham is of opinion that the Hebrews borrowed circumcision from the Egyptians, and did not introduce the rite in compliance with the direct command of Heaven. Diodorus Siculus and Herodotus are cited by him as evidences on his side. This latter proposition seems directly contrary to the testimony of Moses, who tells us that Abraham, though ninety-nine years of age, was not circumcised till he had received the express command of God for the performance of the rite. The arguments on both sides may be seen in one view in Spencer *de Legibus Hebræorum.*

Among the Jews, the time for performing this rite was the eighth day, that is, six full days after the child was born. The law of Moses ordained nothing with respect to the person by whom, the instrument with which, or the manner how, the ceremony was to be performed; the instrument however was generally a knife of stone. The child was usually circumcised at home, where the father or godfather held him in his arms, while the operator, taking hold of the prepuce with one hand, cut it off with the other; a third person held a bowl, filled with sand, to catch the blood; then the operator applied his mouth to the part, and, having sucked the blood, spat it into a bowl of wine, and threw a styptic powder upon the wound (Othon. *Lex Rabb.* p. 133.) This ceremony was usually accompanied with great rejoicings and feasting; and at this time the child received his name in presence of the company. The Jews invented several superstitious customs at this ceremony, one of which consisted in placing three stools—one for the operator, the second for the person who held the child, and the third for Elijah, who, as they supposed, assisted invisibly at the ceremony.

The Jews distinguished their proselytes into two sorts, according as they were circumcised or not: those who submitted to this rite were looked upon as children of Abraham, and obliged to keep the laws of Moses; the uncircumcised were only bound to observe the precepts of Noah, and were called *Noachidæ.*

A sort of circumcision has also been found to exist in various parts of the Indian Seas and Pacific Ocean.

CIRCUMFERENCE, in a general sense, denotes the line or lines bounding a plane figure. However, it is generally used in a more limited sense for the curve line which bounds a circle, otherwise called a periphery; the boundary of a rectilineal figure being expressed by the term perimeter.

CIRCUMFERENTOR, an instrument used by surveyors for taking angles.

CIRCUMFLEX, in *Grammar*, an accent serving to note or distinguish a syllable of an intermediate sound between acute and grave, and generally somewhat long. The Greeks had three accents, the acute, the grave, and the circumflex, marked respectively thus, ´, `, ˜. The acute raises the voice, and the grave lowers it, while the circumflex is a kind of undulation of the voice between the two. It is seldom used among the moderns, except to show the omission of a letter, which makes the syllable long and open. Thus the French write *pâte* for *paste; tête* for *teste; fûmes* for *fusmes*, and the like. They formerly used the circumflex in the participles; some of their authors writing *conneu, peu,* others *connû, pû,* &c. The circumflex is not used in English.

CIRCUMGYRATION, the whirling motion of any body round a centre, as that of the planets round the sun.

CIRCUMLOCUTION, an ambages or circuitous mode of expression, used to express an idea either when a suitable term is not at hand, or to avoid the use of a single term either from delicacy or respect, or to soften the force of a direct expression.

CIRCUMPOLAR STARS, an appellation given to those stars which from their vicinity to the pole move round it without setting.

CIRCUMPOTATIO (*i.e.* a drinking around in succession), a universal custom at funerals among the nations of antiquity, including the Egyptians, the Greeks, and the Romans. Solon at Athens, and the decemviri at Rome, endeavoured to abolish this custom, thinking it indecorous that mirth and drunkenness should mingle with sorrow.

CIRCUMSCRIBED, in *Geometry*, a term applied to a figure which is drawn round another figure, so that all its sides or planes touch the inscribed figure.

CIRCUMVALLATION, or *Line of CIRCUMVALLATION*, in the art of war, a trench bordered with a parapet composed of the earth dug up from the ditch, and surrounding the camp of a besieging army. It is formed to guard the besiegers against any attempt of an enemy to relieve the place, and it also serves to prevent desertion.

CIRCUS, a place set apart for horse and chariot races among the Romans. The Greeks called such a place a hippodrome (ἱππόδρομος). At Rome, the circi were also used for popular meetings of various kinds, and are therefore described by the poets as localities in which friends and acquaintances who did not often meet had opportunities of seeing one another, and where persons might form new friendships. But the principal destination of a circus was, and remained to the latest times, horse and chariot races, together with other gymnastic and athletic exercises, which were designated by the name *ludi circenses*, or simply *circenses*, and of which the Romans were at all times passionately fond. These amusements of the circus did not materially differ from the Greek agones or contests, celebrated at Olympia, Delphi, and elsewhere; and were certainly of a nobler kind than the frightful gladiatorial fights of the amphitheatres, though sometimes a circus also was polluted by these inhuman exhibitions.

The most ancient, largest, and most celebrated circus at Rome was the *Circus Maximus*, in the valley between the Aventine and Palatine. Tradition assigns its construction to king Tarquinius Priscus, and it cannot have been older than the cloacæ, by which the ground was drained and made fit for buildings. It occupied the whole length of the valley, now called *La via de' Cerchi.* In the course of time this place was adorned in a variety of ways, and in the end it became one of the grandest and most magnificent structures of ancient Rome. At first the patricians and equites (for the plebeians were originally not admitted) viewed the games from temporary platforms (*spectacula, fori*, or *foruli*) which each had to make for himself; but afterwards a permanent building was constructed with regular tiers of seats all around the place, except on the side where the horses and chariots entered, and where in B.C. 329 stalls for horses and chariots (*carceres*) were erected. In B.C. 198 it was adorned with gilt statues; and other ornaments continued to be added until the time of Julius Cæsar, who made this circus about three stadia in length, and 400 feet in breadth. He further surrounded the whole of the inner area with a canal (*euripus*) 10 feet broad and as many feet deep. The podium and the lowest tier of seats were of stone, and the upper ones of wood. The circumference of the whole amounted to eight stadia; and the number of spectators said to have found room in this enormous structure is variously stated between 150,000 and 260,000. In the centre of the area was a low wall (*spina*) running lengthways down the course, and this spina was adorned by Augustus with a great obelisk. The same emperor also

built the *pulvinar* or emperor's seat. Claudius caused the carceres, which had been built of tufa and wood, to be made of marble. At each end of the spina there were three wooden pillars (*metæ*) of a conical shape, which were gilt by the emperor Claudius. The subsequent emperors likewise did much to enhance the magnificence of the circus; but it reached its height in the reign of Trajan, when, as Pliny observes, the long flanks of the circus rivalled the beauty of temples. This emperor enlarged the circus so much that it was capable of containing the whole Roman people; and we afterwards hear of 383,000 or even 485,000 spectators. Constantine brought to Rome the splendid obelisk which now stands before the north portico of the Lateran church, to adorn the Circus Maximus. This is the only remnant of the most ancient Roman race-course, although if excavations were made many valuable treasures of art would no doubt be discovered.

The circus next in importance at Rome was the *Circus Flaminius*. It was outside the city on the spot which had previously been called the *prata Flaminia*, where the plebeians used to meet for deliberation before the building of the circus, and where they, no doubt, celebrated the plebeian games. It is generally believed that this circus was built by Caius Flaminius, who was defeated by Hannibal, at the Thrasymene Lake, B.C. 217; at any rate we have no distinct allusion to it until the year B.C. 211. From the neighbouring temple of Apollo, it is sometimes called Circus Apollinaris. The traces of this circus, which can still be recognised, are somewhat more numerous than those of the Circus Maximus, although here, too, everything is built over; but the foundations of the church S. Caterina de' Funari, and of many other buildings in the neighbourhood, belong to the Circus Flaminius.

Besides these two, several other circi were built during the imperial period, as—1. The *Circus Agonalis*, in which only Greek games or contests (*agones*) were held, and the site of which can still be recognised on the Piazza Navona. It was built by the emperor Alexander Severus in the form of a Greek stadium. 2. The *Circus Vaticanus*, commenced by Caligula and completed by Nero. To it belonged the obelisk now standing on the area in front of St Peter's. A few remnants of its walls have been discovered, which show that it must have been destroyed at an early period. 3. The *Circus of Sallust*, situated in the gardens called the gardens of Sallust. It was constructed in such a manner that it could be used also for naumachiæ. Its site is still marked by considerable ruins. The obelisk belonging to it has been removed by Pope Pius VI. to the area in front of the Church della Trinita de' Monti. 4. The *Circus of Flora*, on the Quirinal hill, or between it and the Mons Pincius, is not often mentioned, and seems not to have been used for horse or chariot races. 5. The *Circus of Hadrian* is supposed to have been commenced by Nero, and to have been completed by Hadrian. It was situated in the garden of Domitia, an aunt of Nero, where Hadrian built his mausoleum, and was probably intended for funeral games in honour of those whose remains were deposited in the mausoleum. In the sixteenth and seventeenth centuries some interesting remains of this circus were discovered. 6. The *Circus of Caracalla* is to us the most important of all; for, though it was surpassed by others in splendour and magnitude, important remains of it still exist which give us an idea of the construction of such edifices in general. They are to be found outside the Porta S. Sebastiano, and still bear the name of "Il Circo," or "La Giostra di Caracalla." In all discussions upon ancient circuses, this one must be our guide, as it is more perfectly preserved than any other. It is very minutely described and figured in the work of Bianconi, *Descr. de' Cerchi, ed. Fea.*

All the circuses we have here noticed differed greatly in their length as well as in their breadth. Their original destination was often departed from; and especially the Circus Maximus, from its size, was often used as a place for hunting wild beasts, and for combats between whole troops of cavalry and infantry. It was on this account that Cæsar ordered the euripus to be made to protect the spectators in the lowest row against the infuriated beasts, and especially against the elephants. Besides this euripus, which Nero filled up again, the spectators in the lower seats were protected by iron railings. The most splendid part of the whole building was the spina, which was adorned with statues and altars, and in almost every case had an obelisk imported from Egypt.

As the Circensian games were so much enjoyed by the Romans, we may easily imagine that many other cities imitated them; and hence we find circi mentioned, at Azani, Anagnia, Alexandria in Egypt, Rhodes, Athens, Gaza, Jerusalem, and in Gaul at Nismes, Narbonne, and in the country of the Belgæ.

For a full description of the architectural detail of a circus, see the work of Bianconi above referred to, and Mr A. Rich in Smith's Dictionary of *Greek and Rom. Ant.*, article *Circus*. See also AMPHITHEATRE. (L. S.)

CIRENCESTER, or CICESTER, a parliamentary borough and market-town of England, county of Gloucester, and 16 miles S.E. of the town of that name; 88 miles by road, and 95 by the Great Western railway from London. It occupies the site of Corinum, Corinium, or Duro-cornovium, the capital of the Dobani and an important military station of the Romans, situated at the junction of three Roman roads. In 878 it was taken by the Danes; and was the seat of a great council held by Canute in 1020. A magnificent abbey for Black Canons, of which some remains still exist, was founded here in 1117 by Henry I. Numerous Roman remains have at various times been discovered here; and traces of the ancient walls, two miles in circuit, are still to be seen. It returns two members to parliament; and, not being incorporated, is governed by two high constables and 14 wardsmen, who are elected annually. Pop. (1851) 6096; electors (1851-2) 434. It stands on the river Churn, is connected by a branch with the Thames and Severn canal, and consists of four principal streets of generally well built houses, but is a place of no trade. The church is a fine old structure of the fifteenth century, with an embattled tower 134 feet high, a fine decorated porch, several lateral chapels, and many interesting monuments. It has a free grammar-school, three hospitals, alms-houses, savings-bank, museum, public library, dispensary, breweries, and a carpet factory. Market-days Monday and Friday. An agricultural college has been lately established in the vicinity, with chapel, lecture rooms, library, museum, laboratories, &c., and an experimental farm of 600 acres.

CIRRIPEDES. See index to MOLLUSCA.

CIRTA, a city of Numidia, in the country of the Massylii, situated on a steep rock, and nearly encircled by the Rummel, a tributary of the Ampsaga. It was regarded by the Romans as the strongest position in Numidia, and was made by them the converging point of all their great military roads in that country. By the early emperors it was allowed to fall into decay, but was afterwards restored by Constantine, from whom it took the name of Constantina, which it still retains.

CISNEROS, FRANCISCO XIMENES DE. See XIMENES.

CISALPINE (Latin *cis*, on this side, and *Alpes*), among the Romans was used to signify "on this side of the Alps," with respect to Rome—that is, to the south of the Alps, in opposition to *transalpine*, or beyond the Alps.

CISPADANA GALLIA, in *Ancient Geography*, a district of Italy, to the south of the Po, originally occupied, as its name imports, by the Gauls, and separated from Liguria on the W. by the Iria, running from S. to N. into the Po, and bounded on the S. by the Appenines, and on

the E. by the Adriatic. The term is formed analogically, frequent mention being made in Cicero, Tacitus, Suetonius, and ancient inscriptions, of the *Transpadani*, which, with *Cispadani*, are terms used with respect to Rome. Ptolemy calls the Cispadana *Gallia Togata:* it extended between the Po and Apennines to the Sapis and Rubicon.

CISSAMPELOS PAREIRA, a plant belonging to the natural order of *Menispermaceæ*, a native of South America and the West Indies, of which the root has been introduced into medicine as a diuretic, tonic, and aperient remedy; but the plant from which it is obtained in Brazil, whence it was first first brought to Europe, is still doubtful. It is called *Pareira brava*, or wild vine, and was extolled by the Brazilian practitioners not only as a remedy in diseases of the urinary organs, but as an antidote against the poison of serpents. Brodie has recommended its use in chronic urinary diseases, as in chronic irritations of the bladder; but many consider its virtues much over-rated both in this country and in Brazil.

CISTERCIANS, a religious order founded A.D. 1098, by St Robert, abbot of Molesme. It was so named from its original convent in the forest of Citeaux (Cistercium), about 14 miles N.E. of Beaune. This order became so powerful that it governed almost all Europe both in temporal and spiritual concerns; and through the exertions of St Bernard of Clairvaux had increased so rapidly in power, that within a century from its foundation it embraced 800 rich abbeys in different countries of Europe. Their rule was that of St Benedict. The Cistercians devoted themselves to a contemplative life, and practised great austerities. The abbeys of La Feité, Pontigny, Clairvaux, and Morimond, were offshoots of that of Citeaux; and produced in their turn a great number of separate communities, all which continued under the superintendence of the abbey of Citeaux. The abbey of Morimond alone possessed 700 benefices; and its supremacy was acknowledged by the military orders of Calatrava, Alcantara, and Montesa in Spain, and those of Christ and of Avis in Portugal. But the most famous of all the communities of this order was that of Clairvaux, founded by St Bernard. (See BERNARD, St). Towards the end of the twelfth century, however, the immense wealth of Citeaux began to operate unfavourably on its discipline, and led the way to great corruptions. Jean de la Barrière, abbot of Nôtre-Dame des Feuillants, near Toulouse, succeeded in 1577 in effecting a reform, which gave rise to the Feuillants in France; and likewise to the reformed Bernardines in Italy. But of all the reforms among the Cistercians, the most celebrated was that effected by the abbot of La Trappe in 1664.

Dependent on the abbey of Citeaux there were about 1800 monasteries and an equal number of nunneries. This ancient abbey was the burial-place of all the dukes of Burgoyne of the original line, with the exception of the first two, who died before its foundation. Citeaux has produced, besides St Bernard, two popes (or four according to some), and a great number of cardinals. The remains of this great abbey still exist.

The Cistercians were involved in the general fate of the religious orders during the period of the French revolution of 1789; and they were reduced to a few convents in Spain, Poland, the Austrian dominions, and the Saxon part of Upper Lusatia. Their habit is a white robe or cassock, with a black scapulary, and a woollen girdle. The nuns wear a white tunic and a black scapulary and girdle.—(Manriquez, *Annales Cistercienses*, 4 vols. folio, Lyons, 1642.)

CISTERN (Lat. *cisterna*), a reservoir, or receptacle for water; either natural or artificial.

CITADEL, a fortress or castle in or near a city, and intended for its defence.

CITADINESCA, a name given by some writers to the Florentine marble which appears to represent towns, palaces, ruins, rivers, &c.

CITHÆRON, a famous mountain, or rather a mountain range, in the south of Bœotia, separating that state from Megaris and Attica. It was very celebrated in Grecian mythology, and is frequently mentioned by the great poets of Greece, especially by Sophocles. It was on Cithæron that Actæon was changed into a stag, that Pentheus was torn to pieces by the Bacchantes whose orgies he had been watching, and that the infant Œdipus was exposed. This mountain, too, was the scene of the mystic rites of Bacchus; and the festival of the Dædala in honour of Juno was celebrated here.

CITHARA, a stringed musical instrument among the ancients, probably of the guitar kind. See LYRE.

CITIZEN, a native of a city, or a person who enjoys all the privileges and immunities of the city in which he resides, and of the state of which he is a member. In ancient Greece and Rome these privileges were so numerous and important as to be watched over with the most jealous care by those who enjoyed them. Among the Romans the rights of citizens were either public or private. The former class was technically called the *jus civitatis*, the latter the *jus Quiritium*. The first of these the Roman citizen enjoyed in his political, the second in his private and personal capacity.

The public rights of the Romans were the following:—1, The *jus census*, the privilege of being enrolled in the censor's books; 2, the *jus militiæ*, the right of serving in the army, in which originally none but citizens were allowed to enlist; 3, the *jus tributorum*, or right of paying the public *tributa* in contradistinction to the *vectigalia;* 4, the *jus suffragii*, the right of voting in the public assemblies of the people; 5, the *jus honorum*, the right of bearing public offices in the state; and 6, the *jus sacrorum*, the right of participating in the solemnities with which the public worship of the gods was celebrated. The private rights of the Roman citizens were seven in number:—1, *Jus libertatis*, the right of liberty, in virtue of which the Roman citizen could appeal to the people against the severity of magistrates, the cruelty of creditors, and the insolence of more powerful citizens; 2, the *jus gentilitatis et familiæ*, by which the privileges originally granted to a gens or family were secured to its later representatives; 3, the *jus connubii*, by which no Roman citizen was allowed to marry a slave, a barbarian, or a foreigner, unless by the express permission of the people; 4, the *jus patrium*, which gave a Roman father the complete power of life and death over his children; 5, the *jus dominii legitimi*, or the right of legal property; 6, the *jus testamenti et hæreditatis*, the right of making a will and succeeding to an inheritance; and 7, the *jus tutelæ*, the right of tutelage and wardship. Such were the rights of the Roman citizen in his political and social relations. As a nation the Romans were originally divided into *cives* and *peregrini*. Under the title of *peregrini* were included, until the time of Caracalla, the inhabitants of nearly all the Roman provinces; the citizens of foreign states on friendly terms with Rome; Romans who had lost their civitas; and freed men. Subsequently, a third class was introduced, the *Latini*, who enjoyed a modified civitas, and had the right of trade without that of marriage. Caracalla extended the civitas to every town and village that owned the dominion of Rome; but his generosity was confined to communities, and did not extend to individuals. When Justinian reformed the Roman code, he abolished altogether the gradation of classes. After his time there was no other division than that into subjects of the emperor and slaves.

CITRUS, a genus of plants belonging to the natural order of *Aurantiaceæ*, including the orange, the lemon, the lime, the shadock, &c. See BOTANY.

CITTA DI CASTELLO (the ancient *Tifernum Tiberinum*), a town of the Papal States, pleasantly situated on the left bank of the Tiber, delegation of Perugia, and 25 miles

N. by W. from the town of that name. It has a cathedral, many churches and convents, hospital, manufactures of silk twist, and some trade in wine and oil. Pop. 5430.

CITTA VECCHIA, a city of Malta. See MALTA.

CITTERN, an old species of guitar. In former times the cittern was a regular part of the furniture of a barber's shop; and it is frequently mentioned by our old dramatists.

CITY, according to Cowel, is a town corporate, which has a bishop and cathedral church, and is called *civitas*, *oppidum*, and *urbs*; *civitas*, because it is governed by justice and order of magistracy; *oppidum*, because it contains a great number of inhabitants; and *urbs*, because it is in due form surrounded with walls.

Kingdoms have been said to contain as many cities as they have sees of archbishops and bishops; but, according to Blount, *city* is a word that has obtained since the Conquest; for in the time of the Saxons there were no cities, but all the great towns were called burghs, and even London was then called *Londonburgh*, as the capital of Scotland is called *Edinburgh*. Even long after the Conquest the word *city* was used promiscuously with *burgh*, as in the charter of Leicester, where it is called both *civitas* and *burgus*; which shows that those writers were mistaken who tell us that every city was or is a bishop's see, though with us the word city usually signifies such a town corporate as has a bishop and a cathedral church.

As to the ancient state of cities and villages, whilst the feudal policy prevailed they held of some great lord, on whom they depended for protection, and were subject to his arbitrary jurisdiction. The inhabitants were deprived of the natural and most unalienable rights of humanity. They could not dispose of the effects which their own industry had acquired, either by a latter will or by any deed executed during their life. They had no right to appoint guardians for their children during their minority. They were not permitted to marry without purchasing the consent of the lord on whom they depended. If once they had commenced a lawsuit, they dared not terminate it by an accommodation, because that would have deprived the lord, in whose court they pleaded, of the perquisites due to him on giving his judgment. Services of various kinds, no less disgraceful than oppressive, were exacted from them without mercy or moderation. The spirit of industry was checked in some cities by absurd regulations, and in others by unreasonable exactions; nor would the narrow and oppressive maxims of a military aristocracy have permitted it ever to rise to any degree of vigour or independence.

The freedom of cities was first established in Italy, owing principally to the introduction of commerce. As soon as they began to turn their attention towards this object, they became impatient to shake off the yoke of their insolent lords, and to establish among themselves a free and equal government. The German emperors, especially those of the Franconian and Suabian lines, as the seat of their government was far distant from Italy, possessed a feeble and imperfect jurisdiction in that country. Their perpetual quarrels, either with the popes or their own turbulent vassals, diverted their attention from the interior policy of Italy, and gave constant employment for their arms. These circumstances induced some of the Italian cities towards the beginning of the eleventh century to assume new privileges, to unite together more closely, and to form themselves into bodies politic, under the government of laws established by common consent. The rights which many cities acquired by bold or fortunate usurpations, others purchased from the emperors, who deemed themselves gainers when they received large sums for immunities which they were no longer able to withhold; and some cities obtained them gratuitously, from the facility or generosity of the princes on whom they depended. The great increase of wealth which the crusades brought into Italy occasioned a new kind of fermentation and activity in the minds of the people, and excited such a general passion for liberty and independence, that before the conclusion of the last crusade, all the considerable cities in that country had either purchased or extorted large immunities from the emperors.

This innovation was not long known in Italy before it made its way into France. Louis le Gros, in order to create some power that might counterbalance those potent vassals who controlled or gave law to the crown, first adopted the plan of conferring new privileges on the towns within his own domain. These privileges were called *charters of community*, by which the inhabitants were enfranchised, all marks of servitude abolished, and corporations or bodies politic were formed, to be governed by a council and magistrates of their own nomination. These magistrates had the right of administering justice within their own precincts, of levying taxes, and of embodying and training to arms the militia of the town, which took the field when required by the sovereign, under the command of officers appointed by the community. The great barons imitated the example of their monarch, and granted similar immunities to the towns within their territories. They had wasted such great sums in their expeditions to the Holy Land, that they were eager to lay hold on this new expedient for raising money by the sale of those charters of liberty. Though the constitution of communities was as repugnant to their maxims of policy as it was adverse to their power, they disregarded remote consequences in order to obtain present relief. In less than two centuries servitude was abolished in most of the cities of France, which consequently became free corporations. Much about the same period the great cities of Germany began to acquire like immunities, and laid the foundations of their present liberty and independence. The practice spread quickly over Europe, and was adopted in Spain, England, Scotland, and all the other feudal kingdoms.

The Spanish historians are almost entirely silent concerning the origin and progress of communities in that kingdom; so that it is impossible to fix, with any degree of certainty, the time and manner of their first introduction there. It appears from Mariana (whose credulity, however, has frequently impaired the authority of his narrative), that in the year 1350 eighteen cities had obtained a seat in the cortes of Castile. In Aragon cities seem early to have acquired extensive immunities, together with a share in the legislature. In the year 1118 the citizens of Saragossa had not only obtained political liberty, but were declared to be of equal rank with the nobles of the second class; and many other immunities, unknown to persons in their rank of life in other parts of Europe, were conferred upon them. In England, the establishment of communities or corporations was posterior to the Conquest. The practice was borrowed from France, and the privileges granted by the crown were perfectly similar to those above enumerated. It is not improbable that some of the towns in England were formed into corporations under the Saxon kings; and that the charters granted by the kings of the Norman race were not charters of enfranchisement from a state of slavery, but a confirmation of privileges which they had already enjoyed. The English cities, however, were very considerable in the twelfth century. Fitz-Stephen, who lived in the time of Henry II., gives a description of the city of London; and the terms in which he speaks of its trade, its wealth, and the number of its inhabitants, would suggest no adequate idea of its present state. But all ideas of grandeur and magnificence are merely comparative. It appears from Peter of Blois, archdeacon of London, who flourished in the same reign and had good opportunity of being informed, that this city, of which Fitz-Stephen gives such a pompous account, contained but 40,000 inhabitants. The other cities were small in proportion, and in no condition to extort any ex-

tensive privileges. That the constitution of the burghs of Scotland in many circumstances resembled that of the towns of France and England, is manifest from the *Leges Burgorum* annexed to the *Regiam Majestatem.*

CIUDAD RODRIGO, a town on the Agueda, province of Salamanca, Spain. It is fortified, and has some good public buildings, including a cathedral (built A.D. 1190), several churches and convents, an arena for bull-fights, &c. In the principal square are three Roman columns brought from the ancient Malabriga. A bridge connects the city with the suburbs, which are surrounded by well cultivated and fertile plains. The town, otherwise uninteresting, has been rendered famous by the sieges it underwent during the Peninsular war. It was taken by Marshal Massena in 1810, and again by the Duke of Wellington in 1812. Pop. 4500.

CIUDAD REAL, capital of the province of Ciudad Real, Spain; 97 miles S. from Madrid, on a plain between the Jabalon and Guadiana. It was built and fortified by Alonso el Sabio in 1264, to check the progress of the Moors; and portions of the walls and towers remain. It has several fine churches, and a large hospital, founded by Cardinal Lorenzana. It is one of the least commercial capitals of Spain, deriving most of its trade from agriculture and an annual fair. Pop. 10,000.

CIUDAD REAL, or CIUDAD DE LAS CASAS, a city of Mexico, capital of the State of Chiapas, is situated in the plain of Gueizacattan, about 430 miles S.E. of Mexico. It has a cathedral, four convents for monks and one for nuns, two chapels, hospital, and about 6000 inhabitants.

CIUDADELA, a city, formerly the capital of the island of Minorca, at the head of a deep and narrow bay on its W. coast, 25 miles N.W. of Mahon. It is surrounded by walls, and has a fine Gothic church. Pop. about 5000.

CIVET, a kind of perfume approaching in smell to musk and ambergris. It is obtained from two species of the genus Viverra, one of which is found in Africa and the other in Asia. The civet is contained in a sac situated beneath the tail of both the male and female; and by a contractile movement of the animal it is made to issue through an aperture in the sac. It has the consistence of honey, a clear yellowish colour, and an odour that is disagreeably powerful till diluted by mixture with some other substance. This animal, popularly known as the civet-cat, is of a cinereous hue, tinged with yellow, and marked with dusky spots. (See index to MAMMALIA.) Civets are reared with care for the sake of this secretion, especially in Abyssinia. Civet, when genuine, is worth from 30s. to 40s. an ounce.

CIVIC CROWN, *Corona Civica*, a garland of oak leaves given by the ancient Romans to the soldier who had saved the life of a citizen in battle. The civic crown was accounted the next in honour to the *Corona Obsidionalis*, or that presented by a beleaguered army to the general who had effected their liberation. Plutarch, in his life of Coriolanus, accounts for the preference given to the oak as the material for civic crowns; namely, that the oak was sacred to Jupiter, the guardian of the city. Pliny, in speaking of the honour and privileges conferred on him who had merited this crown, observes, that he who had once obtained it might wear it always. When he appeared at the public spectacles, the senate and people rose up; and on these occasions a place next the senate was reserved for him. He was freed from all public burdens, as were also his father and his grandfather by the father's side. He was also to be regarded in the light of a parent by the person whose life he had preserved.

CIVIDADE, a city of northern Italy, government of Venice and delegation of Udine, on the river Natisone, over which there is a bridge 250 feet in length. It has a collegiate church with a library and archives, and a museum. Pop. 6000.

CIVIL (Lat. *civilis*, from *civis* a citizen), in a general sense, relating to the community, or to the policy and government of the citizens and subjects of a state; as in the phrases civil government, civil right, civil war.

CIVIL, in a popular sense, is applied to a complaisant and polite behaviour in the ordinary intercourse of life.

CIVIL has also several other significations, its meaning in each case implying contrariety to that with which it is used; as civil and criminal, civil and ecclesiastical, civil and military. (See also CIVIL STATE, and CIVIL YEAR.)

CIVIL *Death*, anything that cuts off a man from civil society, or its rights and benefits; as condemnation to the galleys, or to death, to perpetual banishment, outlawry, excommunication, entering into a monastery, &c.

CIVIL LAW

Is a term applied by way of eminence to the municipal law of the Romans. This system of jurisprudence has for many ages been regarded as one of the most conspicuous monuments of human wisdom and genius; and its powerful influence on modern legislation has been felt and acknowledged by every civilized nation of Europe. Although it has long ceased to retain the full authority of written law, it can never cease to attract the attention, and to excite the admiration, of lawyers who are capable of ascending to this clear and copious fountain of juridical knowledge. The study of the civil law may formerly have engrossed a larger share of notice than it can justly claim; but there are many reasons for supposing that, in this country at least, it is too much neglected, both by professional lawyers, and by those who aspire at the reputation of general learning.

It is stated by Mr Hallam, that "the stream of literature that has so remarkably altered its channel within the last century, has left no region more deserted than those of the civil and canon law. Except among the immediate disciples of the papal court, or perhaps in Spain, no man, I suppose, throughout Europe will ever again undertake the study of the one; and the new legal systems, which the moral and political revolutions of this age have produced, and are likely to diffuse, will leave little influence or importance to the other."[1] But in all Catholic countries, the canon law is a necessary study; and even the Protestants of Germany think it a study which cannot be safely neglected. When to a certain extent we recommend the study of the canon as well as the civil law, we at the same time make a clear distinction between the utility to be derived from the one and from the other. A familiar acquaintance with the civil law we are disposed to regard as the best foundation of all juridical science: the student, duly initiated in classical learning, may thus acquire a concise and elegant mode of reasoning on the multifarious topics of jurisprudence; and he thus becomes familiar with those maxims of law which have extended their influence to all the civilized portions of Europe. This species of knowledge is therefore highly valuable in

[1] Hallam's View of the Middle Ages, vol. iii. p. 519.

itself, and it guides us to other knowledge, of more immediate application to the ordinary business of life. In several countries, the civil law continues to be studied with a degree of ardour which Mr Hallam could not fail to consider as surprising, and perhaps preposterous. But the canon law cannot claim the same pre-eminence, nor is it to be recommended to students on account of its intrinsic excellence: it is to be considered as the spurious offspring of the civil law, and as having gradually attained its full growth under the fostering care of priestly usurpation; what is most valuable, it has derived from the Roman jurisprudence, and its own peculiar maxims have all the same general tendency towards the power and aggrandizement of the church.

In those countries most remarkable for the extent and solidity of their erudition, namely, in Germany and Holland, the study of the civil law has long constituted an essential branch of a liberal education; and they persuade themselves that many advantages result from such a plan of study. Many of their professed scholars are excellent civilians, and many of their professed civilians are excellent scholars. It is sufficiently obvious that those who are acquainted with the phraseology and with the spirit of the Roman law, will readily understand many passages of the Latin classics which to others must remain obscure and unintelligible. Even the poets admit of such illustration: Plautus, Horace, and Ovid may frequently be explained from the writings of the civilians.[1]

These general assertions will best be confirmed by a particular example; and the examples are so abundant that the chief difficulty lies in the necessity of making a selection. The subsequent passage in one of the epistles of Pliny may however be regarded as sufficient for our purpose. "Tu quidem pro cætera tua diligentia admones me, codicillos Aciliani, qui me ex parte instituit heredem, pro non scriptis habendos, quia non sint confirmati testamento: quod jus ne mihi quidem ignotum est, quum sit iis etiam notum qui nihil aliud sciunt. Sed ego propriam quandam legem mihi dixi, ut defunctorum voluntates, etiamsi jure deficerent, quasi perfectas tuerer. Constat autem, codicillos istos Aciliani manu scriptos. Licet ergo non sint confirmati testamento, a me tamen, ut confirmati, observabuntur."[2] This point of law, says Pliny, is even known to those who are ignorant of every other; but it seems nevertheless to have been completely misapprehended by Dr Adam, who has thus stated the doctrine of codicils: "When additions were made to a will, they were called *codicilli*. They were expressed in the form of a letter addressed to the heirs, sometimes also to trustees (ad fideicommissarios). It behoved them however to be confirmed by the testament. Plin. *Ep*. ii. 16."[3] The first of these sentences contains a definition of a modern codicil; but, according to the civil law, a codicil was a less solemn form of a will. It might be made by a person who was either testate or intestate; in other words, it could either accompany or subsist without a testament. A person might leave several codicils; whereas no *pagan*, that is, no person who was not a soldier, could leave more testaments than one. It was essential to the character of a testament that it should institute an heir; but a codicil was in all cases incompetent for that purpose, and could only bequeath legacies and trusts: it therefore could not disinherit one heir, or substitute another. As the law stood in the age of Caius, a legacy bequeathed by a codicil, and not ratified by a testament, was null and void,[4] and, according to the doctrine which, in more general terms, was afterwards stated by Papinian, where the codicil was of a date prior to the will, it was held to be ineffectual unless confirmed by that will, or by another codicil.[5] The notion of Dr Adam, that a codicil must succeed a testament, and that it must nevertheless be confirmed by a testament, cannot very easily be comprehended; but the statement of the ancient writer, when properly understood, is easily reconciled to the doctrine of the civilians. The individual whom he mentions had first made a codicil, and afterwards a testament, and had neglected to confirm in the one a legacy which had been bequeathed in the other: a direct bequest could not be effectually made in this manner, but Pliny expresses his determination to take no advantage of the legal informality.

The legislation of Rome under the regal dynasty must have been extremely simple. Of this era however very few reliques have been preserved, nor are the genuine sufficiently distinguished from the spurious. The *Leges Regiæ* have been collected by Lipsius,[6] and other men of learning; and of the supposed laws of Romulus a separate collection was published by Balduinus.[7]

After the expulsion of the last king, the want of a regular code of laws appears to have been felt by the Romans, who were yet an inconsiderable and a rude people. According to the uniform testimony of their own writers, they had recourse to the expedient of sending a deputation to Greece, in order to procure information respecting the laws of a kindred nation. The commonly received account of this embassy was called in question by Giambattista Vico,[8] a professor of rhetoric, who ought to have been a professor of law, at Naples: he has been followed by Bonamy,[9] Gibbon, Niebuhr, Wachsmuth, and many other writers, both civilians and historians. The current of opinion in Germany is decidedly in favour of his conclusion, which however we are not yet fully prepared to admit.[10]

It is stated by Livy, and by Dionysius of Halicarnassus, that ambassadors were sent to Greece, in order to collect information respecting the laws of that country; and the same account, or nearly the same, is repeated by many other ancient writers. Angelo Mai, adopting the opinion of Vico, has urged as an objection against this account, that it is

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[1] The juridical science of Ovid has been illustrated in a work published under this title: "Dissertatio philologico-juridica de insigni in poeta Ovidio Romani Juris Peritia, quam Thesibus suis inauguralibus adjectam voluit auctor J. van Iddekinge, J. U. D." Amst. 1811, 8vo.

[2] Plinii Epistolæ, lib. ii. ep. xvi. edit. Gesner.

[3] Adam's Roman Antiquities, p. 56.

[4] Caii Institutiones, lib. ii. § 270.

[5] Digest. lib. xxix. tit. vii. fr. 5.

[6] Lipsii Opera, tom. iv. p. 277. Antverpiæ, 1637, 4 tom. fol.

[7] Balduini libri duo in Leges Romuli, et Leges xii. Tab. quibus Fontes Juris Civilis explicantur. Paris. 1554, fol. This edition, which is not the earliest, is subjoined to the author's copious commentary on the Institutes.

[8] J. B. Vico de Constantia Jurisprudentis, p. 224. Neapoli, 1721, 4to. See likewise the same author's *Principj di Scienza nuova d'intorno alla comune Natura delle Nazioni*, tom. i. p. 120, ed. Milano, 1801, 3 tom. 8vo.—"Hoc opus," says Fabroni, in allusion to the latter work, "ei in amore et deliciis fuit, et glorians affirmabat se posteris monumentum reliquisse, ex quo judicium facere possent, quantum in hoc studiorum genere valeret, quantumque elaborasset." (Vitæ Italorum Doctrina excellentium, tom. xii. p. 295.)

[9] Dissertation sur l'Origine des Loix des XII. Tables, par M. Bonamy: Mémoires de l'Academie des Inscriptions et Belles Lettres, tom. xii. p. 27.

[10] On the subject of this controversy, two articles, written by Berriat St. Prix, may be found in that valuable repository the *Thémis, ou Bibliothèque du Jurisconsulte*, tom. iv. p. 304. tom. vi. p. 269.

nowhere mentioned in the writings of Cicero:[1] but if we were to admit the fact, it would not be necessary to admit the inference; for Cicero might or might not find occasion to refer to an event which, so far as we can discover, no person regarded as doubtful. The following expressions however seem to contain a manifest allusion to the influence of the Athenian upon the Roman laws: "Adsunt Athenienses, unde humanitas, doctrina, religio, fruges, jura, leges ortæ, atque in omnes terras distributæ putantur."[2] This passage occurs in one of his orations; and, in another work, Cicero notices the coincidence or identity of certain decemviral laws with those of Solon.[3] In the subsequent passage, Tacitus evidently alludes to a fact which must have been considered as incontrovertible: "Creatique decemviri, et accitis quæ usquam egregia, compositæ duodecim Tabulæ, finis æqui juris."[4] The younger Pliny thus addresses one of his friends: "Habe ante oculos, hanc esse terram quæ nobis miserit jura, quæ leges non victa acceperit, sed petentibus dederit; Athenas esse, quas adeas; Lacedæmonem esse, quam regas."[5] Pomponius has likewise adopted the same account: "Postea, ne diutius hoc fieret, placuit publica auctoritate decem constitui viros, per quos peterentur leges a Græcis civitatibus, et civitas fundaretur legibus."[6] Many other passages of ancient writers might be accumulated, not to strengthen the original authority on which we find the fact stated, but to evince that this fact was generally, if not universally admitted.

Dr Macieiowski, professor of the civil law in the university of Warsaw, has directed the edge of his criticism against the character of Livy and Dionysius as historians;[7] and we are not unwilling to admit that on this subject his opinion is entitled to attention. The value and importance of Dionysius's work for the early history of the Roman law, has been discussed by Dr Schulin;[8] and with respect to the character of Livy, we only think it necessary to remark that we regard him as no incompetent authority for such a fact as he has recorded. Had the fact of such a mission been very absurd or very incredible in itself, the state of the question would have been essentially different. It is further urged by the same learned professor, that all the ancient monuments of Roman history must have perished when the city was burnt by the Gauls. But it is not to be doubted that the laws of the twelve Tables, or at least ample portions of them, survived the destruction of the city: those laws are repeatedly mentioned by Cicero, as we should now mention the Great Charter, not as what has existed, but as what still exists;[9] at a later period they were the subject of various commentaries, nor do we meet with any hint or suggestion that such commentaries related to fragments, instead of the entire collection. It is indeed stated by Livy that, after this calamity, an attempt was made by public authority to recover the regal and decemviral laws;[10] and we learn from Cyprian that, during the third century, the laws of the twelve Tables were still to be found engraved on tablets of brass.[11] If then the laws themselves were rescued from the ruins of the city, is there any difficulty in imagining, or any absurdity in believing, that their genuine history was likewise preserved? Let us even suppose that every written monument perished in the common wreck; yet the nation itself was not exterminated; and the oral tradition of one generation became the lettered record of the next.

Some writers have involved the subject in unnecessary doubt and difficulty, by misapprehending the real state of the question; for it has been seriously asked whether the decemvirs transferred the entire laws of Solon to the twelve Tables. If any person imagines that they transferred the entire laws of Solon, or any other legislator, he manifestly entertains a very crude opinion; and he who opposes such an opinion, can only be thought to combat a phantom. Let us examine the passage of Livy as our original text: "Quum de legibus conveniret, de latore tantum discreparet, missi legati Athenas Sp. Postumius Albus, A. Manlius, Ser. Sulpicius Camerinus; jussique inclytas leges Solonis describere, et aliarum Græciæ civitatum instituta, mores, juraque noscere."[12] He soon afterwards states that those ambassadors were nominated among the decemvirs for two reasons: "His proximi legati tres habiti, qui Athenas ierant; simul ut pro legatione tam longinqua præmio esset honos; simul peritos legum peregrinarum ad condenda nova jura usui fore credebant." Nothing can be more plain and intelligible than this account. Three ambassadors, or as we might with equal propriety describe them, three messengers, were sent to Greece, with instructions to procure a copy of the laws of Solon, and to acquaint themselves with the laws and institutions of other states of Greece besides Athens. In the commission for preparing a body of laws, these three individuals were included, in order that this honour might compensate them for their former labours, and that the knowledge which they had acquired of foreign jurisprudence might be rendered useful in the compilation of a new body of laws. The expression *ad condenda nova jura* certainly does not suggest the idea of transferring laws already made. If therefore any enquirer should succeed in proving, what it will however be very difficult to prove, that there is not a single coincidence between any existing fragment of the twelve Tables, and any existing fragment of the laws of Athens or any other state of Greece, no argument could thence be deduced

[1] Maius ad Ciceronem de Republica, lib. ii. cap. xxxvi. p. 201. Romæ, 1822, 8vo.

[2] Ciceronis Orat. pro Flacco, § 26.

[3] Cicero de Legibus, lib. ii. cap. xxiii. xxv.

[4] Taciti Annal. lib. iii. cap. xxvii.

[5] Plinii Epistolæ, lib. viii. ep. xxiv.

[6] Digest. lib. i. tit. ii. fr. 2. § 4. These words of Pomponius, as they now stand, are at variance with the account given by Livy; and Bynkershoek very ingeniously conjectures that they ought to be transposed in the following manner: "Placuit publica auctoritate peterentur leges a Græcis civitatibus, et decem constitui viros, per quos civitas fundaretur legibus."

[7] Macieiowski Opusculorum Sylloge prima, p. 102. Varsaviæ, 1823, 8vo. Having, in the first edition of his history, expressed his disbelief in the story of the embassy to Greece, his opinion was publicly controverted by Professor Ciampi, in a work entitled *Novum Examen Loci Liviani, de Legatis*, &c. Vilnæ, 1821, 8vo. To this antagonist he replies, but without mentioning his name, in an *Excursus ad Livii Historiarum lib. iii. cap.* 31. *sqq.* See likewise the second edition of his *Historia Juris Romani*, p. 54. Varsaviæ, 1825, 8vo.

[8] De Dionysio Halicarnasseo Historico, præcipuo Historiæ Juris Romani Fonte, Dissertatio inauguralis, in Academia Heidelbergensi præmio ornata: scripsit Phil. Frid. Schulin, Moeno-Francofurtanus, Juris utriusque Doctor. Heidelbergæ, 1820, 4to.

[9] "Discebamus enim pueri XII. ut carmen necessarium; quas jam nemo discit." (Cicero de Legibus, lib. ii. cap. xxiii.)

[10] "In primis fœdera et leges (erant autem eæ duodecim Tabulæ, et quædam regiæ leges) conquiri quæ comparerent, jusserunt." (Livii Hist. lib. vi. cap. i.)

[11] "Incisæ sint licet leges duodecim tabulis, et publice ære præfixo jura præscripta sint, inter leges ipsas delinquitur, inter jura peccatur." (Cypriani Opera, p. 4. edit. Baluz. Paris. 1726, fol.)

[12] Livii Hist. lib. iii. cap. xxxi.—According to some writers, they were partly indebted to the Greek colonies in Italy. See the learned work of Dempster, *De Etruria Regali*, tom. i. p. 445.

against Livy's account of the mission. The Romans, at that period a rude and simple nation, were anxious to obtain some knowledge of the laws, customs, and institutions of a kindred people, before they attempted to reduce their own laws to something approaching to a systematic form; and in order to procure this knowledge, they adopted an expedient which must strike every person, who reflects on the state of society at that remote era, as the most obvious and practicable that could have been devised. But of the new laws with which they thus became acquainted, it is evident that many were utterly to be rejected, some to be abhorred; and they might learn what to avoid, as well as what to imitate. We might as rationally expect one nation to adopt the entire language as the entire laws of another nation. When the decemvirs were employed in their important task, the city of Rome had seen three centuries of years, and during that period had partly been governed by written, and partly by unwritten laws. It is therefore to be supposed that the twelve Tables chiefly consisted of a digest of what was regarded as the best portion of their municipal enactments and customs: customary law, which acquires its vigour and consistency in the early stages of society, was doubtless a very essential part; and some modifications, perhaps various regulations entirely new, might be derived from a foreign source. This we conceive to be the authentic history, and these the genuine effects, of the famous mission into Greece; and in the general texture of this story we find nothing that exceeds the limits of rational belief.

Dr Dunbar has well remarked that "the Romans, while yet a rude people, disdained not to appoint an embassy to enquire into the jurisprudence of the Greeks, and to supply, from that fountain, the deficiencies in their civil code. This embassy seems to have been suggested by Hermodorus, an exiled citizen of Ephesus, who afterwards eminently assisted in interpreting the collection of laws brought from Greece. His public services met with a public reward. A statue was erected to him in the Comitia at the public expense; an honour which the jealousy of Rome would have denied to a stranger in a less generous age. But, at this period, she acted from a nobler impulse; and the statue erected to Hermodorus was erected, in reality, to her own honour. Yet the name of this Ephesian, which casts a lustre upon Rome, seemed to cast a shade upon his native city; and that people, according to Heraclitus, deserved to have been extirpated to a man, who had condemned such a citizen to exile."[1] This agency of Hermodorus is not mentioned by Livy: but the erection of his statue is recorded by the elder Pliny;[2] and his connexion with the decemvirs is likewise stated by Pomponius: "Et ita ex accidentia appellatæ sunt Leges duodecim Tabularum: quarum ferendarum auctorem fuisse decemviris Hermodorum quendam Ephesium, exulantem in Italia, quidam retulerunt."[3] By the word *auctor*, as used in this passage, we are evidently to understand a person who advised or influenced the decemvirs; and according to Pliny, his services were those of a translator or expounder. It is therefore highly probable that he was chiefly employed in expounding to them the Greek laws, of which they had obtained a transcript. As he appears to have been a person of superior talents,[4] his own comments might be useful and important; but we are by no means inclined to estimate his services so highly as Professor Gratama, who represents him as the real author of the laws of the twelve Tables.[5]

Before we dismiss the history of the twelve Tables, we are tempted to notice an opinion which another modern author has delivered respecting one of their enactments. "Ancient histories," says Lord Kames, "are full of incredible facts that passed current during the infancy of reason, which at present would be rejected with contempt. Every one who is conversant in the history of ancient nations, can recal instances without end. Does any person believe at present, though gravely reported by historians, that in old Rome there was a law for cutting into pieces the body of a bankrupt, and distributing the parts among his creditors?"[6] This is the speculation of an ingenious man, who is sometimes too precipitate in his conclusions. Annæus Robertus[7] and Heraldus[8] have each proposed a mitigating interpretation of this law of the twelve Tables: Bynkershoek was solicitous to prove that the creditors were entitled to divide, not the body, but the price of the insolvent debtor;[9] and his opinion has been adopted by the learned Dr Taylor,[10] and by some other civilians. But this opinion can neither be reconciled with the obvious meaning of the words, nor with the ancient mode of understanding them.[11] Those who consider such an enactment as altogether incredible, ought at the same time to consider the real character of the Roman people at that period of their history. They certainly were not distinguished by the gentler virtues; and if their laws were altogether silent as to the treatment of debtors, we ascertain from other sources of information that it was extremely harsh and cruel. In more rude communities, where commerce is almost entirely unknown, and where the poor are completely subjected to the rich, the insolvent debtor is very apt to be treated as a criminal. In ancient Rome, we know from historical records, not merely from the letter of the law, that he might be reduced to the condition of a slave; and it is obvious to every person acquainted with ancient history, that the unrelenting treatment of debtors was a ground of open dissension between the different orders of the people. The same laws which conferred on the father of a family the power of life and death over his wife and children, and which awarded capital punishment against the author of a satirical poem, may without much difficulty be conceived to have disposed of a poor debtor's person in the most summary manner.

It was in the 302d year from the building of the city that the decemvirs were appointed, and were invested with extraordinary powers, for the purpose of compiling a body of laws. They accordingly completed ten tables, which in the following year were confirmed by the comitia centuriata; but as some deficiencies were still to be supplied, decemvirs were again created, and the labour was thus brought to a conclusion. The laws of the twelve

[1] Dunbar's Essays on the History of Mankind in rude and cultivated Ages, p. 161. Lond. 1780, 8vo.—See likewise Dr Wallace's Dissertation on the Numbers of Mankind in antient and modern Times, p. 238 Edinb. 1753, 8vo.

[2] "Fuit et Hermodori Ephesii in Comitio, legum quas decemviri scribebant interpretis, [statua] publice dicata." (Plinii Natur. Hist. lib. xxxiv. cap xi.)

[3] Digest. lib. i. tit. ii. fr. 2. § 4.

[4] See Menagii Observationes in Diogenem Laertium, p. 393.

[5] Serpii Gratama Oratio de Hermodoro Ephesio vero XII. Tabularum Auctore. Groningæ, 1817, 4to.

[6] Kames's Sketches of the History of Man, vol. iii p. 253.

[7] Roberti Rerum Judicatarum libri iv. f. 137. b. edit. Paris. 1597, 4to.

[8] Heraldi de Rerum Judicatarum Auctoritate libri ii. p. 518. Paris. 1640, 8vo.

[9] Bynkershoek Observationes Juris Romani, lib. i. cap. i.

[10] Taylori Commentarius in L. Decemviralem de inope Debitore in partis dissecando. Cantabrigiæ, 1742, 4to.

[11] Dr Valpy, a learned divine, has confuted the opinion of Bynkershoek and Taylor, in a long note subjoined to his *Sermons preached on public Occasions*, vol. ii. p. 1. Lond. 1811, 2 vols. 8vo.

Tables were illustrated by the commentaries of several ancient lawyers, and among the rest by Antistius Labeo and Caius: the fragments of those laws have been collected and explained by many of the moderns, by Balduinus, Rævardus, Marcilius, Augustinus, Gravina, Funccius, Bouchaud, and others;[1] but the most able and conspicuous labourer in this province is the younger Gothofredus, whose edition of the Theodosian Code has rendered his name illustrious in the history of jurisprudence.[2]

Law assumed the form of a science during the latter ages of the republic; and jurisprudence, like philosophy, was at length subdivided into sects.[3] The chief splendour of the Roman lawyers is to be traced from the reign of Augustus to that of Alexander Severus;[4] and the last name of great celebrity is that of Herennius Modestinus.[5] With this pupil of Ulpian, the oracles of the civilians became mute:[6] the succeeding lawyers are only known as compilers or expounders; and although the law was long afterwards taught at Rome, Constantinople, and Berytus, we cannot in those declining annals discover any vestiges of ancient genius. The reign of Constantine was not conspicuous for legal science; and by fixing the seat of empire at Byzantium, he diminished all the chances or probabilities of improvement. To the great body of those who inhabited the new metropolis, the language of the law was a foreign language; nor was this the only circumstance unfavourable to the cultivation and progress of jurisprudence.

It is well known that the decisions of certain lawyers obtained the force of law.[7] In a rescript of Constantine, dated in the year 327, we find the highest authority ascribed to the opinions of Julius Paulus,[8] who flourished at the close of the second and the commencement of the third century. After an interval of nearly one hundred years, appeared another imperial constitution, intended to regulate the number and weight of legal opinions. In the judges themselves very little confidence seems to be reposed, nor is it difficult to imagine that their general merits are not undervalued: they are bound to decide points of law, according to the number of accredited opinions; when the numbers are equal, and the decision of Papinian can be produced on one side of a question, his authority must be allowed to preponderate, "qui, ut singulos vincit, ita cedit duobus;" and it is only in the case of a perfect equilibrium of legal opinions, that they are left to the full exercise of their own discrimination.[9] This arrangement is so entirely mechanical, that it is manifestly adapted to the lowest standard of attainment in those entrusted with the administration of the law.

Of the writings of the ancient lawyers, innumerable fragments are incorporated in the Pandects, and various others have been collected by Schulting. The recent discovery of several reliques of the Roman law has given a fresh impulse to the continental civilians. New portions of the Theodosian Code have been brought to light by Clossius and Peyron. To the Vatican Fragments, published by Angelo Mai,[10] we can only make a transient allusion; but the recovery of the long-lost Institutes of Caius is too remarkable an event to be noticed in the same manner. An unsatisfactory abridgement of these Institutes had long been known; but the genuine text of Caius was not discovered till the year 1816. In the library of the chapter of Verona, the celebrated Niebuhr, author of the Roman history, found a juridical manuscript of great antiquity; and when a short extract was communicated to Savigny, he easily ascertained that it formed a portion of the original work of this ancient lawyer, who flourished about the age of Antoninus. In the course of the following year, the Royal Academy of Berlin dispatched to Verona two distinguished members of the university, Professor Göschen, a civilian, and Professor Bekker, a philologer, entrusted with the important commission of executing a transcript of the manuscript; and in the performance of this very formidable task, they were greatly aided by the spontaneous and indefatigable services of Dr Bethmann Holweg, who was afterwards appointed a professor of law at Berlin. The manuscript is a *codex rescriptus*, and to a considerable extent *bis rescriptus;* nor is it easy to conceive the difficulty of deciphering an ancient relique in this condition. Without the aid of a chemical process, it would have been impossible to succeed in the attempt to read what had thus been written and erased.[11] According to the opinion of Kopp, the learned author of the *Palæographia Critica*, who is allowed to possess great knowledge of ancient monuments, the manuscript must have been written before Justinian's reformation of the law.[12] After much laborious preparation, the Institutes of Caius or Gaius were published in the most able and satisfactory manner by Professor Göschen,[13] who, since that period, has been removed to the university of Göttingen, where he now lectures to numerous auditories. He published a second edition in 1824, and several other editions have already appeared. Although the manuscript has been exposed to frequent and material mutila-

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1 See Dirksen's Uebersicht der bisherigen Versuche zur Kritik und Herstellung des Textes der Zwölf-Tafel-Fragmente. Leipzig, 1824, 8vo.

2 Gothofredus's *Fragmenta XII. Tabularum* are to be found in his *Fontes quatuor Juris Civilis.* Genevæ, 1653, 4to. They are reprinted among his *Opera Juridica minora.* Lugd Bat. 1733, fol.

3 Mascovii de Sectis Sabinianorum et Proculianorum in Jure Civili Diatriba. Lipsiæ, 1728, 8vo.

4 See the collection edited by Dr Franck, under the title of "Vitæ tripartitæ Jurisconsultorum veterum, a Bernardo Rutilio, Joanne Bertrando, et Guilielmo Grotio conscriptæ." Halæ Magd. 1718, 4to.

5 The fragments of Modestinus have been illustrated by many different civilians, and, among others, by Brenkman, in a work entitled "De Eurematicis Diatriba: sive, in Herennii Modestini librum singularem Περὶ Εὑρηματικῶν Commentarius." Lugd. Bat. 1706, 8vo. See Bachii *Historia Jurisprudentiæ Romanæ*, p 506. edit. Stockmann. Lipsiæ, 1807, 8vo.

6 "Atque hic jurisconsultorum finis est, hic oracula jurisconsultorum obmutuere; sic ut ultimum jurisconsultorum Modestinum dicere liceat, cessim et retro collapsa jam jurisprudentia." (Gothofredi Hist. Juris Civilis, p. 14.)

7 "Responsa prudentium sunt sententiæ et opiniones eorum, quibus permissum est jura condere: quorum omnium si in unum sententiæ concurrant, id quod ita sentiunt, legis vicem obtinet; si vero dissentiunt, judici licet, quam velit sententiam sequi; idque rescripto divi Hadriani significatur." (Caii Institutiones, lib. i. § 7.) This is one of the numerous instances in which the Institutes of Caius reflect a strong light on the history of the Roman law. Before their discovery, this rescript of Hadrian was totally unknown to modern civilians.

8 Theodosiani Codicis genuini Fragmenta, p. 34.

9 Cod. Theodos. lib. i. tit. iv. p. 24. edit. Wenck.

10 Vaticana Juris Romani Fragmenta, Romæ nuper ab Angelo Maio detecta et edita, Gallicis typis mandaverunt ephemeridum quæ *Themidis* nomine publicantur, Editores. Paris. 1823, 8vo.

11 Abhandlungen der historish-philologischen Klasse der Königlich-Preussischen Akademie der Wissenschaften aus den Jahren 1816–1817, S. 307. Berlin, 1819, 4to. Thémis, tom. i. p. 287. Goescheni præf. in Gaium.

12 Zeitschrift für geschichtliche Rechtswissenschaft, herausgegeben von Savigny, Eichhorn und Göschen, Bd. iv. S. 480.

13 Gaii Institutionum commentarii iv. e codice rescripto Bibliothecæ Capitularis Veronensis nunc primum editi. Berolini, 1820, 8vo.

tions, much remains to instruct and to interest the learned enquirer; and the book has accordingly been received by the foreign civilians with a degree of ardour and exultation, not easily conceived by those who are unacquainted with the progress of such studies among some of the continental nations. Its value in elucidating the history of the Roman law has been discussed by Schrader.[1] Caius has already been illustrated in many other publications, and, in some of the German universities, has been illustrated in separate courses of lectures. It may safely be affirmed, that the discovery of the Institutes of Caius forms a new era in the history of jurisprudence.

Before we proceed to mention the legislative labours of Theodosius, it will be proper to state that, in the compilation of a code of laws, he had been preceded by two private lawyers, Gregorius or Gregorianus, and Hermogenes or Hermogenianus, for their respective names are not completely ascertained.[2] From the order in which their codes are mentioned by ancient writers, it is to be inferred that the labours of Gregorius preceded those of Hermogenianus. Some fragments of both codes have been preserved by Anianus.[3] Gregorius appears to have collected the imperial constitutions belonging to the intermediate reigns, from Hadrian to Constantine the Great. Hermogenianus is supposed to have formed a supplementary collection; and the remaining fragments consist entirely of the constitutions of Dioclesian and Maximinian. Of the former of these compilers, the personal history is involved in complete obscurity. According to the conjectures of modern civilians, the latter must have flourished in the reign of Constantine; and he is supposed to be the same Hermogenianus whose works are quoted in the Pandects. Both compilations are apparently to be considered as the undertakings of private individuals: the ancient commentator on the Theodosian Code has indeed averred that their authority is confirmed by a law, "sub titulo de Constitutionibus Principum et Edictis,"[4] and Gothofredus has naturally enough relied on this averment; but the commentator probably alluded to a constitution which has recently been discovered, and which certainly affords no adequate support to such an opinion. The emperor merely declares his resolution of forming a collection of imperial constitutions, "ad similitudinem Gregoriani atque Hermogeniani Codicis:" he thus acknowledges the propriety of such a model, but is silent with respect to any public sanction of those antecedent codes.[5] It is however probable that they obtained some degree of authority in the forum.[6] This circumstance may naturally be imputed to the intrinsic value of such a collection of laws; and we may conceive the two codes to have obtained the same degree of authority as might belong to the publication of an English author, who had prepared a digest or an abridgement of the Statutes. In either case the credit of the compiler must depend, not upon any formal sanction, but upon the fidelity with which he is generally believed to have executed his undertaking.

It appears to have been the original intention of Theodosius to compile two codes, arranged according to different plans; but his second code was never completed, nor is it easy to conjecture what specific plan he had contemplated. The emperor had thus divulged his intention in the year 429, and the Theodosian Code received his sanction on the fifteenth of February 438. This code of laws, which is sometimes erroneously ascribed to Theodosius the Great, derived its origin from his grandson Theodosius the younger. On the decease of the first Theodosius, the Roman empire was divided between his two sons, the provinces of the east being allotted to Arcadius, those of the west to Honorius. From the sovereign of the east descended Theodosius the Second: after the death of his father and of his uncle, he again united the dominions which had thus been partitioned; but conferring the titles of Cæsar and Augustus upon Valentinian the Third, who married his daughter Licinia Eudoxia, he assigned to him the western provinces of the empire. This son-in-law, who became his successor at Constantinople, was likewise his cousin, being the son of Constantius Cæsar, and of Galla Placidia, the daughter of Theodosius the Great.

The compilers of the code were eight in number, and, as Gothofredus has remarked, they all occupied stations which required an acquaintance with the laws. Antiochus, who was placed at their head, has been confounded by him, as well as by Heineccius, with Antiochus the eunuch, and likewise with a third individual of the same name.[7] By a constitution, which has lately been discovered, and which bears the date of 435, the emperor had invested these commissioners with power to retrench what was superfluous, to add what was wanting, to change what was ambiguous, and to correct what was incongruous.[8] Justinian afterwards invested his commissioners with more ample powers: they were even authorized to consolidate several constitutions into one; and we may presume that neither of the two codes exhibited the imperial laws, or at least a large proportion of them, in their original state. In the novel which sanctions the Theodosian Code, the emperor evidently admits that the compilers whom he had employed were not mere copyists: "Manet igitur, manebitque perpetuo, elimata gloria conditorum, nec in nostrum titulum demigravit nisi lux sola brevitatis."

This code contains the edicts and rescripts of sixteen emperors; and its chronology extends from 312 to 438, thus embracing a period of 126 years. It commences with the reign of the first Christian emperor, and there is a systematic exclusion of the constitutions issued by the military adventurers who, during that interval, were finally unsuccessful in their attempts to usurp the government; but the selection is not limited to the constitutions of the Christian princes, for here we find the apostate Julian among other imperial lawgivers. The code is divided into sixteen books, and the laws which compose each title are arranged in chronological order.

The body of laws thus prepared by the emperor of the east was immediately adopted by the emperor of the west. A very curious document, containing the "Gesta in Senatu Urbis Romæ de recipiendo Theodosiano Co-

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[1] Was gewinnt die Römische Rechtsgeschichte durch Caius Institutionen? untersucht von Eduard Schrader, Professor in Tübingen. Heidelberg, 1823, 8vo.—The learned author has prosecuted similar enquiries in an article entitled "Neuentdeckte Quellen Römischer Rechtskunde," which occurs in the *Kritische Zeitschrift für Rechtswissenschaft*, Bd. i. S. 137. Elvers has published a very useful work under the title of *Promptuarium Gaianum*. Gœtingæ, 1824, 8vo.

[2] Gothofredi Prolegomena ad Codicem Theodosianum, cap. i. Schultingii Jurisprudentia Ante-Justinianea, p. 683. Menagii Juris Civilis Amœnitates, cap. xi. Reinoldi Opuscula Juridica, p. 404. C. F. Pohlii Dissertatio de Codicibus Gregoriano atque Hermogeniano. Lipsiæ, 1777, 4to.

[3] Schultingii Jurisprudentia Ante-Justinianea, p. 681. Lugd. Bat. 1717, 4to. Jus Civile Ante-Justinianeum, tom. i. p. 263. Berolini, 1815, 2 tom. 8vo.

[4] Cod. Theodos. lib. i. tit. iv. l. 1.

[5] Theodosiani Codicis genuini Fragmenta, p. 6.

[6] Heineccii Hist. Juris Civilis, p. 478. edit. Ritter.

[7] See Ritter ad Novell. Theod. p. 6.

[8] Codicis Theodosiani Fragmenta inedita, p. 29.

 dice," has been discovered by Clossius. At this period the Roman senate only exhibited a shadow of its former greatness: the stern and dignified republicans had long been supplanted by the minions of an imperial court; and a senate, possessing a very slender remnant of authority, had been embodied in each of the two great divisions of the empire.[1] The senate of Rome having assembled on this occasion, one of the consuls, Anicius Acilius Glabrio Faustus, proceeded to acquaint the fathers with the legislative enterprize of the one emperor, and the zealous concurrence of the other. " Quam rem æternus princeps, dominus noster Valentinianus, devotione socii, affectu filii comprobavit." He afterwards read the constitution, which has already been mentioned, relative to the project of forming two different codes; and this recitation was succeeded by many exclamations in the highest strain of loyalty. In the midst of various expressions of kindness and regard for the consul, the senators hazarded a few suggestions respecting the custody and transcription of this new code of laws; but we perceive no vestiges of free discussion, or of real deliberation, which always implies the power of adopting either the one or the other of two conflicting opinions. They might presume to regulate certain matters of detail, but were without any real influence in the administration of public affairs. In the instance now before us, their chief functions were manifestly confined to the ready approval of what the consul informed them was the will of the emperor.

The Theodosian Code was thus promulgated in the western, as well as in the eastern empire. The Gothic conquerors of the west permitted their Roman subjects to enjoy the benefit and the protection of their own laws; and a compendium of those laws was soon prepared under the auspices of Alaric king of the Visigoths, whose dominions comprehended certain provinces of Spain and Gaul.[2] This collection contains an abridgement of the three codes of Gregorius, Hermogenianus, and Theodosius, together with some novels, or new constitutions, and an epitome of the Institutes of Caius, extracts from the Sententiæ of Paulus, and from the books of Papinian. It was completed in the year 506, " regnante domino Alarico rege, ordinante viro inlustri Goiarico comite;" and we must apparently conclude that the superintendence of the work had been committed to Goiaric, who was doubtless an officer of the king's court. But it has for several centuries been known under the title of Aniani Breviarium, or the Abridgement of Anianus. The different copies appear to have been attested by his signature; and, according to the opinion of Gothofredus, he presents himself, not as the compiler of the book, but merely as the king's referendary.[3] " Anianus, vir spectabilis, ex præceptione D. N. gloriosiss. Alarici regis, hunc Codicem de Theodosianis legibus, atque sententiis juris, vel diversis libris electum, Aduris anno xxii. eo regnante, edidi atque subscripsi." This attestation is followed by a date, which states the day of the month, and repeats the year of the king's reign; and such a date we may suppose to apply to the act of verifying the copy, not to that of compiling the work itself. We might indeed have expected to find the words " edidi atque subscripsi" arranged in a different order, " subscripsi atque edidi;" but this remark is alike applicable, whether we conceive Anianus to have been the compiler, or merely the collater. To the formation of this collection it is highly probable that several individuals contributed their assistance, under the general direction of Goiaric.[4] To all the books contained in the collection, with the exception of the epitome of Caius, is added an *interpretatio*, or explanation. The manuscripts of the Theodosian Code do not all contain the same explanation, and two different explanations are sometimes subjoined to the same law. It appears from the *auctoritas*, or royal sanction, that explanations were inserted by order of King Alaric, and we must suppose others to have been derived from a different source. This ancient commentary is to be found in Gothofredus's edition of the Theodosian Code; and a very cursory inspection of it seems to have betrayed Sir Edward Sugden into the error of supposing that code partly to consist of a digest of the public laws, and partly of the discussions of private lawyers.[5] This commentary obtained so much credit, that it appears in some measure to have superseded the text. When the writers of the middle ages quote the Theodosian laws, they very commonly refer, not to the text, but to the commentary. Such ancient explanations as these are not without some degree of interest or utility;[6] though they cannot but be supposed to bear sufficient marks of the age to which they belong.

It is only in this ancient abridgement that a considerable proportion of the Theodosian Code has apparently been transmitted to our time.[7] For the first edition of the Code, which was printed at Basel in the year 1528, we are indebted to the commendable zeal of Joannes Sichardus. He had access to several manuscripts; but all of them appear to have been so defective, that very many titles are not to be found in his publication, and indeed several books present themselves in the most mutilated form. He has subjoined the ancient *interpretatio*, together with a collection of the *Novellæ Constitutiones* of Theodosius, Valentinian, and other emperors. His edition is without annotations, but in the margin he has inserted various readings. After an interval of twenty-two years, a more complete edition of the Theodosian Code was pub-

[1] M. C. Curtii Commentarii de Senatu Romano post Tempora Reipublicæ liberæ, p. 206. Halæ, 1768, 8vo. Del Senato Romano opera postuma del Conte Antonio Vendettini. Roma, 1782, 4to

[2] C. G. Bieneri Commentarii de Origine et Progressu Legum Juriumque Germanicorum, part. i. p. 280. Lipsiæ, 1787–95, 2 part. 8vo.

[3] Gothofredi Prolegomena, cap. v. Brunquelli Dissertatio de Codice Theodosiano ejusque in Codice Justinianeo Usu: Opuscula ad Historiam et Jurisprudentiam spectantia, p. 68. Halæ Magd. 1774, 8vo. Savigny's Geschichte des Römischen Rechts im Mittelalter, Bd. ii. S. 42.—The more common opinion is however maintained by Schulting, *Jurisprudentia Ante-Justinianea*, præf. and by Hugo, *Geschichte des Römischen Rechts*, S. 732. " Codicem Theodosianum exscribi jussit," says Cironius, " ut illo uterentur quod Anianius cancellarius suus Aduris promulgavit, cum interpretationibus suis, sub titulo Legis Romanæ." (Observationes Juris Canonici, p. 72. Tolosæ, 1645, fol.)

[4] We therefore adopt the opinion of Gothofredus, that in the following passage Sigebertus Gemblacencis has misunderstood the proper sense of the word *edere*: " Anianus vir spectabilis, jubente Athalarico R. volumen unum de Legibus Theodosii imperatoris edidit; et monente Oruntio episcopo librum Joannis Chrysostomi in Matthæum de Græco in Latinum transtulit." (De Scriptoribus Ecclesiasticis, p. 101. edit. Fabricii.)

[5] Sugden's Letter to James Humphreys, Esq. p. 53. third edit. Lond. 1827, 8vo.

[6] This collection of laws, says the archbishop of Tarragona, is accompanied " cum interpretationibus non ineptis." (Augustinus de Nominibus Propriis του Πανδεκτου Florentini, not. col. 27. Tarracone, 1579, fol.) The merits and defects of these interpretations are minutely discussed by Gothofredus, Prolegomena, cap. vi. See likewise Savigny's Geschichte, Bd. ii. S. 54.

[7] Respecting the newly discovered manuscripts of this Breviarium, the reader will find much information in Haubold's Opuscula, vol. ii. p. 897, and in the preface to the same volume.

lished at Paris by Jean du Tillet, or Tillius, who has however omitted the ancient commentary. In 1566, an edition was published at Lyon by Cujacius, who, among other appendages, has subjoined the ancient commentary, and a collection of the Novels. According to the title-page, the sixth, seventh, eighth, and sixteenth books, "nunc primum prodeunt, cæteri aucti sunt innumeris constitutionibus." Another edition by the same illustrious civilian, but without his name, was published at Paris in 1586; and, in the course of the same year, his name appeared in the title of an edition printed at Geneva. These were followed by other editions of the Theodosian Code; and all the editions include other reliques of ancient jurisprudence.

But the great expounder of the Theodosian Code was Jacobus Gothofredus, or Godefroy, who was born at Geneva in 1587, and died there in 1652. Having at an early age been appointed to a law-professorship in his native city, he acquired a very high reputation as a lawyer of deep and extensive erudition, and in this respect he is only equalled by Cujacius. To his ample stores of philological learning he added a masterly knowledge of history, both civil and ecclesiastical; his industry appears to have been indefatigable, and his reading unbounded. Uniting with his other qualifications a complete knowledge of ancient jurisprudence in all its branches, and applying to his multifarious investigations an acute understanding and a sober judgment, he has produced various works which rise very far above the ordinary standard; but the great and lasting monument of his talents and learning is his edition of the Theodosian Code, on which he bestowed the assiduous labour of thirty years. Thirteen years after his death, it was published under the superintendence of Antoine Marville, professor of law in the university of Valence, who with no small assiduity and perseverance digested his papers into a proper form.[1] If the illustrious civilian of Geneva had himself prepared this edition for the press, it would doubtless have appeared to greater advantage; but even in its present state it is a work of the highest value to the lawyer and to the historian; it is indeed an immense storehouse of juridical and historical knowledge. The commentator has collected a stupendous mass of learning, and his information is derived from every accessible source. To the text of the Code he subjoins the ancient explanation: this is followed by his notes, in which he adverts to the various readings, to the emendation of the text, and to the parallel or conflicting passages in the Theodosian or Justinian laws; and the illustration of each title is completed by his ample commentary, in which he discusses the scope and tendency of the various enactments, and pours around every subject of importance an immense stream of erudition, drawn from the deepest recesses of jurisprudence and history. But in addition to his perpetual commentary, he has composed different tracts which greatly contribute to the elucidation of this collection of laws. "Immortale opus est," says Hugo, "quod Gothofredus perfecit, in quo neque præivit ei quisquam neque ejus vestigia premere ausus est. Nemo Codicem Theodosianum illustrare studuerat; qui primus id consilium cepit, ita quoque perfecit, ut præter spicilegium nil prorsus superesse videretur."[2]

About seventy years after the appearance of this edition, the Theodosian Code, with the commentary of Gothofredus, was republished by John Daniel Ritter, who commenced his undertaking when he was professor of philosophy at Leipzig, and completed it after he had been appointed professor of history at Wittemberg.[3] For a task of this kind he possessed eminent qualifications; being familiarly acquainted with the Roman law and history, he was equally conversant with ancient literature, and he displayed the talents of a skilful critic.[4] To his edition he has added various prefaces, and many shorter notes, and has corrected the text by the collation of manuscripts, and of the former editions. He has reprinted the spurious appendix published by Sirmond, a French Jesuit of uncommon erudition;[5] and to the Novels, which had received no illustration from Gothofredus, he has subjoined many annotations.

The discovery of the Institutes of Caius gave a renovating and powerful impulse to the civilians of the continent; and the recesses of many libraries were explored, in the eager expectation of detecting other reliques of ancient jurisprudence. In the public library at Turin, Professor Peyron discovered a mutilated and undescribed volume in large octavo; and on a more particular examination he found that it was a palimpsest. This volume, as he is led to conjecture, had formed a part of the literary reliques collected in the monastery of Bobbio, which was founded by St Columbanus, a native of Ireland, about the beginning of the seventh century. The second writing consisted of Julius Valerius's Latin version of a narrative of the exploits of Alexander the Great, written by a Greek bearing the name of Æsop. On the application of a proper acid, this version, written with evanescent ink, was very easily effaced, and the more ancient writing became disentangled. Peyron supposes that this manuscript of the Code was transcribed during the earlier part of the sixth century; but, according to Mai, the peculiarities of writing rather belong to the century following. In this manner are preserved thirteen leaves, comprehending portions of the first five books, and two pages which contain a fragment of the sixth book of the Theodosian Code. Nor are these leaves without mutilation: the vellum, in the course of its preparation for a new purpose, has been cut at one side, so that in one page the beginning, and in another the end of the lines, are regularly shorn away; and, in some instances, the tops or bottoms of the leaves are likewise curtailed.[6]

About the same period when Peyron made this discovery at Turin, a similar discovery was made at Milan by Dr Clossius, who is now a professor of law in the university of Dorpat. In the Ambrosian Library he found a quarto volume, containing the treatise *De Officiis*, and several of the orations of Cicero, the Institutes of Justinian,[7] a portion of *Aniani Breviarium*, and *Rhythmus de Assumptione Virginis Mariæ*. The manuscript, which he supposes to belong to the middle of the twelfth century, is written in small, regular, and not inelegant characters, but with pale ink; and the different works contained in the volume appear to have been transcribed by the same hand. The "Gesta in Senatu Urbis Romæ de recipiendo

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[1] Codex Theodosianus, cum perpetuis commentariis Jacobi Gothofredi, &c. Lugduni, 1665, 6 tom. fol.
[2] Hugonis Index Editionum Fontium Corporis Juris Civilis, p. 187.
[3] Lipsiæ, 1736–45, 6 tom. fol. Ritter's edition was soon afterwards reprinted in Italy. Mantuæ, 1740–50.
[4] See Ruhnkenii Opuscula, tom. ii. p. 770.
[5] Appendix Codicis Theodosiani novis Constitutionibus cumulatior; opera et studio Jacobi Sirmondi, Presbyteri Societatis Iesu. Parisiis, 1631, 8vo.
[6] Codicis Theodosiani Fragmenta inedita: ex codice palimpsesto Bibliothecæ R. Taurinensis Athenæi in lucem protulit atque illustravit Amedeus Peyron, Linguarum Orientalium Professor. Augustæ Taurinorum, 1824, 4to.
[7] Prodromus Corporis Juris Civilis, a Schradero, Clossio, Tafelio, Professoribus Tubingensibus, edendi, p. 53. Berolini, 1823, 8vo.

Theodosiano Codice," which we have already recommended to the notice of our readers, cannot but be regarded as a very curious document; and, besides this historical relique, he has rescued from oblivion a considerable number of constitutions, chiefly belonging to the first book of the Theodosian Code.[1] The new materials thus prepared by Peyron and Clossius, have been incorporated with the older stock, and have received much additional illustration from Dr Wenck, the late eminent professor of the civil law in the university of Leipzig.[2] The first five books of the Code, which long appeared so defective and mutilated, are now exhibited in a form materially improved; nor will his annotations be despised, even by such readers as are most familiarly acquainted with those of Gothofredus and Ritter. His notes are sufficiently copious, and afford abundant proofs of the extent of his erudition, and the soundness of his judgment.

After the interval of a century, the example of Theodosius was followed by Justinian. To ten individuals learned in the laws he in the year 528 entrusted the important task of compiling a new code; and at the head of this commission he placed Tribonian, who makes so conspicuous a figure in the history of his reign.[3] The materials for their undertaking were contained in the three codes which have already been mentioned, and in the constitutions of the intervening emperors. Their collection includes the edicts and rescripts of a long series of princes, from Hadrian to Justinian; and they were authorized to select what was most important, to retrench what was superfluous, to rectify what was erroneous, and even to consolidate several constitutions into one. This task they performed with sufficient dispatch: the new code, which was to supersede all the former, received the imperial sanction on the 7th of April 529. But soon after its completion, Justinian found it necessary to issue fifty new decisions, for the purpose of reconciling conflicting principles; and having in the course of a very few years promulgated various other constitutions, he granted a commission to Tribonian and other four persons to revise the code, and insert the additional laws in their proper places. The first edition was suppressed, and the new edition, *Codex repetitæ prælectionis*, was sanctioned on the 16th of November 534. It is divided into twelve books, and each book into a variety of titles.

During this interval, however, Tribonian had been engaged in a work of greater difficulty. On the 15th of December 530, he had been appointed, along with sixteen associates, to prepare a general digest of legal science, not from the edicts and rescripts of the emperors, but from the writings of those lawyers who enjoyed the highest reputation in the forum.[4] The work which they thus compiled contains a very copious collection of legal principles and legal discussions, exhibiting one of the most remarkable specimens of ancient genius and ancient wisdom. It is divided into fifty books. Dr Bluhme has with much labour and ingenuity attempted to ascertain the general principle of arrangement in the titles of which the different books are composed; and his theory has obtained the approbation of Hugo, and other most competent judges. He supposes that the commissioners appointed by Justinian were divided into three sections, and that to each section was assigned the task of extracting the proper materials from a particular series of works. We are thus to expect a triple series in each title: the deviations from this general plan he conceives to be but inconsiderable; and for particular modifications he discovers an obvious and intelligible reason. The first series commences with the commentaries on Sabinus, the second with those on the *Edictum Perpetuum*, and the third with the works of Papinian. He has pursued his enquiries through many minute details, in which we cannot at present accompany him, but must content ourselves with referring to his elaborate *Ordnung der Fragmente in den Pandectentiteln*.[5]

After the completion, but before the publication of the Digest or Pandects, the emperor employed Tribonian, Theophilus, and Dorotheus, to prepare a short and elementary work as a standard introduction to the study of the law. This work is professedly compiled from more ancient treatises of the same nature, and particularly from the Institutes of Caius, whom Justinian styles "Caius noster." The discovery of this latter work is of great importance in illustrating the text of the imperial Institutes, which have for so many centuries retained their place in the schools of jurisprudence, and have so generally served as models to those who in modern times have undertaken to write elementary treatises of law. "This little work," says Dr Bever, "is so truly admirable, both for its method and conciseness, as well as for the elegance of its composition, that it has been imitated by almost every nation in Europe, that hath ever made any attempt to reduce its own laws to a regular and scientific form."[6] It is worthy of remark, that those who are unacquainted with the Institutes and Pandects, are unacquainted with the full compass of the Latin language.[7] The terse and appropriate phraseology with which they so frequently abound, was transfused from the productions of a purer age; nor is it wonderful that they should occasionally be debased by a grosser mixture. "It is remarkable," as Mr Hume has observed, "that in the decline of Roman learning, when the philosophers were universally infected with superstition and sophistry, and the poets and historians with barbarism, the lawyers, who in other countries are seldom models of science or politeness, were yet able, by the constant study and close imitation of their predecessors, to maintain the same good sense in their decisions and reasonings, and the same purity in their language and expression."[8]

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[1] Theodosiani Codicis genuini Fragmenta: ex membranis Bibliothecæ Ambrosianæ Mediolanensis nunc primum edidit Waltherus Fridericus Clossius, Phil. et J. U. Doctor, et Juris Professor Publicus Ordinarius in Regia Universitate Tubingensi. Tubingæ, 1824, 8vo.

[2] Codicis Theodosiani libri V. priorès: recognovit, additamentis insignibus a Walthero Friderico Clossio et Amedeo Peyron repertis aliisque auxit, notis subitaneis, tum criticis tum exegeticis, nec non quadruplici appendice instruxit Car. Frid. Christianus Wenck, Antecessor Lipsiensis. Lipsiæ, 1825, 8vo.

[3] J. P. de Ludewig Vita Justiniani atque Theodoræ Augustorum, nec non Triboniani. Halæ Salicæ, 1731, 4to.

[4] Guil. Grotii Vitæ Jurisconsultorum quorum in Pandectis extant Nomina. Lugd. Bat. 1690, 4to.

[5] Zeitschrift für geschichtliche Rechtswissenschaft, herausgegeben von Savigny, Eichhorn und Göschen, Bd. iv. S. 257.—See likewise an article by Hugo, in the Thémis, ou Bibliothèque du Jurisconsulte, tom. iii. p. 278. Bluhme's speculations have not obtained the same approbation from Dr Tigerstrom, *De Ordine et Historia Digestorum libri duo*, p. 481. Berolini, 1829, 8vo.

[6] Bever's Hist. of the Legal Polity of the Roman State, p. 480. Lond. 1781, 4to.

[7] Opuscula varia de Latinitate Jurisconsultorum veterum: junctim edidit, et animadversiones adjecit Carolus Andreas Dukerus. Lugd. Bat. 1711, 8vo. Ge. Casp. Kirchmaieri Opuscula VI. rarissima de Latinitate Digestorum et Institutionum. Halæ, 1772, 8vo.

[8] Hume's Hist. of England, vol. iii. p. 300

The Institutes were sanctioned on the 21st of November 533; and on the 16th of December, the emperor issued two constitutions, the one in Latin and the other in Greek, by which he confirmed the Institutes, Code, and Pandects, and imparted to them the force and validity of law in the forum, and commanded them to be taught in the schools of Rome, Constantinople, and Berytus. Justinian survived till the year 565, and during that long interval he promulgated many new laws. A collection was at length formed of his Novels, or new Constitutions, to the number of one hundred and sixty-eight. The greatest part of them appear to have been originally written in Greek; some were however written in Latin, and others were at the same time exhibited in both languages.[1] These are followed by thirteen Greek edicts of Justinian, which properly conclude the *Corpus Juris Civilis*, although the common editions comprehend various Novels of Leo,[2] and some other emperors, together with other ancient documents, all of which are only to be considered as appendages.

The task of compiling the Institutes, as we have already seen, was committed to Tribonian, Theophilus, and Dorotheus, of whom the two latter are described as *antecessores*, or public professors of law. Whether one of these was the same Theophilus who wrote a Greek paraphrase of the Institutes, has been long and much disputed among civilians: to recapitulate all the arguments which have been urged on both sides of the question, would require too much time and space; we shall therefore content ourselves with stating, that we are strongly inclined to adopt the opinion of those writers who maintain their identity, and with referring the more curious reader to the ample discussions of Mylius and Reitz.[3] Theophilus was a professor at Constantinople, and Dorotheus at Berytus. During the reign of Justinian, the two imperial cities, together with Berytus, were the only places, within the limits of the empire, where public schools of law were established, or indeed where law was permitted to be publicly taught.[4] Berytus, which the emperor describes as a most beautiful city, was situated on the coast of Syria: here a school of jurisprudence was founded during the third century, and it was long frequented by a numerous train of students; but its prosperity was first interrupted, and was finally subverted, by some of the great convulsions of nature. In the year 384 the town was greatly injured by an earthquake, and in 554 it was visited by another earthquake, which left it a heap of ruins. Some professors and a multitude of students perished in this common calamity: the surviving professors transferred their school to Sidon, and the surviving inhabitants made a vigorous effort to raise a new city from the ruins of the old; but another calamity awaited them, and this famous seat of jurisprudence was totally consumed by fire.[5]

The paraphrase of Theophilus is of great utility and importance in explaining the text of the Institutes. He has not servilely confined himself to the original, and his work in a great measure supplies the place of a perpetual commentary. It is a book indispensably necessary for every more learned and inquisitive student of the civil law. This paraphrase is not indeed entirely free from errors: Reitz conjectures, and not without a considerable degree of plausibility, that Theophilus had dictated it to the students of Constantinople, in the exercise of his functions as a public expounder of the law; and that for its transmission to posterity we are solely indebted to copies taken by his auditors, and uncorrected by himself. To this valuable relique the attention of modern lawyers was first directed by Angelo Poliziano, who died at a premature age in the year 1494. He was a person of singular talents and attainments, who only required a greater length of days to have earned the highest reputation. To the celebrity of an Italian and Latin poet, and of a classical critic, he was solicitous to add that of a civilian; and he was likewise the first individual who attempted a collation of the renowned Florentine manuscript of the Pandects.[6]

Of the Pandects, different Greek versions have been mentioned by different writers. One version has been ascribed to Thalelæus, who was an antecessor in the time of Justinian; but Pohl and Heimbach have shewn that there are no sufficient grounds for believing that he undertook such a task.[7] Another translation is mentioned by Matthæus Blastares as having been executed by Stephanus, an advocate of Constantinople, who had been conjoined with Tribonian in the commission for compiling the original work. The Code was likewise translated into Greek: the translator is supposed to be the person who, in the scholia of the Basilica, is repeatedly described as Κωδικευτης. To many of the judges, as well as the suitors, in the eastern empire, Latin must evidently have been an unknown tongue. When the seat of empire was transferred from Rome to Byzantium, the first emperors were anxious to transfer the use of the Roman language, and for a considerable time this continued to be at least the language of the court. Teachers of Roman eloquence were established in the second metropolis, and they doubtless found many pupils among the youth who aimed at a fashionable education, or were ambitious of preferment; but it was not to be expected that the great body of the people should be induced to unlearn one language, and to acquire another.

During the interval which elapsed between the reign of Justinian and that of Basilius, there were many Greek writers on the Roman law; and not a few names have been recovered from the wreck of time by Lambecius, Suarés, Asseman,[8] and other learned enquirers. Basilius, who has obtained a conspicuous place among the legislators of the empire, derived his lineage from Armenia, but was himself born in Macedonia, and is commonly known by the name of Basilius the Macedonian. He rose from an origin sufficiently humble, and after having been a groom, he be-

[1] F. A. Biener's Geschichte der Novellen Justinian's. Berlin, 1824, 8vo.

[2] C. A. Beck de Novellis Leonis Augusti et Philosophi, earumque Usu et Auctoritate liber singularis: edidit C. F. Zepernick. Halæ, 1779, 8vo.

[3] Jo. Henrici Mylii, J. U. D. Theophilus; sive de Græcarum Juris Institutionum earundemque Auctoris Historia, Ætate, Auctoritate, Fatis, Dotibus, Nævis, liber singularis. Lugd. Bat 1761, 8vo. Reizii Præf. in Theophilum, p. xxv. Of this work of Mylius, the first edition appeared at Leipzig in 1730. The entire tract may be found in Reitz's edition of Theophilus, tom. ii. p. 1034. This edition, in the opinion of Haubold, is unequalled by any similar publication, except Ritter's edition of the Theodosian Code. (Institutiones Juris Romani Litterariæ, p. 205. Lipsiæ, 1809, 8vo.)

[4] Const. *omnem reip.* § 7 ad Antecessores.

[5] Heineccii Hist. Juris Civilis, p. 472. edit. Ritter. Lugd. Bat. 1748, 8vo. But see more particularly "Johannis Strauchii Berytus, seu ad tit. Cod. de Metropoli Beryto Dissertatio publica." Brunsvigæ, 1662, 4to.

[6] Bandini, Ragionamento Istorico sopra le Collazioni delle Fiorentine Pandette fatte da Angelo Poliziano. Livorno, 1762, 4to.

[7] Suaresii Notitia Basilicorum, recensuit C. F. Pohlius, p. 66. Lipsiæ, 1804, 8vo. Heimbach de Basilicorum Origine, Fontibus, Scholiis, atque nova Editione adornanda, p. 25. Lipsiæ, 1825, 8vo.

[8] Assemani Bibliotheca Juris Orientalis Canonici et Civilis. Romæ, 1762–6, 5 tom. 4to.

came sovereign of the east. The eastern empire, in which the Greek language was vernacular, was governed by a collection of laws chiefly written in Latin; and the different versions which had been executed were without the sanction of public authority. It was therefore his object to select such enactments as were still in force, and having digested them into the form of a regular code, to invest them with the imperial sanction. This great undertaking he did not live to complete. He died in the year 886, and was succeeded by his son Leo, surnamed the Philosopher. The body of Greek laws was completed under his direction: the date of its promulgation has not been ascertained; but as the student is referred to it in Leo's Ecloga, which was written in the year 910, the *Basilica* must have been in circulation before that period. Leo ended his reign and his life in the year 911, and was succeeded by his son Constantinus Porphyrogennetus, when only seven years of age. From this learned prince the *Basilica* appear to have received their final revision. Theodorus Balsamon, in his commentary on the Nomocanon of Photius, describes the revised edition as την τελευταιαν ἀνακαθαρσιν;[1] and, according to the opinion of Heimbach, it was not divulged before the year 945.[2]

It has long been a current opinion that, in the western empire, all knowledge of the civil law became extinct, and was not revived till after the lapse of several centuries. "All the world knows," says Lord Kames, "that the Roman law, after being buried in oblivion for ages, came to be restored in Italy by an accident. The very books of that law were understood to be lost past recovery, till a copy of the Pandects was found in the town of Amalphi *anno* 1127,[3] by Lotharius the emperor when he took that town, in the war he carried on against Rodger king of Sicily and Naples. The knowledge of it increased so fast, that it was taught publicly by Vacarius at Oxford about the year 1150, during the reign of king Stephen.[4] This was as swift a progress as any science can be supposed to make."[5] A more recent writer has added something to the old stock of speculation. "The fortunate, or perhaps unfortunate discovery of the Roman *code*, at Amalfi in Italy, produced a great change in the institutions of almost every country in Europe. The dignified clergy of that day immediately perceived how advantageous the adoption of the regulations of Justinian would prove to them; and the popes, who then pretended to dispose of the throne of the Cæsars, were eager to support the arbitrary edicts of emperors, who, like themselves, affected to think that both their persons and their rescripts were inviolable. The neighbouring countries cheerfully submitted to the change, and thus engrafted slavery and the civil law on that even-handed Gothic jurisprudence, which had ensured freedom to all the northern nations."[6] This philosophic speculator, who thus attempts to twist a rope of sand, has not even arrived at the point of distinction between the Pandects and the Code. So true it is that when an English writer ventures to speak of the Pandects, he generally finds his way to be dark and slippery.

It was maintained by Taurellus, Augustinus, Brenkman, and other learned civilians, that all the copies of the Pandects known to be extant are derived from this famous manuscript, which was first deposited at Pisa, and afterwards removed to Florence.[7] This opinion was zealously opposed by the Abate Grandi, professor of mathematics in the university of Pisa, whose *Epistola de Pandectis* was first printed in the year 1726.[8] The course of his enquiries also led him to call in question the traditionary tale respecting the marvellous resuscitation of the Roman law after the siege of Amalfi. Various writers had incidentally maintained the opinion which he adopts; and it had recently been maintained in a separate work by D'Asti.[9] The story of the manuscript seized as a warlike booty, he treats as a mere fiction; and Muratori has remarked, that the earliest authority for this anecdote of the siege is Raynerius de Grancis, a writer of the fourteenth century. To Grandi's work, which attracted no small degree of attention, an answer was published by Bernardo Tanucci, professor of the civil law at Pisa;[10] nor was the mathematician tardy in replying.[11] Tanucci soon prepared a copious rejoinder.[12] Grandi continued the controversy, under the assumed name of Bartolo Luccaberti;[13] and his antagonist concluded his exertions, by enlarging his first epistle, and translating his second defence into Latin.[14] In these disquisitions, they were succeeded by Schwartz, a learned German, who rejected the notion that all the modern copies of the Pandects are derived from the Florentine manuscript.[15] Brenkman, who had devoted so much

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1 Voelli Bibliotheca Juris Canonici veteris, tom. ii. p. 814.

2 Heimbach de Basilicorum Origine, p. 15.—See the article Basilica, vol. iv. p. 426.

3 In the date of this grand discovery there seems to be an error of ten years, for the siege of Amalfi is commonly referred to the year 1137. See however Brenkman's *Historia Pandectarum*, p. 25, 43.

4 See Wenck's Magister Vacarius, primus Juris Romani in Anglia Professor. Lipsiæ, 1820, 8vo.

5 Kames's Essays upon several Subjects concerning British Antiquities, p. 15. Edinb. 1747, 8vo.

6 Stephens's Memoirs of John Horne Tooke, vol. ii. p. 16. Lond. 1813, 2 vols. 8vo.

7 Brenkmanni Historia Pandectarum, seu Fatum Exemplaris Florentini: accedit gemina Dissertatio de Amalphi. Traj. ad Rhen. 1722, 4to. Flaminio dal Borgo, Dissertazione sopra l'Istoria de' Codici Pisani delle Pandette di Giustiniano Imperatore. Lucca, 1764, 4to.

8 Grandi Epistola de Pandectis ad cl. virum Josephum Averanium. Editio altera, notis variis, et appendice veterum monumentorum ab auctore locupletata. Florentiæ, 1727, 4to. The first edition was published at Pisa during the preceding year. His endeavours were seconded by a learned professor of divinity at Pisa, whose work was published at Florence in 1727: "D. Virginii Valsechii Epistola de veteribus Pisanæ Civitatis Constitutis, ad clariss et reverendiss. Patrem D. Guidonem Grandi." This epistle has been reprinted by Hoffmann, *Hist. Juris Romano-Justinianei*, vol. i. app p. 185. Lipsiæ, 1726–34, 2 tom. 4to.

9 D'Asti dell' Uso e Autorità della Ragion Civile nelle Provincie dell' Imperio Occidentale dal dì che furono inondate da' Barbari sino a Lotario II. Napoli, 1720–2, 2 tom. 8vo.

10 Lucæ, 1728, 4to.

11 Grandi Vindiciæ pro sua Epistola de Pandectis, adversus inanes Querelas et Oppugnationes Bernardi Tanuccii. Pisis, 1728, 4to.

12 Tanucci, Difesa seconda dell' Uso antico delle Pandette, e del Ritrovamento del famoso Manoscritto di esse in Amalfi, contra le Vindicie del P. D. Guido Grandi, Abate Camaldolense, e Lettore di Mattematica nello Studio di Pisa, libri due. Firenze, 1729, 4to.

13 Nuova Disamina della Storia delle Pandette Pisane, e di chi prima le rammentasse, come ancora d' altre incidenti Questioni, collo Scioglimento delle Difficoltà, opposte all' *Epistola de Pandectis*, ed alle Vindicie del Rmo. P. Abate Grandi da Bernardo Tanucci, Dottore da Stia Opera di Bartolo Luccaberti, divisa in parti iv. Faenza, 1730, 4to.—Fabroni informs us that Grandi was himself the author of this work. (Vitæ Italorum Doctrina excellentium, tom. viii. p. 249.) Some writers have however supposed Luccaberti to be a real person. See Eckhardi *Hermeneutica Juris*, p. 76, edit. Walchii. Lipsiæ, 1802, 8vo.

14 Tanusii Epistola de Pandectis Pisanis, in Amalphitana Direptione inventis, ad Academicos Etruscos, in qua confutantur quæ Guido Grandius, Cremonensis Abbas, et Antecessor in Pisano Gymnasio, opposuit Francisco Taurellio et Henrico Brenemanno. Florentiæ, 1731, 4to.—The same volume, which extends to 557 pages, includes the Latin translation of his *Defesa seconda*.

15 Schwartz published a disquisition, "An omnia Pandectarum Exemplaria, quæ adhuc extant, e Florentinis manaverint." Altorfii, 1733, 4to.

time and attention to this manuscript,[1] and had formerly maintained the opposite opinion, endeavoured to refute the arguments of Schwartz as well as Grandi;[2] and the same cause, which we do not however espouse, was after a short interval defended by Guadagni, professor of the civil law at Pisa.[3] But the history of the Roman law during the middle ages has recently been investigated with so much ability, and with such perseverance of research, that on this subject the labours of all previous writers appear to be of little comparative value: Savigny's work is indeed one of the most remarkable productions of the age in which we live.[4] After many delays this work was completed in 1831, shortly before the author's death. The extinction of the Roman law with the Western Empire, and its accidental revival after the lapse of six hundred years, will henceforth be viewed as one of the numerous romances of history; but the researches of this very able man, we are sorry to add, are little known or appreciated in England, where the legend of Amalfi is permitted to retain much of its original freshness, and where historical jurisprudence is more imperfectly understood than in any other learned country of Europe. (D. I.)

CIVIL LIST. Under this term were formerly comprehended "all the heads of public expenditure, excepting those of the army, the navy, and the other military departments;" but it is now confined to the expenses proper for the maintenance of the royal household and the dignity of the crown, the amount of which is fixed by parliament on the accession of the sovereign. For particulars regarding the civil list, see ENGLAND.

CIVIL *State*, the whole body of the laity or citizens, comprehending all orders of men not included under the military, maritime, or ecclesiastical states.

CIVIL *Year*, the legal year, or annual account of time which a government appoints to be used within its own dominions; so called in contradistinction to the natural year, which is measured by the revolution of the heavenly bodies.

CIVILIAN, one who is skilled in the Roman law; a professor or doctor of civil law. It is also sometimes applied in a more extended sense to one versed in law and government.

CIVITA CASTELLANA, a fortified episcopal town of the Papal States, delegation and 17 miles E.S.E. of the city of Viterbo. Pop. 3300. It occupies the site of *Falerium Vetus*, well known in history from the celebrated story of Camillus and the schoolmaster. Portions of the ancient walls, tombs, and sepulchral chambers are still to be seen. After the destruction of this city by the Romans in B.C. 241, the second or *Falerii Novi* was built in a plain about 4 miles distant. The ruins of this town present some of the most extraordinary specimens of ancient military architecture now extant, consisting of walls nearly perfect, quadrilateral towers, and gateways; while within there are remains of an ancient theatre, &c.

CIVITA DI PENNE, a town of Naples, province of Abruzzo Ulteriore I., 10 miles W. of Pescara. Pop. 9600. Under the name of Pinna it was the chief city of the Vestini, and is celebrated in the history of the Social war for its obstinate resistance to the Roman army by which it was besieged. It has still some remains of ancient buildings, and is noted for the manufacture of artificial flowers.

CIVITA VECCHIA, a city of Italy, capital of a cognominal delegation of the Papal States, on the Mediterranean, 38 miles W.N.W. of Rome. Lat. 42. 4. 38. N., Long. 11. 44. 52. E. The town is well built, and surrounded by walls, but the streets are generally narrow. It has several churches and convents, lazaretto, theatre, arsenal, warehouses, building-docks, prisons, &c. It is the principal seaport of the Papal States; and steamers between Marseilles, Naples, and the Levant, regularly touch here, so that the arrivals and departures of steamers are seldom less than 30 a month. The harbour, originally constructed by Trajan, is formed by three moles—two projecting from the mainland, and fronted by the third, on the south extremity of which is a lighthouse, with a lantern 74 feet above the level of the sea. There are from 14 to 18 feet water in the port, and the S. entrance has from 8 to 4 fathoms. The imports are chiefly cotton, woollen, silk, and linen stuffs; coffee, sugar, and other colonial products; salt and salted provisions, wines, jewellery, glass, and earthenware. The chief exports are staves, bark, wheat, coal, wool, cheese, skins, and alum. Civita Vecchia occupies the site of the Roman *Centum Cellæ*. On the destruction of that town by the Saracens in 828, the inhabitants removed farther inland, but returned to the former site in 854. From this circumstance the city derives its name of Civita Vecchia, or old town. It was made a free port by Clement XII. Pop. 7000.

CIVRAY, an arrondissement of the department of Vienne, in France, containing 460 square miles. It is divided into 5 cantons, and these again into 48 communes, the inhabitants of which amount to 45,675. Civray, which gives its name to the arrondissement, is situated on the right bank of the Charente, in a fertile district. It contains 328 houses, and 2100 inhabitants. In the neighbourhood there are considerable quarries of marble. Long. 0. 9. E., Lat. 46. 10. N.

CLACKMANNAN, the capital of the shire of the same name, is pleasantly situated on an eminence gently rising out of a plain stretching from east to west to the height of 190 feet above the level of the Forth, and commanding an extensive view from the summit. It consists of one long street, which runs up the acclivity to the gate of the park surrounding Clackmannan tower, a tall and massive building.

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[1] Gebaveri Narratio de Henrico Brenkmanno, de Manuscriptis Brenkmannianis, et suis in Corpore Juris Civilis Conatibus et Laboribus. Accedunt Mantissa de libro longe rarissimo, *Bibliotheca Antonii Augustini*, et Vita Henrici Newtoni. Gottingæ, 1764, 4to.—With the view of studying the Florentine manuscript, Brenkman made a journey to Italy, and was enabled to obtain access to the precious relique through the influence of the English envoy Dr Newton. To this study he devoted several years, but he only lived to execute a part of his plans. Newton, who was much connected with the scholars of the age, received the honour of knighthood, and became judge of the high court of admiralty. He is the author of a collection of *Epistolæ, Orationes, et Carmina*. Lucæ, 1710, 4to. Some notices of the author may be found in Mr Dunster's edition of "Cider, a poem in two books, by John Philips," p. 174. Lond. 1791, 8vo.

[2] Brenkmanni Epistola ad v. c. Franciscum Hesselium, qua examinantur præcipua Capita Epistolæ v. c. D. Guidonis Grandi de Pandectis, nec non Dissertationis similis argumenti, auctore v. c. Christiano Gotlib. Schwarzio. Traj. ad Rhen. 1735, 4to.

[3] Guadagni de Florentino Pandectarum Exemplari, an sit Imperat. Justiniani Archetypum, et an ex eo ceteri, qui supersunt, Pandectarum libri manaverint Dissertatio. Romæ, 1752, 8vo.—This dissertation was inserted in Gori's *Symbolæ Litterariæ*, dec. ii. vol. iv.; and some copies were published in a separate form. Guadagni is likewise the author of a work entitled *Ad Græca Pandectarum Dissertationes*. Pisis, 1786, 4to.

[4] Savigny's Geschichte des Römischen Rechts im Mittelalter. Heidelberg, 1815-31, 6 Bde. 8vo. Paris, 4 vols. 1839.

A small plain immediately to the west of this tower formed the site of the palace of Robert Bruce—every vestige of which has long since disappeared. The church of Clackmannan, which is situated a little south of the principal street, is a handsome modern structure in the Gothic style. Pop. of parish (1851) 5802.

CLACKMANNANSHIRE, one of the counties of Scotland, situated between 56. 5. and 56. 14. north latitude, and between 3. 33. and 3. 56. west longitude from Greenwich. It is bounded on the south and south-west by the river Forth, which separates it from Stirlingshire, on the south-east by Fifeshire, and on every other side by Perthshire. It is the smallest county in Scotland, being little more than eight miles in length, and, at a medium, six miles and a half in breadth; thus extending over fifty-two square miles, or 33,280 acres. But its value is much greater than in the ratio of its extent. About three-fourths of its surface are under cultivation (a greater proportion, with the exception of East Lothian, than that of any other county of Scotland); and it abounds in the useful minerals, which have long been wrought upon a very extensive scale.

Between the Ochil Hills, which form the northern boundary of this district, and the rich alluvial tracts on the banks of the Forth, which winds along in a very irregular line on its opposite extremity, there is a considerable variety of surface. An elevated ridge rises on the west, and, running through the middle of the county, spreads itself gradually till it reaches the eastern boundary, skirting the alluvial or carse lands on the south, and the vale of Devon on the north. And still farther to the north, the Ochil Hills, the highest of which, Bencleuch, in the parish of Tillicoultry, rises nearly 2500 feet above the level of the sea, form a very picturesque landscape, having their generally verdant surface broken by bold projecting rocks and deeply indented ravines, the beds of many a pellucid stream, with coppice and thriving plantations occasionally interspersed. These hills protect the lower grounds from the piercing winds which blow from the north and north-east, and give Clackmannanshire some advantage, in regard to climate, over the adjoining counties.

The only streams worthy of notice which traverse this county are the Devon and the Black Devon, or, as they are often called, the North Devon and South Devon. The Devon rises in the county of Perth, and, descending with impetuosity from the Ochils, where its course is to the east, makes a very sharp turn towards the west. It then continues its course in that direction through the pleasant vale already mentioned, and falls into the Forth at the village of Cambus. Exclusive of its windings, the course of this river is more than twenty-six miles, though the distance in a direct line from its source to its embouchure does not exceed six miles. It has long been remarkable for the deep and dark chasms which it has worn in the rocks, and through which it flows in the earlier part of its course, being in some places hardly visible. The *Devil's Mill*, so called from the supposed resemblance of the sound of the water to that of machinery; the *Rumbling Bridge*, a very narrow and unguarded pass across a chasm 90 feet deep; and the *Cauldron Lynn*, where the water is perpetually agitated in the immense cauldron-like excavations which it has formed in the rock—are much visited by the lovers of natural scenery. Though this river is liable to be suddenly swelled by rains, and frequently descends in torrents overflowing its banks, it is in general of no great depth, but might be rendered navigable for small vessels at a moderate expense, to the effect of bringing 10,000 acres of coal within reach of water-carriage.

The Black Devon has its source in the county of Fife, flows westward in a direction nearly parallel to the Devon, and falls into the Forth near Clackmannan. Many mills and coal engines are set in motion by the waters of this river, whose whole course is over coal strata. In a dry season it is an inconsiderable stream, the greater part of its waters being then collected into reservoirs for the supply of machinery.

The Forth is navigable as far as it forms the boundary of this county. Ships of 500 tons burden run up as far as Alloa. Its windings, or *links* as they are called, are very remarkable. The distance from the quay of Alloa to that of Stirling, measured in the middle of the stream, is 17 miles, and to the bridge of Stirling it is 19½, whereas the distance by land from the latter place to Alloa does not exceed 7 miles. A little above Alloa there are three islets in the river, the largest containing more than 70 acres. A remarkable ledge of rock stretches across the Forth below the two smaller islets, which obstructs the passage of vessels of more than 60 tons burden, and where it is fordable at low water of spring tides. The breadth at this place being only about 500 yards, it was long since proposed to throw a bridge over it, the expense of which was estimated at L.70,000. Mr Rennie, the celebrated engineer, made a survey with a view to a bridge at the Alloa ferry, which he declared to be practicable at an expense of L.150,000; a work which has never been attempted. The passage, however, has of late been improved by means of new piers and steam-boats. The estuary of the Forth, for several miles above and below Clackmannan, exhibits a singular phenomenon in its tides, which rise there from 16 to 22 feet. During neap tides in good weather, and sometimes also during spring tides, if the weather be uncommonly fine, after the water has flowed for three hours, it retires in an hour and a half nearly as far as the line from which it had begun to flow, but returns immediately, and in an hour and a half more reaches the same height it had attained before. This flux and reflux takes place both in the flood and ebb tides, so that double the usual number of tides occur in this part of the river. In very boisterous weather, however, these *lecky tides*, as they are called by sailors, are not regular, the water then only rising without any perceptible current, as if two tides were acting against each other.

The soils of the arable land of Clackmannanshire are in general productive and well cultivated; though the greater part of the elevated range which is interposed between the carse lands on the Forth, and the vale of Devon at the base of the Ochils on the north, consists of inferior soils, often incumbent on an impervious clay. All the crops commonly raised in Scotland grow luxuriantly on either side of this tract, which also contains within itself a considerable proportion of valuable soil. From the rental of the abbacy of Cambuskenneth, founded in 1147, it appears, that wheat was cultivated on the *links* of the Forth at a very early period; yet it is certain that fifty years ago fields of this grain were only occasionally to be met with in the county. As a proof how early and well the carse lands near Alloa had been cultivated, it may be mentioned, that more than a century ago some farms in that quarter paid as much grain and other kinds of produce, in name of rent, as the present money-rent of similar soils would purchase at the average prices of the last twenty-five years. The farms would be thought small in other counties; few of the arable ones exceeding 200 Scotch or 250 English acres, and the far greater number being below 100 acres. The rent of the county was returned to the collector of the property-tax for the year ending in April 1811, at L.32,047, 12s.; so that, after making allowance for that part of the surface which is covered by water, or otherwise altogether unproductive, every acre must have paid at least 20s. upon an average of all soils and situations. At the same time, the rent of the houses was stated at L.2827, 5s. The old valuation, by which the land-tax and county rates are apportioned, is L.26,482, 10s. 10d. Scots, or L.2206, 17s. 7d.

sterling, of which somewhat more than a third belongs to estates held under entail. The richest carse land under current leases now (1854) lets for ten bushels of wheat a Scotch acre, payable by the fiars, and in the measure of the county. Good carse land commonly rents at three bolls an acre, one of which is wheat, one barley, and one oats. The first effective thrashing machine in Scotland was constructed at Kilbagie, in the parish of Clackmannan, in 1787, by Mr George Meikle, the son of its celebrated inventor; and the last one, it is believed, at which old Meikle himself worked, is on the estate of the Earl of Mar, near Alloa. One of the greatest disadvantages which the agriculture of this district labours under is the want of limestone, of which, however, very considerable quantities are brought from Rescobie limeworks, and afterwards calcined in the county, where coal is always plentiful and cheap. Limeshells are also imported to a considerable extent from the Earl of Elgin's works in Fife.

This small county is rich in minerals. Silver, copper, lead, iron-ore (*hæmatites*), cobalt, and arsenic, have all been discovered in the Ochil Mountains, between Airthry and Dollar; but, after having been wrought for a time with little success, the labour was discontinued. The operations, however, were not conducted upon an extensive scale; in no instance did the miners penetrate below the level of the plain from which the Ochils rise; and it is still believed that these hills abound in valuable metallic veins, ready to reward more skilful and enterprizing adventurers. Ironstone is wrought to a considerable extent for the Devon iron-works, in the parish of Clackmannan. It is found either in beds, or in oblate balls imbedded in slaty clay, and yields from twenty-five to thirty per cent. of iron. That obtained from the mine formerly worked at Vicar's Bridge, near Dollar, afforded, it is said, above forty per cent.

The Abbey Craig, near Stirling, a great mass of greenstone rock, crystallized in the internal structure and rudely columnar in its external appearance, deserves to be particularly noticed in this view of Clackmannanshire, from its having afforded a very useful substitute, in the manufacture of flour, for the French buhr-stones, which it was so difficult to procure during the last war. This discovery was made by a miller of the name of James Brownhill, then employed at the Alloa mills. Several hundreds of these millstones are now working both in England and Scotland, and are found to be in some respects almost equal to the buhr. The Society for the Encouragement of Arts in London presented this ingenious person with a hundred guineas for his discovery, after they had received the most satisfactory proofs of its great importance.

Coal has been wrought for two hundred years in this county. The quantity at present annually obtained may be estimated at 260,000 tons, of which a great part is shipped at Alloa, Clackmannan Pow, and Kennetpans, for foreign ports; and large quantities of coal are also now conveyed along the railways which extend to Aberdeen. In the scale of working, the collieries stand thus,—1. Alloa; 2. Clackmannan; 3. North Sauchie; 4. Tillicoultry; 5. Kennet; 6. Sheerdale. It is all bituminous or common coal of a good quality; but no smithy or caking coal has yet been discovered. The thinnest seam which has been wrought is 27 inches thick; and in a depth of 105 fathoms, there are nine seams of more than this thickness. The thickest that has yet been discovered is about seven feet. The strata which compose the coal-field are varieties of sandstone, shale, fire-clay, and argillaceous ironstone. Limestone is found among the lowest beds of the coal strata. Organic remains of shell-fish and plants abound in them; and of the latter, many are of genera now found only in the equatorial regions. Carbonic acid gas, termed chokedamp, is the most abundant of the noxious vapours found in the coal-mines of this field. Carburetted hydrogen, or inflammable air, was never known here till lately, and it is still in small quantity. The great coal-field of Scotland, which passes in a diagonal line from the mouths of the Forth and Tay to the Irish Sea, is bounded by the Ochils. No coal has been found to the north of them, excepting at Brora, in the county of Sutherland.

Machinery for drawing water from the mines was constructed and much improved in this county, before the invention of the steam-engine. The Alloa colliery is drained by an overshot water-wheel, 30 feet diameter, which lifts the water from the depth of 300 feet. The Sauchie collieries are drained by powerful steam-engines: that employed by the Devon Company, in particular, is one of great power, and is capable of drawing water from the depth of 280 feet. The Stirling and Dunfermline railway runs through the county of Clackmannan, and affords very great facilities for the transmission of goods and the conveyance of passengers. From the Devon iron-works, and the various collieries of the county, as well as from the great brick and tile works, there are railways to Alloa.

At the Alloa colliery the workmen have for a great number of years had a court composed of five of their own number, appointed annually by the proprietor of the works. By this court all differences amongst themselves are settled. The highest fine exacted is half a guinea, and all the fines are put into a general fund for the support of the poor.

Under the head of manufactures, the distilleries of this county formerly constituted by far the most prominent and considerable branch. In this small district there were 40 years ago no fewer than six large distilleries. Of these, Kilbagie and Kennetpans paid to government an excise-duty greater than the land-tax of Scotland; the former alone paying no less at one time than about half a million sterling. Previously to 1788, the quantity of grain annually consumed at Kilbagie, exceeded 60,000 bolls (45,000 quarters); while 700 cattle and 200 swine were annually fattened upon the grains and dreg. The saving in the stock of food for man effected by the stoppage of the distilleries was therefore much less considerable than had been imagined; an acre of barley used in distillation yielding nearly as much animal food as an acre of middling pasture. It is understood that cattle may be fattened in a complete manner, in the proportion of two, of 50 stones avoirdupois each, for every gallon of a still, when working from grain; affording the means, at the same time, of enriching the soil for future crops, by the abundance and good quality of the manure they produce. For several years there have been only three distilleries in the county. The manufacture of woollen goods and worsted has been long carried on in this county. The following statistics will show the importance which these manufactures have attained in Clackmannanshire. In Tillicoultry, which is the principal seat of the woollen manufacture, there were in 1851 fifteen factories containing 39 sets carding machines, &c., of which nine were self-acting mills of the largest and most approved kind. About 40,000 stones of wool were annually required for the manufactures. The power, partly water and partly steam, required for driving the whole machinery, was 184 horse-power.

In 1811, the total number of persons engaged in the factories was 836 men, 602 women, 352 children—in all 1790.

There are now in the entire county 20 woollen mills, driven by 320 horse-power, employing 2600 persons, and annually consuming 1,800,000 lb. of wool.

At the Devon iron-works, already noticed, about 112 tons of pig iron are prepared weekly, a considerable part of which is used by the foundry at these works. In the parish of Dollar, on the banks of the Devon, a bleachfield was esta-

blished in 1787, of which the water supply and the machinery are excellent. The cloth bleached here consists chiefly of the fine table-linen manufactured at Dunfermline. There is a very complete set of corn-mills at Alloa, besides other mills for various purposes in different parts of the county. In the same town and its neighbourhood there are five breweries, a glass work, a copper work, a rope and sail manufactory, a tannery, a tile and brick work; and in 1832 a steam-engine manufactory was organized.

The port of Alloa is well situated for commerce, and has a substantial well-built quay, and a little above the harbour, a dry dock capable of receiving vessels of large burden; the depth of the water at spring-tides being sixteen feet, and the width of the gates thirty-four and a half. There is a custom-house here, which comprehends the ports of Stirling and Kincardine, and Clackmannan Pow, and at which 155 vessels were registered in 1831, carrying 19,000 tons, and navigated by 1020 men. There are cleared outwards annually, on an average, from 1100 to 1200 vessels, carrying 55,000 tons, and employing about 3300 seamen; and inwards, about 700 vessels, carrying 32,000 tons, and 1800 men. The principal exports are coals, pig and cast iron, ales for London, and British spirits. The annual imports consist, for the most part, of grain for the distilleries and breweries, of which a great proportion is barley from the county of Norfolk, and goods from Leith, Glasgow, Greenock, and London. Timber, iron, and other commodities, are occasionally imported from the Baltic. Alloa is connected by railway with Stirling, Edinburgh, and Glasgow, and communicates by steam-packets with Granton near Edinburgh.

Among the antiquities of this county may be mentioned the ruins of Castle Campbell, originally called Castle Gloom, in a singularly wild and almost inaccessible situation, within a recess of the mountains, above the village of Dollar. The period of its erection and its early history are unknown. In 1465 it became the property of the Argyll family, from whom it derived its present name; and was the ordinary residence of Archibald Earl of Argyll at the time of the Reformation. In this stronghold John Knox found a temporary retreat. In 1644 it was burned by Montrose, and since that time it has been suffered to remain in ruins. The tower of Alloa, built prior to the year 1300, the residence of the Erskines, earls of Mar, now belonging to the representative of that noble family, is in good preservation. The walls are 11 feet in thickness, and the highest turret is 89 feet above the ground. The tower of Clackmannan was long the seat of the chief of the Bruces after the failure of the male line. There is a charter, dated the 9th of December 1359, quoted by Douglas, in which David II. grants to Sir Robert Bruce, whom he there styles his dearly beloved relation, the castle and manor of Clackmannan, with divers other lands within the county. Since the death of Henry Bruce of Clackmannan, in 1772, without a male representative, it has been made a question whether the Earl of Elgin or Bruce of Kennet be now the chief of that royal race.

Clackmannanshire sends a member to parliament, conjunctly with the county of Kinross. By the Reform bill, there are annexed to Clackmannanshire, for the purposes of election, the parishes of Culross and Tullyallan, formerly comprehended in the county of Perth; Alva, formerly belonging to Stirling; and the Perthshire portion of Logie. This arrangement has increased the population to 22,951 souls. Clackmannanshire thus comprehends eleven parishes, the constituency of which now amounts to 1149. There is no royal burgh in this county. Clackmannan, which gives its name to the county, is the only town in it besides Alloa deserving of notice.

There are now legal assessments for the maintenance of the poor in all the parishes of Clackmannanshire.

The numbers of houses and inhabitants for the years 1841 and 1851, are given in the subjoined table:—

Years.	Houses.			Persons.		
	Inhabited.	Uninh.	Building.	Males.	Females.	Total.
1841	3406	111	6	9,386	9,769	19,155
1851	2950	96	53	11,342	11,609	22,951

CLAGENFURT. See KLAGENFURT.

CLAGETT WILLIAM (1646-1688), an eminent divine, who was preacher to the society of Gray's Inn, and chaplain to James II. Archbishop Sharp and Bishop Burnet have both given him a high character. He published a variety of miscellaneous tracts, the principal of which is his "Discourse concerning the Operations of the Holy Spirit." Four volumes of his sermons were published after his death by his brother Nicholas Clagett, father of the bishop of Exeter of that name.

CLAIR OBSCURE. See CLARO OBSCURO.

CLAIR, ST. See CANADA.

CLAIRAULT, or CLAIRAUT, ALEXIS-CLAUDE, was born May 7, 1713, at Paris, where his father was a teacher of mathematics. Under his father's tuition he made so rapid progress in mathematical studies, that in his thirteenth year he read before the French Academy a memoir of the properties of four curves which he had then discovered. When only sixteen, he finished his treatise on *Curves of Double Curvature*, which, at its publication, two years later, procured his admission into the Academy of Sciences, although even then he was below the legal age. Having formed an acquaintance with Maupertuis, Lemonnier, and others, he began his researches on the figure of the earth, the results of which were published in 1743. In his work on this subject he promulgated his famous theorem in regard to the variation of gravity, which has been corrected by Mr Airy. In 1750 he gained the prize of the St Petersburg Academy, for his treatise on the Lunar Theory; and in 1759 calculated the perihelion of Halley's Comet. Towards the close of his life he was regarded as the great rival of D'Alembert. Clairault died at Paris, May 17, 1765. See ASTRONOMY.

CLAMECY, a small town of France, capital of a cognominal arrondissement, in the department of Nièvre, at the confluence of the Yonne and Beuvron, 38 miles N.N.E. of Nevers. Pop. (1851) 6002. It has some remains of its ancient castle, and of the massive walls by which it was formerly surrounded; several Gothic churches, a handsome modern chateau; manufactures of woollen cloths, earthenwares, paper, and leather; and a considerable trade in wood and charcoal, principally with Paris, by means of the Yonne.

CLAMPING, in joinery, the fitting of a piece of wood into a board across the grain, to prevent its warping. Clamp, in a general sense, denotes a piece of timber or iron used to fasten work together.

CLANDESTINE (Lat. *clandestinus*), secret, private, withdrawn from public view; generally used in an ill sense. Thus a marriage is said to be clandestine when performed without the publication of banns and the consent of parents or guardians. See MARRIAGE.

CLANS, in *History*, and particularly in that of Scotland, tribes or septs. The nations which overran Europe were originally divided into many small tribes; and when they came to parcel out the lands which they had conquered, it was natural for every chieftain to bestow a portion, in the first place, upon those of his own sept or family. These all held their lands of him; and as the safety of each individual depended on the general union, each small society clung together, and was distinguished by some common appellation, either patronymic or local, long before the introduction of surnames or ensigns armorial. But when these became

common, the descendants and relations of every chieftain assumed the same name and arms with him; other vassals were proud to imitate their example; and by degrees the same distinctions were communicated to all those who held of the same superior. Thus clanships were formed; and in a generation or two that consanguinity which was at first in a great measure imaginary was believed to be real. An artificial union was converted into a natural one. Men willingly followed a leader whom they regarded both as the superior of their lands and the chief of their blood; and served him not only with the fidelity of vassals, but with the affection of friends. In the other feudal kingdoms, we may observe such unions as we have described, imperfectly formed; but in Scotland, whether they were the production of chance, or the effect of policy, or strengthened by preserving genealogies both genuine and fabulous, clanships were universal. Such a confederacy might be overcome, but it could not be broken; and no change of manners or government has been able, in some parts of the kingdom, to dissolve associations which are founded upon prejudices so natural to the human mind. It is easy to imagine how formidable were nobles at the head of followers, who, counting that cause just and honourable which their chief approved, were ever ready to take the field at his command, and to sacrifice their lives in defence of his person or of his fame. Against such men a king contended with great disadvantage; and that cold service which money purchases, or authority extorts, was not an equal match for the ardour and zeal generated by this patriarchal brotherhood in arms.

Some have regarded the word *clan* as merely a corruption of the Roman *colonia;* but Whitaker considers it as purely British, signifying a *family* or sept.

CLAPHAM, a parish in Surrey, 4 miles S.W. from St Paul's, and one of the most favourite of the suburban districts around London. It has several churches and chapels; a grammar and other schools, orphan asylum, literary institute, savings-bank, &c. The common, extending over 200 acres, is planted with trees and surrounded by handsome houses, and ornamental wood. Pop. of parish (1851) 16,290.

CLAPPERTON, Hugh (1788-1827), a distinguished African traveller, was born at Annan, Dumfriesshire, where his father was a surgeon. Having acquired some knowledge of practical mathematics, including navigation and trigonometry, he was apprenticed at the age of seventeen on board a large vessel which traded between Liverpool and North America. After having made several voyages across the Atlantic, he was impressed for the navy, and sent on board the Clorinde, where his intelligence and activity soon raised him to the rank of midshipman. In 1813 he was sent with a number of others to Plymouth dockyard to be drilled in the improved cutlass exercise, and afterwards drafted on board the Asia, the flag-ship of Vice-admiral Sir Alexander Cochrane, to the crew of which, then on a voyage to Bermuda, he acted as drill sergeant. He was next ordered to the command of a flotilla on the Canadian lakes, promoted to the rank of lieutenant, and soon afterwards to the command of a schooner. In the year 1817, when the flotilla on the lakes was dismantled, he returned to his native country on half pay.

In 1820 Clapperton removed to Edinburgh, where he contracted an intimacy with Dr Oudney, who first directed his attention to the cause in which both were destined to perish. After the return of Captain Lyon, the British government determined on equipping a second expedition for the purpose of exploring northern Africa. Dr Oudney was accordingly appointed to proceed to Bornu as consul, and Captain Clapperton and Colonel Denham were added to the party. After having arrived at Tripoli, they set out early in 1822, in a line nearly south to Mourzook, where they arrived on the 8th of April. Circumstances, however, having prevented them from proceeding farther, Clapperton and Oudney made an excursion to the westward into the country of the Tuaricks, which they penetrated as far as Ghraat, E. Long. 11.

On the 29th Nov. Clapperton, with his fellow travellers, set out for the kingdom of Bornu, and on the 17th Feb. 1823 reached Kouka the capital, where they were well received by the sultan; and remaining here till the 14th Dec., they again set out for the purpose of exploring the course of the Niger. They arrived in safety at Murmur, where Oudney breathed his last in the arms of his companion. Clapperton, however, penetrated alone as far as Sackatoo, N. Lat. 13. and E. long. 6½., which was the extreme point of the expedition in that direction. Circumstances prevented him from proceeding to the Niger, which lay only five days' journey to the westward. On returning to Kouka he was rejoined by Denham, who scarcely knew his emaciated associate. The two travellers then set out for Tripoli, and thence proceeded to England, where they arrived on June 1, 1825. The results of this expedition were embodied in a work containing the travels of Denham, Clapperton, and Oudney.

Immediately after his return Clapperton accepted the conduct of another expedition to Africa, and set out in August 1825, in company with Captain Pearce, Mr Dickson, Dr Morrison, and a youth named Richard Lander as his servant. On this occasion he landed at Badagry, in the Bight of Benin, and immediately commenced his journey into the interior, along with Lander and two of the others. Both of them, however, soon fell victims to the hardships of the journey. In January 1826, Clapperton reached Katunga, the capital of Youriba, and soon afterwards crossed the Niger at Boussa, the place where Park met his untimely fate. In July he arrived at Kano, a city which he had previously visited. Here he left his servant with the baggage, and proceeded alone to Sackatoo, intending to obtain permission from Bello, the sultan of Sackatoo, to visit Timbuctoo, and revisit Bornu. But his plans were frustrated in consequence of a war which Bello was then waging with the scheik of Bornu, to whom Clapperton bore considerable presents from the king of England. While he was detained by bad health at Sackatoo, the sultan deceiving Lander persuaded him to join his master with the baggage; and on his arrival the intended presents were immediately seized, and the travellers prohibited from proceeding farther.

For some months Clapperton enjoyed tolerable health, but on 13th March 1827, having been suddenly attacked with dysentery, he lingered on till the 13th April, when he expired in the arms of his faithful servant.

Although Clapperton failed in the main object of his ambition, which was afterwards accomplished by Lander, he contributed materially to the advancement of our geographical knowledge of northern Africa. (See Africa.) On the return of Lander to England he published a work entitled "Records of Captain Clapperton's last Expedition to Africa," which appeared in 1830, in 2 vols. 12mo.

CLARE, a maritime county in the north of Munster, Ireland, is bounded N. by the bay and county of Galway, E. by Lough Derg and the river Shannon, which separate it from Tipperary, S. by the estuary of the Shannon, and W. by the Atlantic Ocean. Area, by ordnance survey, 1294 square miles, or 827,994 acres; of which 455,009 are arable, 296,033 uncultivated, 8304 in plantations, 728 in towns, and 67,920 under water.

This county presents great diversity of surface. The barony of Tulla is in part mountainous and moory, intersected in the east and south by a range of hills. Bunratty also contains much rocky ground with good herbage; and towards the southern portion of the barony, adjoining the rivers Fergus and Shannon, some of the level rich land called corcasses, strongly contrasting with the bog, marsh, and rocky pasture prevailing throughout the main portion of the

county. Inchiquin has some beautiful tracts of pasture land with moory hills, and in the eastern portion a calcareous rocky and light soil. Clonderlaw is much encumbered with moor and mountain, but capable of improvement by the application of lime, which is easily procurable. The baronies of Ibrickan, Moyferta, Islanas, and Corcomroe are also within reach of the means of improvement, and in some parts stand much in need of them. Burren produces a short sweet herbage, fit for sheep of middling size and short wool; but it is extremely rocky, the entire surface of the central portion of the barony appearing as one unbroken mass of mountain limestone resembling some of the neighbouring portion of the adjoining county of Galway, of which Oliver Cromwell characteristically remarked that it had not sufficient wood to hang a man, water to drown him, or earth to bury him.

Although the surface of the county is hilly, and in some parts even mountainous, it nowhere rises to a great elevation. Much of the western baronies of Moyarta and Ibrickan is composed of bog land. Bogs are frequent also in the mountainous districts elsewhere, except in the limestone barony of Burren, the inhabitants of some parts of which supply themselves with turf from the opposite shores of Connemara. Generally speaking, the eastern parts of the county are mountainous, with tracts of rich pasture land interspersed; the west abounds with bog; and the north is rocky and best adapted for grazing sheep. In the southern part, along the banks of the Fergus and Shannon, are the bands of rich low grounds called corcasses, of various breadth, indenting the land in a great variety of shapes. They are composed of deep rich loam, and are distinguished as the black corcasses, adapted for tillage, and the blue, used more advantageously as meadow land.

The coast is in general rocky, and occasionally bold and precipitous in the extreme, as may be observed at the picturesque cliffs of Moher within a few miles of Ennistymon, which rise perpendicularly at O'Brien's tower to an elevation of 580 feet. The coast of Clare is indented with several bays, the chief of which are Ballyvaghan, Liscannor, and Malbay; but from Black Head to Loop Head, including the entire western boundary of the county by the Atlantic, there is no safe harbour for a vessel except Liscannor Bay. The county possesses only one large river, the Fergus; but nearly 100 miles of its boundary line are washed by the river Shannon, which, after almost dividing Ireland from north to south, and dispensing its bounties to the adjoining counties of Roscommon, Leitrim, Longford, Westmeath, Galway, King's County, Kerry, Tipperary, and Limerick, enters the Atlantic Ocean between this county and Kerry. The numerous bays and creeks on both sides of this noble river render its navigation safe in every wind; but the passage to and from Limerick is often tedious, and the port of Kilrush may reasonably be expected at some future period to rise in importance under favourable circumstances. The river Fergus is navigable from the Shannon to the town of Clare, which is the terminating point of its natural navigation, the port of all the central districts of the county, and which ought to have been the county town. There are no canals in the county; but a railway from Limerick to Ennis, a distance of 26½ miles, is in progress.

There are upwards of one hundred lakes and tarns in the county, of which the largest are Loughs O'Grady, Graneg, Tedane, Inchiquin, Inniscronan, and Clonlea; but they are more remarkable for picturesque beauty than size or utility, with the exception of the extensive and navigable Lough Derg, formed by the river Shannon between this county and Tipperary. Lough Derg is the largest lake in the whole tract of the Shannon, and one of the finest in Ireland. Besides the perennial lakes, there are many temporary or periodical accumulations of water either forced upwards from under ground of a higher level, or produced by surface water draining down from more elevated spots These dry up in summer, and are called turloghs or loghans On the subsiding of the water, its place is supplied by a copious growth of fine grass, affording pasturage to numerous flocks and herds. These turloghs admit of easy drainage.

Although mineral and metallic substances have been found in many places throughout the county, they do not often show themselves in sufficient abundance to induce the application of capital for their extraction. The principal are lead, iron, and manganese. Lead mines are worked at Kilbricken in the barony of Bunratty (about six miles from Ennis), and at Annaglough. The Milltown lead mine in the barony of Tulla is probably one of the oldest mines in Ireland, and at one time, if the extent of the ancient excavations may be taken as a guide, there must have been a very rich deposit. The richest lead mine in Clare now is the Ballyhickey mine, about 2 miles from Kilbricken. Copper pyrites occurs in several parts of Burren, but in small quantity. Coal has been discovered, but the seams are too thin to warrant the expectation of profit from their being wrought. Limestone occupies all the central and northern parts of the county in a tract bounded on the S. by the Shannon, on the E. by a line running parallel with the Ougarnee river to Scariff Bay, on the N. by the mountain of Talla and the confines of Galway, on the W. by Galway Bay and a line including Kilfenora, Corofin, and Ennis, and meeting the Shannon at the mouth of the Fergus. Within half a mile of the Milltown lead mine are immense natural vaulted passages of limestone, through which the river Ardsullas winds a singular course; and in the grounds of Kiltannon, the residence of James Molony, Esq., the Affic rivulet, one of the numerous tributaries of the Fergus, "dips beneath the surface, and flows for a considerable distance through the caverned limestone; and along its margin paths have been formed to show the limpid water and the singularly fantastic rock—sufficient light being admitted through the natural chinks and apertures of the cavern." The lower limestone of the eastern portion of the county has been found to contain several very large deposits of argentiferous galena. Flags, easily quarried, and raised in blocks or slabs of considerable size, are procured near Kilrush. Thin flags, used for covering houses, are raised near Ennistymon; as are slates for the same purpose in several places, the best being those of Broadford and Killaloe, which are nearly equal to the finest procured in Wales. A species of very fine black marble has been discovered near Ennis; it takes a high polish, and is free from the white spots with which the black Kilkenny marble is marked.

The mineral springs, which are found in many places, are chiefly chalybeate. That of Lisdownvarna, about 8 miles from Ennistymon, has long been celebrated for its medicinal qualities, particularly in biliary obstructions: it is ferruginous, with an astringent taste, and a strong yet not fetid smell. It possesses the additional advantage of being contiguous to the sea, thus affording the valetudinarian the option of sea-bathing if deemed advisable. There are chalybeate springs of less note at Scool, Cloneen, Kilkishen, Burren, Kilcoran, Broadford, Lahinch, Kilkee, Kilrush, Killadysart, and Cassino, near Miltown Malbay. Springs called by the people "holy" or "blessed" wells, generally mineral waters, are common; but the belief in their power of performing cures in inveterate maladies is nearly extinct.

The Atlantic Ocean and the estuary of the Shannon afford many situations admirably adapted for summer bathing places. Among the best frequented of these localities are Burren, Miltown Malbay, one of the best beaches on the western coast, Lahinch, about 2 miles from Ennistymon, and near the interesting cliffs of Moher, with a magnificent and unrivalled beach, on Liscannor Bay, exposed to the full sweep of the western blast, but a delightful summer resi-

dence; also Kilkee, the most fashionable resort for sea bathing on all the western coast of Ireland, and Kilrush on the Shannon estuary.

The climate is healthy. The strong gales from the Atlantic, though unfriendly to planting, insomuch that trees sixty miles inland, if not sheltered, incline towards the east, seem to produce no injurious effects on the human constitution. Yet low fevers are common, and often pass through whole parishes, cutting off numbers. Their frequency and malignity are attributed more to the slovenly habits and want of cleanliness too prevalent among the peasantry, than to any insalubrity in the climate. The use of ardent spirits and insufficient drainage of the land also contribute their baleful agency to increase the extent and virulence of these epidemics; but there is little reason to doubt that were these causes removed, the fevers which have been banished from the fens of Lincolnshire might also be expelled from the county of Clare.

The greater portion of Ireland is bare of wood, but in no part of the country is this barrenness more extreme and apparent. Many square miles present themselves to the view with scarcely the vestige of a tree to vary the monotony of the scene. Many tracts, however, now bare of timber, and affording but a scanty herbage for sheep, and which were once covered with woods, would again be clothed with abundant and profitable wood if properly nurtured and protected from the invasion of sheep and goats. At present plantations are mainly confined to the demesnes and ornamental grounds of the gentry.

The county of Clare which is divided into 11 baronies contains 80 parishes, and includes the diocese of Kilfenora, the greater part of Killaloe, and a very small portion of the diocese of Limerick. It is within the military district of Limerick, with barracks for infantry at Clare Castle, Ennis, Killaloe, and Kilrush; for artillery, in the forts at Scattery Island, Donnaha, Kilcredano, Blackwater, and Kilkerrin. The constabulary force consists of 399 men and officers, with headquarters at Ennis; and nine districts comprise 56 stations at Ennis, Kilrush, Corofin, Killaloe, Ennistymon, Killadysart, Tulla, Newmarket, and Broadford. There are also four revenue police stations, and nine coast-guard stations in the county. The assizes are held at Ennis, where the county prison, the county infirmary, and the district lunatic asylum, are situated. The only savings-bank in the county is at Ennis. There are eight poor-law unions, most of them unfortunately distinguished as having been among the most distressed unions in Ireland.

The amount of property in the county valued under the act 6th and 7th Will. IV., cap. 84 (Griffith's valuation), is L.313,801, and the net annual value of property rated to the poor in the county is L.209,656;—the difference in these valuations having probably arisen from a desire to make the poundage of the rates for the relief of the poor appear excessive, with the object of obtaining more assistance from the fund raised in the more prosperous districts of Ireland, under the name of a rate in aid of distressed unions. The chief towns are Ennis, the county town, situated at the junction of the Clareen and the Fergus, with a population in 1851 of 8623; Kilrush, population 4471; Ennistymon, population 1741; and the ancient and thriving little town of Killaloe, the headquarters of the Inland Steam Navigation Company, with a population of 2230. The county returns three members to the imperial parliament—two for the county at large, constituency under 13th and 14th Vict., cap. 69, in 1853, 3144—and one for the borough of Ennis, constituency 149.

By Ptolemy the inhabitants of this neighbourhood are called Gangani, and are supposed to have been descended from the Concani of Spain.

This county, together with some of the neighbouring district, was anciently called Thomond or Tuadmuin, that is North Munster, and formed part of the monarchy of the celebrated Brian Boroihme, who held his court at Kincora near Killaloe, where his palace was situated on the banks of the Shannon. The site is still distinguished by extensive earthern ramparts. Settlements were effected by the Danes; and in the thirteenth century by the Anglo-Normans, but without permanently affecting the possession of the district by its native proprietors. In 1543 Murrogh O'Brien, after dispossessing his nephew, and vainly attempting a rebellion against the English rule, proceeded to England, and submitted to Henry VIII., resigning his name and possessions. He soon received them back by an English tenure, together with the title of Earl of Thomond, on condition of adopting the English dress, manners, and customs, and maintaining no kerns or gallowglasses. In 1565 this part of Thomond (sometimes called O'Brien's country) was added to Connaught, and made one of the six new counties into which that province was divided by Sir Henry Sidney under the act 11th Elizabeth, cap. 9. It was then named Clare, probably from the name of an English adventurer Thomas de Clare, who obtained a grant from Henry III. of all the lands he should conquer from the Irish, and whose family for some time maintained a precarious position in the district. In 1602 the county was re-annexed to Munster. The O'Briens and other native chieftains had many fierce contests to preserve their independence against the Anglo-Norman and English adventurers, and generally succeeded in maintaining their position as native kings and chieftains of Thomond. From some cause or other the comparative immunity of Clare in ancient times from foreign rule and settlement, and from absenteeism, has proved of doubtful advantage to its modern condition, which has until lately been characterized by extreme social disorganization frequently exhibited in systematic agrarian outrage. The chief ancient families of note in the district were the O'Briens, now represented by the Marquess of Thomond and the O'Briens of Dromoland, of which family are Sir Lucius O'Brien, Bart., who is a lineal descendant of the famous Brian Boroihme; the Macnamaras, now represented by Major Macnamara, formerly M.P. for the county; and the O'Loghlens, of which family is Sir Colman O'Loghlen, Bart.

The county abounds with remains of antiquities, both military and ecclesiastical. Of the former there were lately visible 119 fortified castles, seven of which were inhabited. They are mostly of small extent, a large portion being fortified dwellings. The chief of them is Bunvatty Castle, built in 1277. Raths or Danish forts are to be found in every part. They are generally circular, composed either of large stones without mortar, or of earth thrown up and surrounded by one or more ditches. The list of abbeys and other religious houses formerly flourishing here (some now only known by name, but many of which survive in ruins) comprehends upwards of twenty. The most remarkable are—Quin, said to be one of the finest and most perfect specimens of ancient monastic architecture in Ireland; Corcomroe; Ennis, in which is a very fine window of uncommonly elegant workmanship; and those on Inniscattery, or Scattery Island in the Shannon, said to have been founded by St Senanus. In the island on which, according to tradition, in the time of St Senan, and before the arrival of the Danes, no woman was permitted to land, is a round tower, and the ruins of what are called the seven churches: it is called Holy Island, and is still much frequented by pilgrims. St Senan is often called Saint Shannon; and the boatmen of the neighbourhood reluctantly venture on the management of a vessel which had not made a pilgrimage round his "Sainted Isle," or had not a stone in her keel from the holy strand to keep her from sinking. Scattery Island is one of the most popular burial places in the county, but as it is difficult of access in stormy weather, burials take place at Shanahill near Kilrush, in the belief that all bodies buried at this latter place are miraculously conveyed under the bed of the river into the holy

Clare.

ground of Inniscattery. Kohl remarks that there is no other country in Europe where there are such interesting cemeteries as in Ireland, partly on account of the abundance of ivy, and partly on account of the practice that still prevails of burying the dead among ruins. Four other round towers are to be found in various stages of preservation—at Drumcliffe, Dysert, Kilnby, and Inniscaltra. The cathedral of the diocese of Killaloe, at the town of that name, is a plain massive building originally erected in 1160; and near it are the ruins of the mausoleum of Brian Boroihme. Cromlechs are found chiefly in the limestone rocky district of Burren, though there are some in other baronies. That at Ballygannor is formed of a stone forty feet long and ten broad. The celebrated tomb of Conan, on Mount Callan, is still extant.

Although the soil and surface of the country is in general better adapted for grazing than tillage, yet in the richer lands the latter is extensively carried on. Spade culture is still practised in some parts, and little attention is given to the proper rotation of crops. Husbandry, however, is improving, and will improve in proportion as the prejudices and corruption of former times decline. The diminution in the numbers of the population, and the establishment of a system of poor law, will facilitate and force on both industrial and social amelioration in this district.

In the year 1847 the number of farms or holdings, according to the agricultural returns, was 32,133; which number had declined in 1852 to 16,832. This diminution in the number of farms had been accompanied by a decreased growth of wheat, the ground under that crop in 1847 being 24,308 acres, whilst in 1853 only 7445 acres of wheat were cultivated. The cultivation of potatoes has increased in the same period from 6129 to 31,240 acres. The total extent of land under crops in 1853 was 165,384, viz., wheat 7445, oats 43,382, barley, beans, pease, &c., 18,748, potatoes 31,240, turnips 9664; other green crops 3045; flax, 1007, meadow and clover 50,853. The live stock of the county in 1853 numbered 14,235 horses, 8602 mules and asses, 124,089 cattle, 102,145 sheep, 40,155 pigs, 13,985 goats, and 254,612 poultry, of the total value of L.1,108,954. The live stock of this county in 1849 was valued at L.822,747. Dairies were formerly more numerous than at present, when simple grazing is found more profitable. It cannot be said that there are any manufactures in the county of Clare, although flannels and friezes are made for home use. Hosiery of various kinds, chiefly coarse and strong, is made around Corofin, Ennistymon, and other places; but at present no particular manufacture is attempted on a large scale.

The fishery districts of Kilrush and Seafield extend from Limerick to Blackhead, and comprise 193 miles of maritime boundaries, which in 1853 had 217 registered fishing vessels, employing 1057 men and boys; and the inhabitants of Burren share in the rich fisheries of Galway Bay. The Shannon west of Scattery Island, and the sea along the coasts, are good fishing stations, abounding with cod, haddock, ling, soles, turbot, ray, mackerel, and other fish; but the rugged nature of the coast and the tempestuous sea render this district of comparatively small value for the purposes of navigation and commerce. Near Pooldoody is the great Burren oyster bed, called the Red Bank, where a large establishment is maintained, and from which a constant supply of the excellent Red Bank oysters is furnished to the Dublin and other large markets. Crabs and lobsters are caught in great plenty on the shores of the bay of Galway in every creek from Blackhead to Ardfry. The salmon fishery of the Shannon is very considerable, and eels form another important article of consumption; they abound in every rivulet, and the eel weirs have been charged with being mainly instrumental in causing great damage to the neighbouring lands by obstructing the passage of the waters of the streams.

In 1852 the number of children on the rolls of the national schools for the six months ending the 31st March, was 16,839; of which number 16,654 were Roman Catholics, 125 belonged to the Established church, and the religion of the remainder (60) was not stated in the return.

Clare ‖ Clarification.

According to the latest returns, the state of instruction among the population above the age of five years in the county of Clare, was as follows:—

	Rural Districts.	Civic Districts.	Total.	Proportion per cent. in 1851.	Proportion per cent. in 1841.
Could read and write	17,339	2387	19,726	20	14
Could read only	12,699	1088	13,787	14	14
Could neither read nor write	61,819	4309	66,128	66	72

The population of the county at different periods has been ascertained to be—

Year.	No.	Increase.	Decrease.
1821	208,089	..	...
1831	258,322	50,233	...
1841	286,394	28,072	...
1851	212,428	.	73,966

The decrease of the population is supposed to have taken place in the five years preceding 1851, during which period 25 per cent. of the population of Clare was destroyed by famine and consequent pestilence, or removed by emigration. (H. S—R.)

Clare, or Claremorris, a market-town of Ireland, county of Mayo, 15 miles S.E. of Castlebar. It is neat and well built; and has a court-house, church, 2 chapels, dispensary, union work-house, and an active retail trade. Pop. (1851) 2062, including 500 in workhouse.

Clare Island. See Mayo.

CLARENCIEUX, the second king at arms. See Herald.

CLARENDON, Constitutions of, certain declaratory ordinances made in the reign of Henry II., in a parliament held at Clarendon in Wiltshire, A.D. 1164, by which the power of the pope and his clergy was checked, and the total exemption they claimed from secular jurisdiction greatly narrowed.—(Howell's *State Trials*, vol. ii. p. 546.)

Clarendon, *Earl of.* See Hyde.

CLARET. See Wine-making.

CLARI, Giovanni Carlo Maria, chapel-master at Pistoja, was born at Pisa in 1669. The time of his death is unknown. He was the most celebrated pupil of Colonna, chapel-master of S. Petronio, at Bologna. (See Colonna.) The works by which Clari distinguished himself pre-eminently are his vocal duets and trios, with a continued bass, published in 1720. In these beautiful and learned compositions, the tonal responses and modulations are in the modern style. An edition of these duets and trios, with a pianoforte accompaniment, was published at Paris in 1823, by Mirecki, a Polish musician, and pupil of Cherubini. In such esteem were these compositions held by Cherubini, that, in the course of his studies, he had repeatedly transcribed them with his own hand, as models of excellence. Clari composed one Opera, *Il Savio Delirante;* and for the church, a *Stabat,* and four other works. (G. F. G.)

CLARICHORD, or Clavichord, an old musical instrument of the spinet kind.

CLARIFICATION, the act of clearing; particularly the clearing or fining of liquids from feculent matter by the separation of the insoluble particles. This is performed by depuration, filtration, or coagulation.

The substances usually employed for clarifying liquors are the albumen of eggs, blood, and isinglass. The first two are used for such liquors as are clarified whilst boiling hot; the last for those which are clarified in the cold state, such as wines, &c. The whites of eggs are beaten up into a froth and mixed with the liquor, when they unite with and entangle the impure matters that float in it; and, presently

coagulating by the heat, carry these impurities up to the surface in the form of scum. Blood operates in the same manner. Isinglass is much employed for fining wines. For this purpose, about a quarter of an ounce may be thrown into the cask; or the isinglass may be previously dissolved and boiled down to a slimy consistence. It is then mixed with the liquor by rolling the cask about; after which it is allowed to settle.

CLARIGATIO, in *Roman Antiquity*, a ceremony observed in the proclamation of war. Four heralds being chosen from among the fetiales (a college of priests who acted as guardians of the public faith), one of their number was deputed to act as their representative. This individual, who was styled *pater patratus*, was crowned with the sacred herbs, and sent to the confines of the hostile state; and there, having called the gods to witness that his complaints were just, he demanded redress for the injury sustained. If the offending state failed to comply with his demands within the period stipulated, which was usually thirty or thirty-three days, the herald again proceeded to their frontiers; and hurling a bloody spear within their confines, pronounced a solemn declaration of war. In after times, when war was declared against a distant nation, this ceremony was performed in a field designated Ager Hostilis, near Rome.

CLARINET. See Music, § *Musical Instruments*, and *Appendix* to Music.

CLARION, a small kind of trumpet.

CLARISSES, an order of nuns, so called from their founder St Clara. She was born at Assisi in Italy; and having dedicated herself to religion, founded this order in the year 1212. It comprehends not only those nuns who follow the rule of St Francis to the letter, but likewise those who observe the same rule as modified by several popes. After the conquest of Mexico by Fernando Cortez, Isabella of Portugal, wife of the emperor Charles V. sent thither some nuns of this order, who founded communities of Indian young women, and instructed them in religion, and in such accomplishments as were suitable to their sex. These communities were very considerable—usually consisting of 400 or 500 individuals.

CLARKE, Adam, LL.D., a learned scholar and biblical critic, born of humble parents in 1762, and bred up as a minister among the Wesleyan Methodists. His early education was very limited; but by perseverance and industry he surmounted all obstacles, and became remarkable for the variety and extent of his literary acquirements, on which account he received from the university of St Andrews first the degree of M.A., and afterwards that of LL.D. In 1802 he published an excellent Bibliographical Dictionary in six vols., by which he acquired much reputation. He was then selected by the Record Commission to be the editor of *Rymer's Fœdera*. But his great work, to which all his studies had been more or less preparatory, was his English version of the Holy Scriptures—which excited much attention from the novelty of some of the opinions he entertained, especially as to the fall of our first parents. The first volume appeared in 1810; the eighth and last in 1826. Dr Clarke fell a victim to the Asiatic cholera in 1832.

Clarke, *Edward Daniel*, a celebrated traveller and philosopher, was born at Willingdon, Sussex, June 5, 1769. He received his education at Uckfield, and at the grammar-school of Tunbridge; but he does not appear to have made very satisfactory progress. In 1786 he obtained the office of chapel clerk at Jesus College, Cambridge, but the loss of his father at this time involved him in many difficulties. In 1790 he took his degree, and soon after became private tutor to the Honourable Henry Tufton, nephew to the Duke of Dorset. In 1792 he obtained an engagement to travel with Lord Berwick, through Germany, Switzerland, and Italy; and was thus fortunately enabled to gratify that passion for travelling which had long predominated in his mind over every other. After crossing the Alps and visiting a few of the principal cities of Italy, including Rome, he repaired to Naples, where he remained nearly two years. During his stay he made several excursions to Vesuvius, in one of which he narrowly escaped the fate of Pliny the Elder, having ascended to the edge of the crater during an eruption.

Mr Clarke finally returned to England in the summer of 1794, having been disappointed in the expectation of undertaking a journey to Egypt and the Holy Land. After unsuccessfully attempting a periodical work, he became tutor in several distinguished families, and studiously kept up the practice of journalizing even during short excursions. In 1799 he set out with Mr Cripps, a gentleman of fortune, on a tour through the continent of Europe. From Cambridge they proceeded direct to Norway and Sweden; thence through Russia and the Crimea to Constantinople, Rhodes, and afterwards to Egypt—where, however, their stay was short, as that country was still in the hands of the French. From Egypt they set out for Palestine; and, after visiting Jerusalem, Nazareth, Bethlehem, and other places of interest, they returned to Aboukir Bay. Subsequent to the capitulation of Alexandria, Mr Clarke was of considerable use in securing for England the statues, sarcophagi, maps, manuscripts, &c., which had been collected by the French savans. Greece was the next country visited by the two friends. From Athens they proceeded by land through ancient Thrace to Constantinople; and, after a short stay in that city, directed their course homewards through Rumelia, Austria, Germany, and France, and arrived in England after an absence of three years and a half.

Clarke, who had now obtained considerable reputation, took up his residence at Cambridge, and there continued chiefly to reside till the day of his death. He received the degree of LL.D. shortly after his return, on account of the valuable donations, including a colossal statue of the Eleusinian Ceres, which he had made to the university. In 1805 he published a "Dissertation on the Sarcophagus in the British Museum," and endeavoured, with much ingenuity, to show that it was the coffin of Alexander the Great; but the deciphering of the hieroglyphics upon it since Dr Clarke's time has proved that it was the soros of a monarch named *Her-necht-hebi* (*Amyrtæus*), of the twenty-eighth dynasty. Towards the end of 1808 Dr Clarke was appointed to the professorship of mineralogy, then first instituted. Nor was his perseverance as a traveller otherwise unrewarded. The MSS. which he had collected in the course of his travels were sold to the Bodleian Library for L.1000; and by the publication of his travels he realized altogether a clear profit of L.6595.

Besides lecturing on mineralogy and discharging his clerical duties, Dr Clarke eagerly prosecuted the study of chemistry, and made several discoveries, principally by means of the gas blow-pipe which he had brought to a high degree of perfection. His health, however, soon began to give way under ardent study and long-continued excitement; and after a short illness he expired at London, March 9, 1821. He was buried in Jesus College, Cambridge, where his fellow-collegians erected a monument to his memory. In all the relations of life Dr Clarke was a most amiable man. The leading qualities of his mind were enthusiasm and benevolence, united with a characteristic capacity of enduring long-continued mental as well as physical exertion. The following are his principal works:—

Testimony of different Authors respecting the Colossal Statue of Ceres placed in the vestibule of the Public Library at Cambridge, 8vo, 1801–1803; *The Tomb of Alexander, a Dissertation on the Sarcophagus brought from Alexandria, and now in the British Museum*, 4to, 1805; *A Methodical Distribution of the Mineral Kingdom*, fol., 1807; *A Letter to the Gentlemen of the British Museum*, 4to, 1807; *A Description of the Greek Marbles brought from the shores of the Euxine, Archipelago, and Mediterranean, and deposited in the vestibule of the University Library, Cambridge*, 8vo, 1809; *Travels in various Countries of Europe, Asia, and Africa—Part I., containing Russia, Tar-*

tary, and Turkey, 4to, 1810—*Part II., containing Greece, Egypt, and the Holy Land*, section first, 4to, 1812; section second, 1814. the last volume was published in 1819 In this year also appeared his octavo volume on the Gas Blow-pipe; and in the year following a Dissertation on the Litnus. Besides these works, Dr Clarke wrote a number of articles for scientific journals.

CLARKE, *Dr Samuel* (1599-1682), a preacher and writer of considerable note in the reign of Charles II. was, during the interregnum, and at the time of the ejection, minister of St Dennet Fink, in London. In November 1660, he, in the name of the Presbyterian ministers, presented an address to the king for his declaration of liberty of conscience; and he was also one of the commissioners of the Savoy. He was the author of *A Looking-Glass for Saints and Sinners; The Marrow of Ecclesiastical History; A General Martyrology;* and the *Marrow of Divinity.*

CLARKE, *Samuel*, the son of the former, was fellow of Pembroke-hall, Cambridge, but was ejected from his fellowship and his living during the commonwealth for refusing to take the oaths. He was the author of *Annotations on the Bible*, and died in 1701.

CLARKE, *Dr Samuel*, a celebrated English philosopher and divine, was the son of Mr Edward Clarke, alderman of Norwich, and who had represented that city in parliament for several years. He was born October 11, 1675; and having finished his education at the free school of Norwich in 1691, removed thence to Caius College, Cambridge, where his uncommon abilities soon began to display themselves. Though the philosophy of Descartes was at that time the reigning system at the university, yet Clarke easily mastered the new system of Newton, and contributed greatly to the spread of the Newtonian philosophy by publishing an excellent translation of Rohault's *Physics* with notes, which he finished before he was twenty-two years of age. The system of Rohault was founded entirely upon Cartesian principles, and was previously known only through the medium of a rude Latin version. Clarke not only gave a new translation, but added to it such notes as were calculated to lead students insensibly to other and truer notions of science. "The success," says Bishop Hoadley, "answered exceedingly well to his hopes; and he may justly be styled a great benefactor to the university in this attempt." It continued to be used as a text-book in the university till supplanted by the treatises of Newton, which it had been designed to introduce. Whiston relates that, in 1697, he met young Clarke (at that time chaplain to Moore, bishop of Norwich), then wholly unknown to him, at a coffeehouse in that city, where they entered into conversation about the Cartesian philosophy, particularly Rohault's *Physics*, which Clarke's tutor, as he tells us, had put him upon translating. "The result of this conversation was," says Whiston, "that I was greatly surprised that so young a man as Clarke then was should know so much of those sublime discoveries, which were then almost a secret to all but to a few particular mathematicians. Nor do I remember," continues he, "above one or two at the most, whom I had then met with, that seemed to know so much of that philosophy as Clarke." This translation of Rohault was first printed in 1697, 8vo. There have been four editions of it: the last and best is that of 1718, which has the following title: *JACOBI ROHAULTI Physica. Latine vertit, recensuit, et uberioribus jam Annotationibus, ex illustrissimi Isaaci Newtoni Philosophia maximam partem haustis, amplificavit et ornavit S. Clarke, S. T. P. Accedunt etiam in hac quarta editione novæ aliquot tabulæ æri incisæ et Annotationes multum sunt auctæ.* It was translated into English by Dr John Clarke, dean of Sarum, and published in two vols. 8vo.

Clarke afterwards turned his thoughts to divinity; and in order to qualify himself for the sacred office, devoted himself to the study of Scripture in the original, and of the primitive Christian writers. Having taken holy orders, he became chaplain to Moore, bishop of Norwich, who was ever afterwards his constant friend and patron. In 1699 he published two treatises; one entitled "Three practical Essays on Baptism, Confirmation, and Repentance;" and the other, "Some Reflections on that part of a book called Amyntor, or a Defence of Milton's Life, which relates to the Writings of the Primitive Fathers, and the Canon of the New Testament." In 1701 he published "A Paraphrase upon the Gospel of St Matthew;" which was followed, in 1702, by the "Paraphrases upon the Gospels of St Mark and St Luke," and soon afterwards by a third volume upon St John. They were subsequently printed together in two volumes 8vo; and have since passed through several editions. He intended to have treated in the same manner the remaining books of the New Testament, but something accidentally interrupted the execution of his design.

Meanwhile Bishop Moore gave him the rectory of Drayton, near Norwich, and procured him a parish in the city. In 1704 he was appointed to the Boyle lectureship, and chose for his subject the Being and Attributes of God. Having been appointed to the same office in the following year, he chose for his subject the Evidences of Natural and Revealed Religion. These lectures were first printed in two distinct volumes; but were afterwards collected together, and published under the general title of "A Discourse concerning the Being and Attributes of God, the Obligations of Natural Religion, and the Truth and Certainty of the Christian Revelation, in opposition to Hobbes, Spinoza, the author of the Oracles of Reason, and other Deniers of Natural and Revealed Religion." (For an account of Clarke's famous argument, and his metaphysical speculation generally, see DISSERTATION I., vol. i., pp. 139-151; and in an ethical point of view, see DISSERTATION II., vol. i., pp. 343-347.)

In 1706 he wrote a refutation of some positions which had been maintained by Dr Dodwell on the immortality of the soul; and this drew him into the controversy with Collins, of which an account is given in the same DISSERTATION. He also at this time wrote a translation of Newton's Optics, for which the author presented him with L.500. In the same year also, through the influence of Bishop Moore, he procured for him the rectory of St Bennet's, Paul's Wharf, London; and soon afterwards appeared at the court of Queen Anne, who appointed him one of her chaplains in ordinary; and afterwards, in 1709, presented him to the rectory of St James's, Westminster. On his elevation to this latter office, he took the degree of doctor in divinity, defending as his thesis the two questions: 1. *Nullum fidei Christianæ dogma, in Sacris Scripturis traditum, est rectæ rationi dissentaneum;* no article of the Christain faith, delivered in the Holy Scriptures, is disagreeable to right reason: 2. *Sine actionum humanarum libertate nulla potest esse religio;* without the liberty of human actions, there can be no religion. During the same year, at the request of the author, he revised and corrected Whiston's English translation of the Apostolical Constitutions.

In 1712 he published a carefully punctuated and annotated edition of Cæsar's Commentaries, adorned with elegant engravings. It was printed in folio, 1712, and afterwards in 8vo, 1720, and dedicated to the Duke of Marlborough. During the same year he published his celebrated treatise on *The Scripture Doctrine of the Trinity.* It is divided into three parts. The first contains a collection and exegesis of all the texts in the New Testament relating to the doctrine of the trinity; in the second the doctrine is set forth at large, and explained in particular and distinct propositions; and in the third, the principal passages in the liturgy of the Church of England relating to the doctrine of the trinity are considered. Whiston informs us, that some time before the publication of this book, a message was sent to him from Lord Godolphin and

other ministers of Queen Anne, importing "That the affairs of the public were with difficulty then kept in the hands of those that were for liberty; that it was therefore an unseasonable time for the publication of a book that would make a great noise and disturbance; and that therefore they desired him to forbear till a fitter opportunity should offer itself," a message that Clarke of course entirely disregarded. The ministers were right in their conjectures; and the work not only provoked a great number of replies, but occasioned a formal complaint from the lower house of convocation. Clarke, in reply, drew up an apologetic preface, and afterwards gave several explanations, which satisfied the upper house; and having pledged himself that his future conduct would occasion no trouble, the matter dropped.

In 1715 and 1716, he had a discussion with Leibnitz relative to the principles of natural philosophy and religion, which was at length cut short by the death of his antagonist. A collection of the papers which passed between them was published in 1717. In 1719 he was presented by Lord Lechmere to the mastership of Wigston's hospital in Leicester. In 1724 he published seventeen sermons, eleven of which had not before been printed. In 1727, upon the death of Sir Isaac Newton, he was offered by the court the place of Master of the Mint, worth on an average from L.1200 to L.1500 a year. This secular preferment, however, he absolutely refused,—a circumstance which Whiston regards as "one of the most glorious actions of his life, and affording undeniable conviction that he was in earnest in his religion." In 1728 was published "A Letter from Dr Clarke to Benjamin Hoadley, F.R.S., occasioned by the controversy relating to the Proportion of Velocity and Force in Bodies in Motion;" printed in the Philosophical Transactions. In 1729 he published the first twelve books of Homer's Iliad. This edition was printed in quarto, and dedicated to the Duke of Cumberland. "The translation of Homer, who was Clarke's favourite author," says Bishop Hoadley, "with his corrections, may now be styled accurate; and his notes, as far as they go, are indeed a treasury of grammatical and critical knowledge. He was called to his task by royal command, and he has performed it in such a manner as to be worthy of the young prince for whom it was laboured." The year of its publication was the last of Clarke's life. Hitherto, though not robust, he had always enjoyed a firm state of health; but on the morning of Sunday, 11th May 1729, when going out to preach before the judges at Sergeant's Inn, he was seized with a sudden illness, which caused his death on the Saturday morning following. He died, May 17, 1729, in the 54th year of his age.

Soon after his death were published, from his original manuscripts, by his brother Dr John Clarke, dean of Sarum, *An Exposition of the Church Catechism*, and ten volumes of sermons, in 8vo. His *Exposition* is composed of those lectures which he read every Thursday morning, for some months in the year, at St James's church. In the latter part of his life he revised them with great care, and left them completely prepared for the press. Three years after his death appeared also the last twelve books of the Iliad, published in 4to by his son Mr Samuel Clarke; who informs us in the preface, that his father had finished the annotations to the first three of these books, and as far as the 359th verse of the fourth; and had revised the text and version as far as verse 510 of the same book.

Dr Clarke was of a cheerful and even playful disposition. An intimate friend of his, the Reverend Mr Bott, used to relate, that once when he happened to call for him he found him swimming upon a table. At another time, when the two Drs Clarke, Mr Bott, and several men of ability and learning were together, and amusing themselves with diverting tricks, Dr Samuel Clarke, looking out at the window, saw a grave blockhead approaching the house; upon which he cried out, "Boys, boys, be wise, here comes a fool." This turn of his mind has since been confirmed by Dr Warton, who, in his observations upon the line of Mr Pope,

Unthought-of frailties cheat us in the wise,

says, "Who could imagine that Locke was fond of romances; that Newton once studied astrology; that Dr Clarke valued himself on his agility, and frequently amused himself in a private room of his house in leaping over the tables and chairs; and that our author himself was a great epicure?"

CLARKE, *William* (1696–1771), a learned divine, was born at Haghmon Abbey, Shropshire. He was elected fellow of St John's College, Cambridge, in 1716; and in 1724 was presented by Archbishop Wake to the rectory of Buxted in Sussex. In 1738 he was made prebendary and residentiary of the cathedral church at Chichester. Some years before this he had become known by a preface to Dr Wotton's *Leges Walliæ Ecclesiasticæ et Civiles Hocli Boni, et aliorum, Walliæ Principum;* and he was probably the author of a *Discourse on the Commerce of the Romans*, which was highly extolled by Dr Taylor in his *Elements of the Civil Law*, and is reprinted in Bowyer's *Miscellaneous Tracts*. But Mr Clarke's chief work was, *The Connexion of the Roman, Saxon, and English Coins*, &c., 4to, 1767; and its appearance was owing to the then recent discovery of the old Saxon pound. It was dedicated to the Duke of Newcastle; and in its composition Clarke was chiefly indebted to Bowyer, who took upon him all the care of the publication, drew up several of the notes, and wrote part of the dissertation on the Roman sesterce. Mr Clarke was afterwards promoted to the chancellorship of the church of Chichester, and the vicarage of Amport. In Nichols's Anecdotes of Bowyer there are several letters and extracts of letters written to that learned printer by Mr Clarke, which place his character in a favourable light.

CLARKSON, THOMAS, one of the most zealous labourers for the abolition of the slave-trade, to which object he devoted his life, was the son of a clergyman at Wisbeach, where he was born in 1760. He lived to witness the extinction of the British slave-trade in 1807, and the emancipation of the negroes in 1838. He died at Playford Hall, Suffolk, in 1846. See SLAVERY.

CLARO-OBSCURO, CHIAROSCURO, or CLAIR-OBSCURE, in painting, the art of distributing to advantage the lights and shadows, both with respect to relief, and to general effect. The term is also applied to a design of only two colours, as black and white, or black and yellow; or to a design washed only with one colour, the shadows being brown, and the lights heightened up by white. It is likewise applied sometimes to prints of two colours taken off at twice.

CLASS, a scientific division or arrangement of beings or of things which have something in common, or are ranged under a common denomination. Thus, *animals* are divided into the classes of quadrupeds, birds, fishes, &c., which again are subdivided into orders, and these into genera and species. See ANIMAL KINGDOM, and BOTANY.

CLASSIC, or CLASSICAL, an epithet applied to ancient Greek and Roman authors of the first rank; and thence to such modern authors as are held in the highest estimation. The term seems to owe its origin to Tullius Servius, who, in order to make an estimate of every person's estate, divided the Roman people into six *classes*. The estate of the first class was not to be under L.200, and these by way of eminence were called *classici*, classics; hence authors of the first rank came to be called *classics*, while all the rest were said to be *infra classem*.

CLASSICUM, in *Roman Antiquity*, the alarm given by the sound of trumpet as the signal for battle. Hence also applied to the instrument itself.

CLATHRI, in *Antiquity*, a kind of lattice or trellis-work for securing doors and windows.

CLAUBERG, JOHN (1622-1665), was born at Salingen in the duchy of Berg, and professed philosophy and theology, first at Herborn, and afterwards at Duisburg. He was one of the first who introduced into Germany the Cartesian philosophy, which he had studied under John Ray at Leyden. His philosophical works (*Opera Omnia Philosophica*), collected at Amsterdam by John Theodore Schalbruch, two vols. 4to, with a life of the author by John Christian Hennius, show how thoroughly he appreciated the merits of the French philosopher. The most esteemed of Clauberg's works is his *Logica Vetus et Nova;* but he has not admitted in this collection a little work entitled *Ars Etymologica Teutonum e Philosophiæ fontibus derivata*, published by him at Duisburg in 1663, in 8vo, and which Morhoi has highly commended in his *Polyhistor*, and Leibnitz included in his *Collectanea Etymologica.* This brochure was intended as the prelude to a large work, *De Causis Linguæ Germanicæ*, which, however, the projector did not find leisure or encouragement to execute. In a separate form have been collected *J. Claubergii et Martini Hundii Dissertationes selectæ, quibus controversiæ fidei adversus omnis generis adversarios explicantur*, and *J. Claubergii et Tobiæ Andreæ Exercitationes et Epistolæ varii argumenti.*

CLAUDE, JEAN (1619-1687), an eminent French Protestant divine, was born at Sauvetat near Agen, where his father was a Protestant minister. He held for eight years the office of professor of theology in the Protestant college of Nismes; and after he was compelled to abandon his chair, he still maintained his ground on the field of controversy by his able replies to Bossuet, Arnauld, Nicole, and others. On the revocation of the edict of Nantes he fled to Holland, where he was pensioned by the Prince of Orange. He continued to preach occasionally at the Hague till his death. His principal works are the *Réponse au Traité de la perpétuité de la Foi sur l'Eucharistie*, 2 vols. 8vo; *Défense de la Reformation, ou Réponse aux Préjugés légitimes de Nicole;* and *Plaintes des Protestans cruellement opprimés dans le Royaume de France.*

CLAUDE LORRAINE, or CLAUDE GELÉE (1600-1682), the celebrated landscape painter, was born at the village of Chamaone in Lorraine. When it was discovered that he made no progress at school, he was apprenticed to a pastry-cook. He afterwards rambled to Rome to seek a livelihood; but from his clownishness and ignorance of the language, he failed to obtain permanent employment. Chance threw him at last in the way of Augustin Tassi, a painter, who hired him to grind his colours, and to do all the household drudgery. His master hoping to make him serviceable in some of his greatest works, taught him by degrees the rules of perspective and the elements of design. Under his tuition the mind of Claude began to expand, and he devoted himself to artistic study with great eagerness. He exerted his utmost industry to explore the true principles of painting by an incessant examination of nature; and for this purpose he made his studies in the open fields, where he very frequently remained from sunrise till sunset, watching the effect of the shifting light upon the landscape. He generally sketched whatever he thought beautiful or striking, marking every curious tinge of light with a similar colour; and from these sketches he perfected his landscapes so as to make them true to nature to a degree which has never been surpassed.

Claude was not only acquainted historically with the facts, but also scientifically with the laws of nature; and Sandrart relates that he used to explain to him, as they walked through the fields, the causes of the different appearances of the same landscape at different hours of the day, from the reflections or refractions of light, or from the morning and evening dews or vapours, with all the precision of a philosopher. He elaborated his pictures with great care; and if any performance fell short of his ideas, he altered, erased, and repainted it several times over, till it corresponded with the image pictured in his mind.

His skies are aërial and full of lustre, and every object harmoniously illumined. His distances are admirable, his invention delightful, his colouring delicate, and his tints have an inimitable sweetness and variety. He frequently gave an uncommon tenderness to his finished trees by glazing; and in his large compositions, which he painted in fresco, he was so exact, that the distinct species of every tree might readily be distinguished. His figures, however, are very indifferent; but he was so conscious of his deficiency in this respect, that he usually engaged other artists to paint them for him, among whom were Curtois and Filippo Lauri. In order to avoid a repetition of the same subject, and also to detect spurious copies of his works, he made a tinted outline drawing (in paper-books prepared for this purpose) of the designs of all those pictures which were transmitted to different countries; and on the back of the drawings he wrote the name of the person who had been the purchaser. These books he named *Libri di Verità.* This valuable work has been engraved and published, and is one of the greatest boons ever conferred upon the students of the art of landscape. Claude died at Rome at the age of eighty-two. Many noble specimens of his genius may be seen in the National Gallery, and in the Louvre at Paris.

CLAUDE, ST, a town of France, capital of a cognominal arrondissement, department of Jura, at the confluence of the Bienne and Isson, 28 miles S.E. of Lons-le-Saulnier. Pop. (1851) 5835. It has considerable manufactures of articles in wood, horn, and ivory; and of toys, jewellery, hardware, &c.

CLAUDIA, a Roman matron (not a vestal virgin, as frequently stated), who is said to have cleared herself of the imputation of incontinence in the following manner:—When the image of Cybele was brought out of Phrygia to Rome, the barge in which it was conveyed stuck fast on a bank in the Tiber; whereupon Claudia tied her girdle, the badge of chastity, to the barge, and drew it along to the city,—a feat which a thousand men had been unable to do. (Ovid, *Fast.* iv. 305.)

CLAUDIANUS, CLAUDIUS, a celebrated Latin poet, flourished under the emperor Theodosius and his sons Arcadius and Honorius. It appears from the direct testimony of Suidas that Claudian was a native of Alexandria. He went to Rome in A.D. 395, when he was about twenty years of age, and there he obtained the patronage of Stilicho—a man distinguished alike in the cabinet and the field, and who possessed so much influence under the emperor Honorius that for many years he was the real governor of the Western Empire. Stilicho afterwards fell into disgrace, and was put to death in 408; and it is conjectured that the poet was involved in the misfortunes of his patron. It has also been asserted, though without sufficient evidence, that Claudian suffered severe persecution from his successor Hadrian, an Egyptian by birth, who was captain of the guards to Honorius. However this may be, he was afterwards in high favour, and obtained various honours, as appears from an inscription discovered at Rome in the fifteenth century. Through the interposition, too, of Serena, the wife of Stilicho, he obtained in marriage a lady of high rank and wealth in Libya.

There are a few Christian hymns which, through mistake, have been ascribed by some critics to Claudian; but we have the explicit testimony of his contemporary St Augustin that Claudian was a heathen. The time of his death is uncertain. The style of Claudian is classically pure, and his works bear the impress of true genius. Among the editions may be noticed that of 1765, *cum notis variorum*, 8vo; the Delphin edition of 1677, 4to; that of Gesner, Leipsic, 1759, 2 vols. 8vo; and that of the younger Burmann, Amsterdam, 1760, 4to, which is decidedly the best. There is a com-

plete metrical translation of his whole works by A. H wkins, 2 vols. 8vo, Lond. 1817.

CLAUDIUS I. and II. See ROMAN HISTORY.

CLAUSE, in *Grammar*, a member of a period or sentence. Also an article in a contract, a charge or condition in a testament, &c.

CLAUSENBURG. See KLAUSENBURG.

CLAUSTHAL. See KLAUSTHAL.

CLAVARIUM, an allowance made to the Roman soldiers for the purchase of shoe-nails. In later times they frequently mutinied, demanding largesses of the emperors under this pretence.

CLAVES INSULÆ, a term used in the Isle of Man, where all weighty and ambiguous causes are referred to a jury of twelve, called *claves insulæ*, the keys of the island.

CLAVICHORD, and CLAVICTHERIUM, two musical instruments of the spinet kind, in use in the sixteenth century.

CLAVICLE, the collar bone. See ANATOMY, vol. iii., p. 31.

CLAVICYMBALUM, an old keyed-instrument of the harpsichord kind.

CLAVIUS, CHRISTOPHER (1537–1612), a German Jesuit and mathematician, born at Bamberg. He was employed to rectify the calendar, and undertook a defence of it against Scaliger. His works, in five vols. fol., contain a Commentary on Euclid's *Geometry*, and other elementary treatises.

CLAVUS, in *Antiquity*, a purple stripe on the robes of the Roman senators and knights, which was broad or narrow according to the rank of the wearer. Hence the distinction of tunica angusti-clavia and lati-clavia. See ANGUSTICLAVIA.

CLAVUS *Annalis*. According to a Tuscan custom, the early Romans kept a register of time by means of nails; and hence the term *clavus annalis*. For this purpose there was an ancient law, ordaining the chief magistrate to drive a nail every year on the ides of September into the side wall of the temple of Jupiter Optimus Maximus.

CLAY. See BRICKMAKING, and INDEX.

CLAY, *Henry*, a distinguished American statesman, was born April 12, 1777, in Hanover county, Virginia, where his father was a clergyman. He was educated for the bar; and having been licensed as an attorney in 1797, he removed to Lexington, Kentucky, where his abilities soon procured for him the most honourable distinction. He was elected in 1806, and again in 1810, to fill a vacancy in the United States senate; and was afterwards chosen speaker of the House of Representatives in Washington. In this capacity he warmly advocated the war with Great Britain; and in 1814 he was sent to Ghent as one of the commissioners for negotiating a peace. On his return, he was again elected speaker in congress; and afterwards filled the office of secretary of state during the presidency of Adams. In 1832 he stood as candidate for the presidentship, but was defeated by General Jackson. During the agitation of the tariff question he was the principal means of restoring peace to the country by bringing in the celebrated compromise bill. He resigned his seat in the senate in 1842, was again defeated by the election of President Polk in 1844, and did not resume his place in congress till 1849. In 1851 he gave in his final resignation on account of the state of his health, which rapidly declined till his death in the following year. As a speaker, he was distinguished by the clear and silvery tones of his voice; and though he was never elected president, his ability as a statesman has rendered him worthy of one of the highest places in the annals of his country.

CLAYTON, ROBERT, D.D. (1695–1758), a distinguished prelate and member of the Royal and Antiquarian Societies of London. He was advanced to the bishopric of Killala in 1729, translated to the see of Cork in 1735, and to that of Clogher in 1745. His preferment, in spite of his Arian opinions, was chiefly owing to the influence of his friends at court; but having ventured to propose in the House of Lords that the Nicene and Athanasian creeds should be expunged from the liturgy, a prosecution was ordered against him by the crown. He died, however, on the day fixed for the opening of the trial.

His publications are, 1. *A Letter in the Philosophical Transactions*, No. 461, p. 813, giving an account of a Frenchman seventy years old (at Inishanan, in his diocese of Cork), who said he gave suck to a child; 2. *The Chronology of the Hebrew Bible vindicated*, 1751, 4to; 3. *An impartial Inquiry into the time of the coming of the Messiah*, 1751, 8vo; 4. *An Essay on Spirit*, 1751, 8vo; 5. *A Vindication of the Histories of the Old and New Testaments, in answer to the Objections of Lord Bolingbroke, in two Letters to a young Nobleman*, 1752, 8vo; 6. *A Defence of the Essay on Spirit, with Remarks on the several pretended Answers*, 1753, 8vo; 7. *A Journal from Grand Cairo to Mount Sinai, and back again, translated from a manuscript written by the prefetto of Egypt, in company with some Missionaries* de propaganda fide *at Grand Cairo;* to which are added, *Remarks on the Origin of Hieroglyphics, and the Mythology of the ancient Heathens*, 1753, 8vo; 8. *Some Thoughts on Self-love, Innate Ideas, Free-will, Taste, Sentiments, Liberty and Necessity, occasioned by reading Mr Hume's Works, and the short Treatise written in French by Lord Bolingbroke on Compassion*, 1754, 8vo; 9. *A Vindication of the Histories of the Old and New Testaments*, Part II., adorned with several Explanatory Cuts, 1754, 8vo; 10. *Letters between the Bishop of Clogher and Mr William Penn, concerning Baptism*, 1755, 8vo; 11. *A speech delivered in the House of Lords in Ireland, on Monday, 2d February 1736, for omitting the Nicene and Athanasian Creeds out of the Liturgy*, 1756, 8vo; 12. *A Vindication*, Part III., 1758, 8vo.

CLAZOMENÆ (*Kelisman*), a town of Ionia, and a member of the Ionian Dodecapolis, on the gulf of Smyrna, about 20 miles from that city in a S.W. direction. It stood originally on the isthmus connecting the mainland with the peninsula on which were Erythræ and other towns of note; but the inhabitants, alarmed by the encroachments of the Persians, abandoned the continent and removed to one of the small islands of the bay, and there established their city in security. This island was connected with the mainland by Alexander the Great by means of a pier, the remains of which are still visible. Though Clazomenæ was not in existence before the arrival of the Ionians in Asia, its original founders were only partly Ionians, the great proportion being Phliasians and Cleonæans. It remained for some time subject to the Athenians, but about the middle of the Peloponnesian war it revolted. After a brief resistance, however, it again acknowledged the Athenian supremacy, and repelled the Lacedæmonians when they attempted to gain possession of the town. Under the Romans Clazomenæ was included in the province of Asia, and enjoyed immunity. Anaxagoras the philosopher was born here B.C. 499.

CLEANTHES, a Stoic philosopher, who flourished about B.C. 240. He was originally a boxer; and during the time he studied philosophy under Zeno he worked all night at drawing water for a gardener. When this circumstance became known to the Areiopagus, who had cited him before them to give an account of his somewhat suspicious mode of life, they decreed him a present of ten minæ, which he indignantly refused. From his powers of patient endurance he was known by his fellow-pupils as *the ass;* but so high was their esteem for him, that on the death of Zeno he became his successor in the school. He wrote numerous treatises on topics common to the Stoic philosophers generally.

CLEARCHUS, a tyrant of Heraclea in Pontus, who was killed by Chion and Leonidas, Plato's pupils, during the celebration of the festivals of Bacchus. He had enjoyed the sovereign power for twelve years.

CLEARCHUS was also the name of a Lacedæmonian who was sent to gain over the Byzantines to the Lacedæmonian interest. Being soon afterwards recalled, he refused to obey, and fled to Cyrus the Younger, who made him captain of 13,000 Greeks, whom he had hired to fight against his brother. He obtained a victory over Artaxerxes, who was so enraged at the defeat that when Clearchus fell into his hands by the treachery of Tissaphernes, the king immediately put him to death.

CLEAT, a small piece of wood or iron with either one

or two projecting ends, fixed in different parts of a ship to belay ropes to.

CLECHE, in *Heraldry*, a kind of cross, charged with another cross of the same figure, but of the colour of the field. See HERALDRY.

CLEDGE, among miners, the upper stratum of fullers' earth.

CLEDONISMUS, among the ancient Greeks, a kind of divination drawn from words occasionally uttered. Cicero observes, that the Pythagoreans believed the pronouncing of certain words, for instance *incendium*, during a meal, very unlucky. Thus, instead of prison, they used the word *domicilium;* and to avoid *erinnys*, furies, they said *eumenides*.

CLEF, or CLIFF, in *Music*, a character which, placed at the beginning of a stave, determines the degree of elevation of that stave in the general system, and indicates the names of all the notes which that stave contains. Thus we have the C clef, the F clef, the G clef.

CLEISTHENES, a famous Athenian magistrate, who is said to have instituted ostracism (Ælian, *V. H.* iii. 24). He flourished B.C. 510. See ATTICA.

CLEMENS ROMANUS, bishop of Rome at the end of the first century, and supposed to be the same with the Clement mentioned in Philip. iv. 3. Of his personal history nothing is known. To him are ascribed two epistles, and a work called the *Recognitiones;* but the epistles, if genuine, are interpolated, and the Recognitions are generally regarded as spurious. *The Clementines*, a series of Judaizing homilies, are supposed by Neander to be the work of an Ebionite.

CLEMENS, TITUS FLAVIUS, surnamed *Alexandrinus* because he lived at Alexandria, was born at Athens. His early life was spent partly in the study of philosophy and partly in travelling. Though previously acquainted with the Christian system, he does not seem to have embraced Christianity till he entered the school of Pantænus, to whom he afterwards became assistant. During the reign of Severus he fled to Palestine; and after residing for a short time at Jerusalem and Antioch, it is probable that he returned to Alexandria, where he died about B.C. 220. In his philosophy Clement was an eclectic, and in his interpretation of Scripture he shows much of that fanciful exegesis which received its fuller development in his pupil Origen. Of his works a considerable number still remain. They are principally written with the intent of elevating the Greeks from the condition of heathens to that of perfect Gnostics. In the fifth book of the *Stromata* there is much valuable information on the subject of Egyptian hieroglyphics. The best edition of Clement's works is that of Potter, Oxon. 1715, 2 vols. fol.

CLEMENT V., POPE, a Frenchman, and Archbishop of Bourdeaux, succeeded Benedict XI. in 1305. He transplanted the holy see to Avignon in France, greatly contributed to the suppression of the Templars, and was author of a compilation of the decrees of the general councils of Vienne, styled *Clementines*. He died in 1314.

CLEMENT VII., *Giulio de Medici, Pope*, memorable for his refusal to divorce Catharine of Aragon from Henry VIII.; and for the bull he published upon the king's marriage with Anne Boleyn, which sealed the schism between Rome and England. During his pontificate Rome was stormed and pillaged by the armies of Charles V. Clement died in 1534, and is justly regarded as infamous for his avarice and deceit.

CLEMENT XI., *Gian Francesco Albani*, was elected pope A.D. 1700. He was engaged in hostilities with the Emperor Joseph I., but was defeated and obliged to sue for peace. He was, however, no less tenacious of his temporal prerogatives than of his spiritual power, which he maintained in his bull *Vineam Domini* against the Jansenists, and again in the famous bull *Unigenitus* issued in condemnation of Quesnel's *Reflections on the New Testament*. The latter of these was ultimately recognised by the French king, but tended for a long time to alienate the French from their obedience to the Roman see. Clement espoused the cause of the Pretender, thinking him a fit instrument for regaining England to Catholicism. He also succoured the Venetians against the Turks, who had invaded Corfu, but were compelled to raise the siege. Clement was at once a generous and amiable man, and devoted a large share of his revenue to the embellishment of Rome, and the patronage of literature and art. He died in 1721.

CLEMENT XIV., *Gian Vincenzo Ganganelli*, was born at St Angelo, October 1705, and chosen pope, before he had attained a bishopric, in 1769, when the see of Rome was involved in a violent contest with the foreign powers. His reign was distracted by the contests which then raged in regard to the abolition of the Jesuit order; and Ganganelli has rendered himself famous by issuing a bull for their suppression. His latter days were embittered by apprehensions of poison, which made him frequently regret the loss of that tranquillity which he enjoyed when only a simple Franciscan. He died in 1774, and his death, which was immediately attributed to poison, gave rise to the circulation of the most extravagant reports, which seem to have been countenanced by the foreign powers for the sake of inflaming popular odium against the Jesuits. It was confidently reported that at the *post mortem* examination the head fell off from the body, and that the stench poisoned and killed the operators. The operators, however, showed themselves alive and in good health, and the surgeons and physicians testified to the falsehood of the report. Clement XIV. appears to have been a man of virtuous character, and possessed of considerable abilities. His enlightenment and liberality, however, were little suited to the taste of the age in which he lived. The collection of letters published under his name is not devoid of interest; but it is well known that they were written by Caraccioli, who, however, persisted till his death in asserting that he was only their translator.

CLEMENTI, MUZIO, the composer and pianist, was born at Rome in 1752, and died at London on 10th March 1832. After studying music under various masters at Rome, he was taken to England, when 14 years old, by Mr Peter Beckford, who was so charmed with the boy's skill as a harpsichord-player that he promised to establish him in this country. Under Mr Beckford's roof, in Dorsetshire, Clementi studied music so assiduously that when eighteen years old he had become not only the greatest harpsichord-player of his time, but had published his second work, which originated the new style of sonatas for that instrument. C. P. E. Bach had already opened the new path which Clementi improved and extended. Clementi then went to London, where his constant intercourse with the best Italian singers improved his taste. In 1780 he visited Paris, and next year Vienna, where he became intimately acquainted with Haydn and Mozart. He returned to London in 1783, and revisited France in 1784. Returning to London in 1785, he devoted himself to teaching until 1800, when he entered into a partnership for pianoforte-making and music-selling. In 1803 he went to St Petersburg with his remarkable English pupil John Field. He afterwards travelled in Italy, whence he returned to England in 1810. He was twice married. His works are numerous, and all excellent of their kind. He composed 106 sonatas for the harpsichord and for the pianoforte; a number of other pieces for the pianoforte; a large work, "Gradus ad Parnassum," or the art of pianoforte-playing; several symphonies and overtures; arrangements of Haydn's "Creation" and "Seasons," &c.; and edited three volumes of a *selection of practical harmony for the organ or pianoforte*. Clementi's style of composition is elegant and brilliant, but generally dry and unimpassioned. He stood at the head of the best school of pianists, understanding perfectly the true nature and powers

of his instrument, and taught many eminent pupils, among whom were J. B. Cramer and John Field. (G.F.G.)

CLEMENTINE, a term among the Augustines for a person who, after having been nine years a superior, ceases to be so, and becomes a private monk, in conformity with a bull of Pope Clement.

CLEMENTINES, the constitutions of Pope Clement V. and the canons of the council of Vienne.

CLENARD, or KLEINARTS, NICHOLAS, a celebrated grammarian, was born at Diest, Brabant, in 1495. After having taught humanity at Louvain, where he had studied, he travelled into France, Spain, Portugal, and Africa. He wrote, 1. *Tabula in Grammaticam Hebrœam*, Louvain, 1529, 8vo; 2. *Institutiones Linguœ Grœcœ*, Louvain, 1530, composed with the aid of Rescius; 3. *Meditationes Grœcanicœ*, Louvain, 1531; 4. *Epistolarum Libri duo*, Louvain, 1550, 8vo. Clenard died at Granada in 1542.

CLEOBIS and BITON, the sons of Cydippe, a priestess of Hera (Juno) at Argos. When oxen could not be procured for their mother's chariot, they put themselves under the yoke, and drew it 45 stadia to the temple, amidst the acclamations of the multitude. Cydippe entreated the goddess to reward their affection with the gift that was best for mortals. The goddess heard her prayer; and during the night they both died as they slept in the temple. The Argives raised statues to their memory at Delphi. (Herodot. i. 31.)

CLEOBULUS, one of the Seven Sages, was son of Evagoras, and a native of Rhodes. He seems to have possessed considerable authority in his native city of Lindus, although the precise nature of his office is doubtful. There is still extant in Diogenes Laertius a letter from Cleobulus to Solon; and several sayings are ascribed to him which, if genuine, show him to have been considerably in advance of his age. His daughter Cleobuline was also highly distinguished for her intellectual acquirements and moral worth. She was the author of some of the most famous riddles of antiquity.

CLEOBURY MORTIMER, a market-town in the county of Salop, on the Rea, 26 miles S.E. of Shrewsbury, and 137 from London. Pop. (1851) 1738. It is so called from the Mortimer family, to whom it once belonged, and who had a castle here which was destroyed in the time of Henry II. The church is a fine old building in the early English style. The Clee hills in the vicinity are rich in coal, iron, and limestone. Market-day Wednesday.

CLEOMBROTUS, son of Anaxandrides king of Sparta, who became regent after the battle of Thermopylæ. On the approach of the Persians he was deterred from building a wall across the isthmus of Corinth, by an eclipse of the sun. He died in the 75th Olympiad, and was succeeded by Pleistarchus, the infant son of Leonidas.

CLEOMBROTUS I., son of Pausanias king of Sparta, and brother to Agesipolis I., whom he succeeded on the throne. He was entrusted with the conduct of three successive expeditions against the Bœotians; and to avoid the suspicion of treachery which his former hesitancy and ill-success had inspired at home, he rashly gave battle to Epaminondas at Leuctra on disadvantageous ground, and fell in the engagement, B.C. 371. He was succeeded by his son Agesipolis II.

CLEOMBROTUS II., king of Sparta during the exile of his father-in-law Leonidas II. On the recal of Leonidas (240 B.C.) he was in turn deposed and banished to Tegea, whither he was accompanied by Cheilonis his wife.

CLEOMEDES, a Greek astronomer, whose treatise on the circular theory of the heavenly bodies is still extant. The latest edition is that of Schmidt, Lips. 1832. Cleomedes probably lived in the second and third centuries.

CLEOMENES, a sculptor, son of Apollodorus of Athens, is supposed to be the author of the celebrated statue known as the Venus de' Medici, which bears on its pedestal an inscription to that effect, the genuineness of which has been much disputed, though apparently without good reason. He flourished some time between B.C. 363 and 146. (See Smith's *Dict. of Greek and Rom. Biog. and Mythol.*)

CLEOMENES, king of Sparta, son and successor of Anaxandrides. Before his succession to the throne his sanity was regarded with general suspicion, and he was nearly set aside in favour of his younger brother. His first exploits consisted in the expulsion of the Peisistratidæ from Athens, and in the active support which he gave to the party of Isagoras in opposition to the claims of Cleisthenes. During his absence from Sparta on an expedition against the Æginetans, the intrigues of Demaratus procured his recal; but Cleomenes easily rid himself of the obnoxious colleague, by bribing the priestess at Delphi to pronounce a sentence of illegitimacy against him. About this time he undertook a war against the Argives, whom he defeated in the neighbourhood of Tiryns; and his impiety in burning some of the fugitives within the precincts of the sacred grove of Argus became associated in the popular superstition with his subsequent madness. When the means by which he had procured the abdication of Demaratus became known at Sparta, he fled to Thessaly, and afterwards to Arcadia, where he plotted an invasion of his native country. The dread of his revenge reconciled the Spartans to his recal; but his conduct was so furious that they soon found it necessary to order his confinement in the stocks. This ignominious treatment, however, he did not long survive; for borrowing a knife from the helot who guarded him, he wounded himself so severely that he died.

CLEOMENES II. was the son of Cleombrotus I. and succeeded his brother Agesipolis II., B.C. 370. He reigned 60 years, and had two sons, Acrotatus and Cleonymus. He was succeeded by Areus I. son of Acrotatus.

CLEOMENES III. succeeded his father Leonidas II. (B.C. 236). He was a man of an enterprising spirit, and devoted his energies to effect the restoration of the ancient discipline of Lycurgus. He suppressed the senate because they opposed his designs, poisoned his colleague Eurydamidas, and illegally raised his own brother Eucleidas to the throne. He made war against the Achæans in order to destroy the Achæan league, and for this purpose concluded an alliance with Ptolemy, king of Egypt. Aratus, the general of the Achæans, however, called Antigonus to his assistance; and Cleomenes, defeated at Sellasia, retired into Egypt to the court of Ptolemy Euergetes, whither his wife and children had preceded him as hostages. Ptolemy received him with great cordiality; but his successor, Ptolemy Philopater, jealous of the safety of his crown, treated him with marked disrespect, and threw him into prison on the charge of conspiring against his life. Cleomenes, however, effected his escape; but after a vain attempt to raise an insurrection, he put himself to death (B.C. 220), and his body was exposed on a cross by order of the king.

CLEON, the Athenian demagogue, was the son of Cleænetus, and by trade a tanner. Towards the close of the administration of Pericles, he became distinguished for the virulence of his invectives against the rich; and during the Peloponnesian war his influence over the people determined in a great measure the fate of Attica. (See ATTICA). He fell in a battle when misconducting an expedition into Thrace, B.C. 422. His political career is satirized in several of the comedies of Aristophanes.

CLEON is also the name of a poet of Clusium, who wrote on the Argonautic expedition; of a rhetorician of Halicarnassus, who composed an oration for Lysander; of a Syracusan geographer; of a Magnesian philosopher, who wrote commentaries treating of portentous events; and of a sculptor of Sicyon, whose statues are mentioned by Pausanias.

CLEOPATRA (B.C. 69–30), the celebrated Egyptian queen, was daughter of Ptolemy Auletes, at whose death she ascended the throne along with Ptolemy her younger

brother. A quarrel, however, soon arose between them; and Cleopatra, by the advice of the king's councillors, was expelled the kingdom, and forced to take refuge in Syria. Here she had equipped an army, and was preparing to march into Egypt, when the arrival of Cæsar in pursuit of Pompey opened up an easier path for her ambition. Having gained access to the chamber of the conqueror, her charms and caresses easily procured a decision in her favour; and accordingly she was reinstated in her former power. The death of Ptolemy, and the total defeat of his army, placed her in sole possession of the throne; but Cæsar, dreading the indignation of the Egyptians, with whom she was exceedingly unpopular, divided the kingdom between her and a younger brother, to whom she was nominally married. After the departure of Cæsar from Egypt, Cleopatra followed him to Rome, and was provided with apartments in the palace, where she lived openly as his mistress. After the assassination of Cæsar (B.C. 44) she returned to Egypt, and actively assisted the triumvirate against his murderers. Before the arrival of Antony in Asia Minor, she had poisoned her brother Ptolemy and made herself the sole occupant of the throne. Her voyage up the Cydnus to meet the Roman general is elaborately described by Plutarch, and has been dramatized by Shakspeare. The first use which she made of her power was to procure the death of her sister Arsinoë, and avenge herself on her obnoxious generals. She returned to Egypt attended by Antony, who from this time forward became her slave; and though separated for a while during his visit to Italy, she met him again in Syria on his return from the Parthian expedition, and was publicly acknowledged as his wife. The voluptuous indolence to which Antony now surrendered himself under the fascinations of the queen inspired Augustus with the hope of crushing his rival at a single blow. Partly to disguise his hostile intentions, he proclaimed war against "that accursed Egyptian who had bewitched him." Disappointed of a retreat into Egypt, Cleopatra accompanied the fleet of Antony, and at the battle of Actium (B.C. 31) was the first to give the signal for flight. She entered Alexandria with all the pomp of a triumph, but the desperate situation of her affairs deterred the neighbouring princes to whom she applied for succours from lending her any effectual aid. Finding escape impossible, she resolved to attempt a negotiation with Augustus; and in the hope of winning his favour, did not scruple to sacrifice her paramour for that object. Under pretext of wishing him to die with her, she decoyed Antony to an unfinished mausoleum, in which she had collected her treasures; and there (according to Dion Cassius) Anthony threw himself on his sword and expired in her arms. Her interview with Augustus, however, convinced her that she had nothing to hope from his weakness, and every ignominy to fear from his ambition. At first, to beguile the vigilance of her keepers, who had removed all instruments of death from her apartments, she pretended willingness to go to Rome, and was preparing presents for the Roman empress, when seizing a favourable opportunity she unexpectedly put an end to her life (B.C. 30), either by means of a poisoned comb, or by the poison of an asp. With her ended the dynasty of the Ptolemies, who had filled the throne of Egypt for 300 years. Her son Cæsarion, whom she had borne to Julius Cæsar, was put to death by Augustus; but Alexander, Ptolemy, and Cleopatra, the children of Antony, were reserved to grace his triumph at Rome. The leading features in Cleopatra's character were unbounded ambition and voluptuousness; and to gratify these passions her extraordinary talents, accomplishments, and beauty, were unceasingly employed. She left the library of Pergamus as a monument of her literary tastes; the pages of Plutarch are filled with the record of the refinement which gave a kind of dignity to her excesses; while her haughty and resolute contempt of death filled even the Roman poet with awe. (Hor., *Car.* i. 37.)

CLEOSTRATUS, an astronomer of Tenedos, who, according to Pliny, introduced the division of the zodiac into signs, beginning with Aries and Sagittarius. He flourished about 400 years B.C.

CLEPSYDRA, a water-clock or kind of time-piece used by the Greeks and Romans, which measured time by the discharge of a certain quantity of water in a given time. For the history and construction of clepsydræ, see HYDRODYNAMICS.

CLERC, DANIEL LE (1652-1728), an eminent French physician of great learning, was born at Geneva. He is best known by his very valuable *Histoire de la Médecine*, in three parts, in which he has traced the healing art from its earliest dawn to the time of Galen and the end of the second century. He did not live to finish, as he intended, the more modern history of medicine.

CLERC, *Jean le* (1657–1736), an eminent scholar and biblical critic, was born at Geneva, where his uncle was professor of Hebrew. He became early distinguished for his attainments in classical literature; and after studying under Mestrezat and Turretine, he was ordained at Geneva in 1679. His opinions, however, were more in accordance with the views of Curcellæus and Episcopius—a circumstance which led him to retire from Geneva to Grenoble, and afterwards to Paris. After a short visit to England he removed to Amsterdam, where in 1684 he became professor of philosophy, belles-lettres, and Hebrew, in the Remonstrant College. In 1728, while lecturing, he lost the use of his speech through a paralytic stroke; and his memory failing, he lingered on till his death in a state bordering on idiocy. As a critic, Le Clerc may be ranked the first of his time; but the Socinianizing tendency of his views estranged him from the great mass of Protestant divines. His polemical works in general betray a somewhat bitter and dogmatic tone, while his miscellaneous writings bear the marks of hasty composition.

His works are exceedingly voluminous. The best known are his Latin commentaries on several books of the Bible; his *Ars Critica; Harmonia Evangelica;* Translation of the New Testament into French; *Traité de L'Incrédulité;* and the *Parrhasiana, ou Pensées diverses sur les Matières de Critique, d'Histoire, de Morale, et de Politique.* Besides these he edited the *Bibliothéque Historique et Universelle*, 26 vols.; the *Bibliothéque Choisie*, 28 vols.; and the *Bibliothéque Ancienne et Moderne*, 29 vols. He also published several editions of the ancient classics.

CLERC, *Sebastian le* (1637–1714), an eminent French engraver, was born at Metz. After having held the office of engineer to the Marshal de la Ferté, he went to Paris in 1665, and applied himself to designing and engraving with such success, that M. Colbert gave him a pension of 600 crowns. In 1672 he was admitted into the royal academy of painting and sculpture; and in 1680 was made professor of geometry and perspective in the same academy. Besides a vast number of designs and prints, he published *A Treatise on Theoretical and Practical Geometry, A Treatise on Architecture*, and other works. Le Clerc was an excellent artist, and his smaller works, in which he was most successful, are only equalled by the engravings of Callot and Della Bella. His most esteemed prints are, 1. The *Passion of our Saviour*, on 36 small plates; 2. The *Miracle of Feeding the Five Thousand;* 3. The *Elevation of the large Stones used in Building the Front of the Louvre;* 4. The *Academy of the Sciences*, a middle-sized plate, lengthwise; 5. The *May of the Gobelins*, a middle-sized plate, lengthwise; 6. The *Four Conquests*, large plates, lengthwise, representing the taking of Tournay, the taking of Douay, the defeat of the Comte de Marsin, and the Switzerland Alliance; 7. The *Battles of Alexander*, from Le Brun, six small long plates, including the title, which represents the picture gallery at the Gobelins; and, 8. The *Entry of Alexander into Babylon*, a middle-sized plate, lengthwise, in the first impressions of which the

face of Alexander is seen in profile, but in the second it is a three quarter face, and therefore called *the print with the head turned.*

CLERGY, Benefit of, an obsolete, but once very important feature in the English criminal law. It was a relic of the claim of exemption from the authority of the common law tribunals, on the part of the clergy, and marked the extent to which the demand was acceded to in England. The conclusion of the protracted conflict was, that the common law courts abandoned the extreme punishment of death assigned to some offences, when the person convicted was a *clericus*, in holy orders, and the church was obliged to accept the compromise and let a secondary punishment be inflicted. For the more atrocious crimes the partial exemption was not obtained; and hence offences came to be divided into clergyable and unclergyable. According to the common practice in England of working out modern improvements through antiquated forms, this exemption was made the means of modifying the severity of the criminal law. It became the practice for every convict to claim and be allowed the benefit of clergy; and when it was the intention by statute to make a crime really punishable with death, it was awarded "without benefit of clergy." A full account of the origin and progress of the system will be found in the 28th chapter of the fourth book of Blackstone's commentary. The benefit of clergy in cases of felony was abolished in the modifications of the criminal law by Sir Robert Peel in 1827 (8th Geo. IV. cap. 28.) (J. H. B.)

CLERK, a term applied to ministers of religion, and to some civil officers. The post-classical *clerus* and *clericus* have been satisfactorily traced to the Greek κλῆρος, a portion or heritage. In the distribution of the portions of the tribes under the Jewish dispensation, it was called the heritage of the tribe of Levi to receive the contributions of the faithful as persons set apart for the worship of God, and not endowed with a fixed inheritance. Hence the word came to be applied to the ministers or clergymen of the early church, and its meaning obtained an extended application to all men of learning, and persons who could compose or write documents, since these qualifications were almost the exclusive possession of the clergy. In the French dictionaries of Moreri and the Trevoux, an account of a variety of offices, lay and ecclesiastical, will be found under the head *Clerc*. In Britain, during the subsistence of monastic establishments, the term generally implied a secular priest in contradistinction to a regular.

Among the older English writers, the word clerk was almost invariably applied to a clergyman; and this is still its legal meaning when employed in formal documents, without any explanatory phraseology. In common language, it came to be synonymous with scribe, and has been applied to a large class of officers of varied functions and positions, from men who partake of the character of ministers of state down to humble copyists, whose qualification consists in the ability to write a legible hand. The rights and duties of clerks, involving the responsibilities which they may bring on their employers, are an important practical part of the law, but it comes properly under that general branch applicable to employer and employed, which it is usual to discuss under the head master and servant.

The proceedings of the two houses of parliament, of the various courts of justice, and of the several ministerial departments, are generally drawn and recorded by clerks who hold a position corresponding with the importance of their functions. The clerk of the parliaments is at the head of the ministerial officers, at the disposal of the legislature. He is considered as specially attached to the House of Lords in the separate proceedings of the two houses. The House of Commons is attended by a clerk of the House of Commons, who is an equally high and important officer, though nominally he is the deputy of the clerk of the parliaments. They are aided by a staff of assistants, and other subordinate clerks. Though the functions of these officers in attending to the order of business, authenticating bills and other documents, and drawing out the routine proceedings, are very onerous and distinguished, it is an important constitutional fact that the English legislature was ever jealous of allowing stipendiary officers to draw and put in terms their legislative acts. While in other countries the clerk or recording officer made up from his own account of what had taken place the legislative act in which it was embodied, the English parliament had the terms of the measure laid before it *verbatim* in the shape of a bill, leaving nothing to the discretion of a permanent stipendiary officer. Hence this class of functionaries failed to obtain in England the influence they have held elsewhere. In Scotland, the clerk of the parliaments and of the supreme courts of justice was a high officer of state, called the Lord Clerk Register, and the character of his influence may be inferred by a statement in Sir George M'Kenzie's annals, that the Clerk Register under Charles II. claimed some reward for drawing the acts of parliament favourably to the prerogative.

Until a comparatively late period, there were a large number of clerkships, connected chiefly with the courts of justice, having ancient and quaint names derived from some incident of their origin. Thus, there was the Clerk of the Hanaper and the Clerk of the Petty-bag, said to be so distinguished from the kind of receptacle—a hamper in the one case, and a little bag in the other—in which the writs in their custody were deposited. The Clerk of the Pells wrote on pells, or skins, while the Clerk of the Pipe, the head of an important department in the exchequer, was so named from the pipe-shaped roll in which he extended his accounts of debts to the crown. The reason why these venerable distinctions were religiously preserved was because they had each gradually accumulated an incrustation of fees and privileges, which made them valuable objects of patronage. The "six clerks" of the court of chancery, besides their emoluments, had the privilege of each naming ten of the "sixty clerks," who were agents licensed to conduct a particular kind of business; and in a similar manner a body of clerks in the privy-council office of Scotland, called Clerks to the Signet, acquired the peculiar privileges enjoyed by the respectable body of practitioners still called clerks, or more commonly Writers, to the Signet. The early jobbing in the patronage of the six clerks became picturesquely conspicuous in the pages of Clarendon. Sir Julius Cæsar, a very aged man, being master of the rolls, proposed to provide for his son by making him one of the six clerks. The patronage was considered a perquisite of the master of the rolls; but on this occasion the treasurer Portland gave it to another person, who paid L.6000 for it. It was represented to the treasurer that he owed Sir Julius some indemnity; and desiring a memorandum of the matter, a slip of paper was given to him with the words "Remember Cæsar" written on it. The careless lord treasurer allowed this memorandum to lie unnoticed until, after its cause was forgotten, it was discovered at a period of political alarm. He consulted his friends about the mystical document, and, as Clarendon says, "After a serious and melancholy deliberation, it was agreed that it was the advertisement from some friend who durst not own the discovery; that it could signify nothing but that there was a conspiracy against his life, and they all knew Cæsar's fate by contemning or neglecting such animadversions."

Several public investigations, and especially those of the finance committees of 1797 and 1808, showed that the clerkships connected with the courts of justice went to increase the proper official income of statesmen, or to provide pensions for their relations. Thus in 1808 it

appeared that the office of clerk of the crown in the king's bench, with an income of L.12,511, was partitioned between the two sons of an influential marquis; the clerkship of the pells in Ireland was held by an eminent statesman with a salary of L.3500; and the clerkship of the common pleas there, with an income of L.11,094, belonged to an earl. The report of 1797 showed that the clerk of the hanaper in chancery was an earl and his heirs; and the report of 1808 showed the office in the possession of two ladies, his "sisters and co-heiresses." In some instances the clerkships appeared to be held in trust for persons who must have been supposed too young or too imbecile to grant the necessary receipts for the salary. What facilitated the existence of such offices, but at the same time rendered them the more oppressive, was that the incomes were derived from old fees on litigants, frequently commenced without warrant, and gradually acquiring an authoritative existence through long inveterate custom. At the time when such large incomes were thus drawn, the working clerks were often remunerated with a parsimony inimical to the public service. The tendency of late legislation has been to adjust the official staff of each department to its existing operative exigencies. Hence the clerkships with quaint names have gradually been abolished. Of the varied class of such offices which had to be mentioned as existing institutions in the previous editions of this work, some notion may be formed from what follows.

By two statutes of the year 1832, for regulating the establishments of the common law side of the exchequer and the court of chancery, several old consuetudinary clerkships were abolished, and among them that of the clerk of the pleas in the former, and in the latter the offices of clerk of the hanaper, clerk of the crown in chancery, clerk of the patents, clerk of custodiers of lunatics and idiots, clerk of the presentations, clerk of enrolments in bankruptcy, and clerk of dispensatories and faculties (2d and 3d Will. IV. cap. 10, 111). A list of offices of this kind, abolished, occupies a considerable schedule in an act passed in 1837 "to abolish certain offices in the supreme courts of common law, and to make provision for a more effective and uniform establishment of officers in those courts" (7th Will. IV. and 1st Vict. cap. 30). Among the offices so abolished were, on the plea side of the queen's bench, the chief clerk, the clerk of the rules, the clerk of the papers, the clerk of the dockets and judgments, the clerk of the declarations, the clerk of the common bails or appearances estreats and posteas, the clerk of the inner and upper treasurers, clerk of the outer treasury, clerks of nisi prius, clerk of the errors, clerk of the outlawries and filacer and exigenter; in the court of common pleas, the several clerks, of the judgments, of the outlawries, of the reversals of outlawries, of the dockets, of the warrants, enrolments, and estreats, of the essoigns, of the treasury, of the juries, of the errors, of the jurata, and of the supersedeas; in the exchequer court, there were abolished the clerk of the rules, the clerk of the errors, and the clerk of the pleas. (J. H. B.)

CLERKE, Captain Charles, a celebrated English navigator, spent his youth in the navy, and was present at several actions during the war of 1755. In the engagement between the Bellona and Courageux he was carried overboard along with the mizen-top mast of the Bellona, but was picked up without having received any injury. He made his first voyage round the world as midshipman under Commodore Byron, and was afterwards on the American station. In 1768 he sailed round the world a second time in the Endeavour, on board of which he was raised to a lieutenancy. He returned in 1775, and was soon afterwards appointed master and commander. Under Captain Cook he was appointed captain of the Discovery; and on the death of that officer he succeeded to the chief command. His health, which had long been feeble, began rapidly to fail from the cold to which he was exposed while searching for a passage between Asia and America; and he died Aug. 22, 1778, when within view of the coast of Kamtschatka.

Clerk, *John, of Eldin* (1730–1812), the author of the celebrated naval manœuvre of *Breaking the Line*, which led to Lord Rodney's victory over the French under De Grasse. (See War § Naval Tactics). It is worthy of observation, as a singular fact, that a man who has written so distinctly on the mode of managing a fleet should never have made a single voyage. Sir Howard Douglas has claimed the invention of this manœuvre for Lord Rodney, but on very slender grounds.

CLERMONT, or Clermont Ferrand, the ancient *Augustonemetum*, a city of France, capital of Basse Auvergne and of the department of Puy-de-Dôme, situated on a hill composed chiefly of volcanic tufa, in the fertile district of Limagne, and surrounded on the S. and W. by a line of mountains, of which the Puy-de-Dôme is the culminating point. The city lies in Lat. 45. 46. N., Long. 3. 5. E., and is 220 miles S. by E. from Paris. Pop. (1851) 30,563. It is composed of the two towns of Clermont and Mount Ferrand, connected by a fine avenue of walnut trees and willows, two miles in length. The streets are generally ill laid out, narrow, and crooked; and the houses are built of dull gray lava, which has a gloomy effect. It has several handsome squares ornamented with fountains, and is well supplied with water brought by subterranean conduits from Royat, a league distant. The principal public building is the cathedral—a Gothic edifice of the thirteenth century, and though still unfinished its interior is considered one of the finest existing specimens of Gothic architecture. The church of Nôtre-Dame-du-Port is curiously decorated externally with mosaic work, bas-reliefs, &c., and is very ancient—parts of it dating from 870. Clermont has also a university, academy, royal college, botanic garden, public library of 18,000 vols., museums of natural history and antiquities, two hospitals, theatre, &c. The manufactures are woollen and linen goods, silk stockings, paper, cutlery, jewellery, &c. Being the entrepôt for the produce of the surrounding departments, it carries on a considerable trade in hemp, flax, corn, wine, cheese, wool, hides, and cattle. In the suburb of St Alyre to the N.W. of the city is a remarkable calcareous spring, the copious deposits of which have formed a curious natural bridge. At Clermont was held the celebrated council of 1095, which gave rise to the first crusade. Pascal was a native of Clermont.

Clermont de Lodeve, a city of the department of the Herault, in France, on the river Ergue. It contains 791 houses and 6199 inhabitants.

Clermont *Manuscript*, a stichometric copy of St Paul's Epistles (including "Hebrews"), found in the monastery of Clermont in France, and first used by Beza, together with the Cambridge MS., in preparing his New Testament. This copy is in octavo, and written on fine vellum in Greek and Latin. It is complete with the exception of a few verses. The Latin text gives the oldest form of the Latin translation made as early as the second century, but the handwriting is that of the second half of the sixth century. The MS. itself was in the possession of Morinus, and is now deposited in the imperial library at Paris (No. 107). It was edited, with a facsimile, by Tischendorf in 1852.

CLEROMANCY (κλῆρος, lot, μαντεία, divination), a divination by throwing dice, and observing the points or marks turned up.

CLEVELAND, a city, capital of the county of Cuyahoga, state of Ohio, North America, occupies a commanding situation on lake Erie, at the mouth of the Cuyahoga river, and at the northern termination of the Ohio canal. The town is built principally upon a gravelly plain 80 feet above the lake; the streets are wide, crossing each other at right angles, and are ornamented with many elegant buildings. Near the centre is a large public square of ten acres, divided into

four equal parts by intersecting streets, and neatly inclosed and shaded by trees. The harbour, one of the best on the lake, is formed by the mouth of the Cuyahoga, with a pier on each side, 200 feet apart, and extending 425 yards into the lake. In 1850 the coastwise imports amounted in value to $7,030,957; exports $6,855,556. The principal part of its trade, however, is carried on by the canals and railroads, which connect it with Portsmouth, Pittsburg, Cincinnati, and other towns. In 1799 there was only one family residing here; and in 1825 only about 500 persons; while in 1850 the population amounted to 17,034. In 1814 it was incorporated as a village, and in 1836 as a city.

Cleveland, *John* (1613–59), an English poet of some eminence in his time, who, during the civil war, engaged as a literary champion in the royal cause against the parliamentarians. His works, which consist of poems, characters, orations, epistles, &c., were printed in 8vo in 1677. The last edition appeared so long ago as 1687; yet Cleveland was in his day esteemed one of the best of the English poets, and enjoyed a popularity far surpassing that of Milton.

CLEVES, Cleve, or Kleve, a walled town of Rhenish Prussia, government of Dusseldorf, capital of a circle, and formerly of the duchy of the same name, 46 miles N.W. of Dusseldorf. It is a neatly-built town in the Dutch style, situated on a declivity in a fertile district near the Dutch frontier, and about two miles from the Rhine, with which it is connected by a canal. The old castle (formerly the residence of the dukes of Clèves, and in which Anne of Clèves, one of the wives of Henry VIII., was born) has a massive tower 180 feet high, built in 1439, and commanding a very extensive view. Clèves has two Roman Catholic and three Protestant churches, a synagogue, high school, and house of correction. Its chief manufactures are linens, cottons, silks, woollens, flannels, tobacco, &c. In the vicinity are a royal park and a zoological garden. Pop. (1849) of town 8401; of circle 49,335. The district of Clèves, situated on both sides of the Rhine, was governed by counts from the ninth century, till in 1417 it was raised to a duchy by the Emperor Sigismond. On the death of Duke William in 1609 without issue, the duchy fell to Sigismond, elector of Brandenburg, who had married a niece of the late duke. In 1805 it was ceded by Prussia to France; and in 1806 was made a grand duchy by Napoleon, and bestowed upon Murat. In 1815 it was restored to Prussia.

CLEW, in nautical language, the lower corner of a square sail, and the after corner of a fore-and-aft sail. Clew-garnet is a tackle for hauling up the clew of a foresail or a mainsail.

CLIENT (Lat. *cliens*), among the Romans, a citizen that put himself under the protection of a man of distinction and influence, who, in respect of that relation, was called *patronus*. The patron afforded his protection, advice, and even pecuniary assistance to his client on certain occasions; and the client gave his vote for his patron, when the latter sought any office for himself or his friends. Clients owed respect to their patrons, and patrons owed their clients protection. This connection was hereditary, descending from one generation to another. The client bore the name of his patron, and attended him in war as his vassal Hence illustrious families were proud of the number of their clients, and strove to increase the number of those transmitted to them by their ancestors. The connection too between a master and his liberated slave was expressed by the same terms.

The right of patronage, it is said, was instituted by Romulus, in order to unite the rich and the poor in such a manner as that the one might live without contempt, and the other without envy; but the condition of a client became in course of time little else than a species of servitude. Dionysius has given a summary of the mutual rights and obligations between patron and client.

Client is now used to signify a party in a lawsuit who entrusts his cause to a counsellor or a solicitor.

CLIFDEN, a seaport-town of Ireland, county of Galway, at the head of an inlet of Ardbear harbour, 46 miles N.W. of Galway, and 178 from Dublin. It has a Gothic parish church, Roman Catholic chapel, market-house, bridewell, workhouse, hospital, and dispensary. Vessels of 200 tons can come up to the town. Exports, grain, herrings, butter, &c. Pop. (1851) 2252, including 639 in workhouse.

CLIFTON, a suburb of Bristol, and generally considered as forming part of the city, is picturesquely situated on the sides and summit of a precipitous limestone-hill overhanging the Avon. Pop. (1851) 17,634. It is a favourite residence of the wealthier inhabitants of Bristol, and is celebrated for its hot well spring. See Bristol.

CLIMACTERIC (from *climacter*, a ladder, gradation), among physicians, a critical year in a person's life. According to some, this is every seventh year; but others admit only the years produced by multiplying 7 by the odd numbers 3, 5, 7, and 9, to be climacterical. These years have been supposed from remote antiquity to bring with them some remarkable vicissitudes with respect to health and fortune. The grand climacteric is the 63d year; but some, making two, add to this the 81st. The other remarkable climacterics are the 7th, 21st, 35th, and 49th.

CLIMATE.

Ancient use of the word *climate*.

The word *Climate*, or κλίμα, being derived from the verb κλίνειν, *to incline*, was applied by the ancients to signify that obliquity of the sphere with respect to the horizon from which results the inequality of day and night. The great astronomer and geographer Ptolemy distinguished the surface of our globe, from the equator to the arctic circle, into climates or parallel zones, corresponding to the successive increase of a quarter of an hour in the length of midsummer-day. Within the tropics, these zones are nearly of equal breadth; but, in the higher latitudes, they contract so much, that it was deemed enough to reckon them by their doubles, answering consequently to intervals of half an hour in the extension of the longest day. To compute them is an easy problem in spherical trigonometry. As the sine of the excess of the semidiurnal arc above a quadrant is to the radius, so is the tangent of the obliquity of the ecliptic, or of 23° 28′, to the cotangent of the latitude. The semidiurnal arcs are assumed to be 91° 52½′, 93° 45′, 95° 37½′, 97° 30′, &c.; and the following table, extracted from Ptolemy's great work, will give some general idea of the distribution of seasons over the surface of our globe:—

Climate or Parallel.	Latitude.	Length of Midsummer Day.	Breadth of Zone.	Climate or Parallel.	Latitude.	Length of Midsummer Day.	Breadth of Zone
I.	0° 0′	12h.00	4° 15′	XIV.	43° 4′	15″ 15	1° 57′
II.	4 15	12 15	4 10	XV.	45 1	15 30	1 50
III.	8 25	12 30	4 5	XVI.	46 51	15 45	1 41
IV.	12 30	12 45	3 57	XVII.	48 32	16 00	1 32
V.	16 27	13 00	3 47	XVIII.	50 4	16 15	1 36
VI.	20 15	13 15	3 38	XIX.	51 40	16 30	1 10
VII.	23 51	13 30	3 21	XX.	52 50	16 45	1 40
VIII.	27 12	13 45	3 10	XXI.	54 30	17 00	1 30
IX.	30 22	14 00	2 56	XXII.	55 00	17 15	1 00
X.	33 18	14 15	2 42	XXIII.	56 00	17 30	1 00
XI.	36 00	14 30	2 35	XXIV.	57 00	17 45	30
XII	38 35	14 45	2 21	XXV.	58 00	18 00	
XIII.	40 56	15 00	2 9	XXVI.	59 30	18 30	

These numbers are calculated on the supposition that the obliquity of the ecliptic was 23° 51′ 20″, to which, accord-

ing to the theory of Laplace, it must have actually approached in the time of Ptolemy. They seem to be affected by some small errors, especially in the parallels beyond the seventeenth, as the irregular breadth of the zone abundantly shows; but they are, on the whole, more accurate than those given by Varenius.

Ptolemy describes the general appearances which the heavens will present on each parallel, and assigns the corresponding lengths of the shadow of the gnomon at both solstices. He justly maintains, in opposition to the more ancient opinion, that the equatorial region is habitable, since the action of the sun, not continuing long vertical, is there mitigated; but he will not venture to describe the inhabitants, because no person, he says, having yet penetrated so far south, the reports circulated respecting them appeared to be merely conjectural. He therefore passes over the first parallel to the second.

This *second* parallel, then, according to Ptolemy, runs through the isle of Taprobana, supposed to be Ceylon, in the latitude of 4° 15′. The *third* parallel, in the latitude of 8° 25, traverses the gulf of *Adulitus*. The *fourth* parallel crosses the *Adulitic* gulf, in latitude 12° 45′. The *fifth* parallel passes through the isle of *Meroe*, in Upper Egypt, at latitude 16° 27′. The *sixth* parallel runs through the territory of the *Napati*, in latitude 20° 15′. All these climates or parallels lying below the tropic, the inhabitants are therefore *Amphiscians*, or see the sun pass twice over their heads in the course of the year. The *seventh* parallel, at the latitude of 23° 51′, and consequently bordering the tropic, runs through Syene, in Upper Egypt. The *eighth* parallel, in latitude 27° 12′, traverses Ptolemais, in the Thebaid. The *ninth* zone, corresponding to a day of fourteen hours of length, passes through Lower Egypt, at the latitude of 36° 12′. The *tenth* parallel, in latitude 33° 18′, runs through the middle of Phœnicia. The *eleventh* parallel, at the thirty-sixth degree of latitude, passes through the isle of Rhodes. The *twelfth* parallel, in latitude 38° 35′, crosses Smyrna. The *thirteenth* parallel traverses the Hellespont, in latitude 40° 56′. The *fourteenth* parallel, in latitude 43° 4′, runs through Marseilles. The *fifteenth* parallel passes through the middle of the Pontic Sea, in latitude 45° 1′. The *sixteenth* parallel runs through the sources of the Ister or Danube, in latitude 46° 51′. The *seventeenth* parallel, corresponding to a day of sixteen hours in length, traverses the mouths of the Borysthenes, in latitude 48° 32′. The *eighteenth* parallel, at the latitude of 50° 4′, crosses the Palus Mæotis. The *nineteenth* parallel passes through the most southern part of Britain, in latitude 51° 40′. The *twentieth* parallel crosses the mouths of the Rhine, in latitude 52° 50′. The *twenty-first* parallel passes through the mouths of the Tanais, in latitude 54° 30′. The *twenty-second* parallel, at the fifty-fifth degree of latitude, traverses the country of the *Brigantes*, in Great Britain, that is, the southern and larger portion of this island, reckoning from the Frith of Forth. The *twenty-third* parallel, in the fifty-sixth degree of latitude, passes through the middle of Great Britain. The *twenty-fourth* parallel, at the latitude of 57°, runs through *Caturactonium*, in Great Britain. The *twenty-fifth* parallel, corresponding to a day of eighteen hours, runs through the southern parts of Little Britain, in latitude 58°. The *twenty-sixth* parallel, corresponding to a day of 18½ hours in length, traverses the middle of Little Britain, in latitude 58° 30′. It should be observed that the latitudes of the places in our own island are most inaccurately given by Ptolemy, and generally advanced about two or three degrees farther north than their true position. By Little Britain he meant undoubtedly that part of Scotland which lies on the north side of the Friths of Forth and Clyde, and forms almost a peninsula.

The high zones become so narrow, that Ptolemy separates the *twenty-sixth* to an interval of half instead of a quarter of an hour in the length of the day; but he thinks it superfluous to extend this subdivision farther into such remote and inhospitable countries. Resuming the calculation, however, he places the parallel where midsummer day is prolonged to nineteen hours, in the latitude of 61°, or the north of Little Britain. The parallel of 19½ hours would pass through the Ebudes, Hebrides, or Western Isles, in latitude 62°. The parallel of twenty hours runs through the island of Thule, in the latitude of 63°. The parallel of twenty-one hours would traverse the unknown Scythian nations, in latitude 64½°. The parallels of twenty-two and twenty-three hours would run through the latitudes of 65½° and 66°. He places in latitude 66° 8′ 40″ the arctic circle itself, where the sun does not set during the whole of midsummer day. Within this circle the inhabitants are *Periscians*, or have the sun lingering above the horizon during part of the summer, and the shadow of the gnomon successively projected in every direction. In the latitude of 67°, the sun continues almost a whole month above the horizon; in the latitude of 69½°, he shines two months; in the latitudes 73⅓°, 78⅓°, and 84°, that luminary displays his presence for three, four, and five months. At the pole itself, the sun appears, during the space of six months, describing circles parallel to the horizon.

Modern application of this word.

Climate, in its modern acceptation, signifies that peculiar condition of the atmosphere in regard to heat and moisture which prevails in any given place. The diversified character which it displays has been generally referred to the combined operation of several different causes, which are chiefly reducible, however, to these two; *distance from the equator*, and *height above the level of the sea*. Latitude and local elevation form, indeed, the great bases of the law of climate; but as we shall soon see, other causes are not to be neglected in the estimation of differences of climate.

If we dig into the ground, we find the temperature to become gradually more steady, till we reach a depth of perhaps forty or fifty feet. When this perforation is made during winter, the ground gets sensibly warmer till the limit is attained; but in summer, on the contrary, it grows always colder, till it has reached the same limit. At a certain depth, therefore, under the surface, the temperature of the ground remains quite permanent.

It would be a hasty conclusion, however, to regard this limit of temperature as the natural and absolute heat of our globe. If we dig on the summit of a mountain, or any very elevated spot, we shall discover the ground to be considerably colder than in the plain below; or, if we make a similar perforation on the same level, but in a more southern latitude, we shall find greater warmth than before. The heat thus obtained at some moderate depth is hence only the mean result of all the various impressions which the surface of the earth receives from the sun and the atmosphere.

The method employed hitherto for ascertaining the temperature at different depths under ground, consists in digging a hole, and burying a sluggish thermometer for several hours, or the space of a whole night. The celebrated naturalist and accurate observer, Saussure, in the month of October 1785, made an interesting set of observations on the banks of the Arve, near Geneva. By digging downwards on successive days, he reached at last the depth of 31 feet. While the surface of the ground had retained a heat of 60°·3 by Fahrenheit's scale, the temperature of the earth at the depth of 4 feet was 60°·8, at 16 feet 56°, at 21 feet 53°·6, and at 28 feet 51°8. A thermometer buried 31 feet deep was found, when taken up in summer, to stand at 49°·5, and when raised in winter, to indicate 52°·2. Notwithstanding this great depth, therefore, it had still felt the vicissitude of the seasons, having varied 2°·7 in the course of the year. The extreme impressions must have taken six months to penetrate to the bulb, since the temperature was lowest in summer and highest in winter.

Temperature below surface of the earth.

But this plan of observing is clumsy and imperfect, there not being sufficient time to allow the mass of earth to regain its proper degree of heat, and too much for the instrument to retain its impression unaltered before it can be raised up and observed. In order to throw distinct light on a subject so curious and important, Robert Ferguson, Esq. of Raith, a gentleman whose elegant mind is imbued with the love of science, caused a series of large mercurial thermometers, with stems of unusual length, to be planted in his spacious garden at Abbotshall, about 50 feet above the level of the sea, and near a mile from the shore of Kirkcaldy, in latitude 56° 10′. The main part of each stem having a very narrow bore, had a piece of wider tube joined above it; and to support the internal pressure of the column of mercury, the bulbs were formed of thick cylinders. The instruments, inclosed for protection in wooden cases, were then sunk beside each other to the depths of one, two, four, and eight feet, in a soft gravelly soil, which turns, at four feet below the surface, into quicksand, or a bed of sand and water. These thermometers were carefully observed from time to time by Mr Charles Norval, the very intelligent gardener at Raith; and we have had access to a register of their variations for nearly three years. It thence appears that, in this climate, and on naked soil, the frost seldom or never penetrates one foot into the ground. The thermometer at that depth fell to 33° of Fahrenheit on the 30th December 1815, and remained at the same point till the 12th February 1816; but in the ensuing year it descended no lower than 34°, at which it continued stationary from the 23d December 1816 to 1st January 1817. At the same depth, of one foot, it reached the maximum 58° on the 13th July 1815, but in the following year it rose only to 54° on the 21st July; and in the year 1817 it mounted to 56° about the 5th July. This thermometer, in the space of three years, travelled, therefore, over an interval of 25°, the medium being $45\frac{1}{2}$, and attained its highest and lowest points about three weeks after the solstice of summer and of winter.

Depth which frost penetrates.

The thermometer planted at the depth of two feet sunk to 36° on the 4th February 1816; but it stood at 38° about the beginning of January 1817. It rose to 56° on the 1st of August 1815; but in the next year it reached only 53° on 24th July; and, in 1817, it again reached 56° on 10th July. At the depth of two feet, the extreme variation was therefore 20°; and the maxima and minima took place about four or five weeks after either solstice.

The thermometer of four feet depth had sunk to 39° about the 11th February 1816, and was stationary at 40° near the 3d February 1817. It rose to 54° on the 2d August 1815, and stood at 52° during the greater part of August and September in the years 1816 and 1819. It ranged, therefore, only 15°, the mean being $46\frac{1}{2}$°, and the extreme points occurring near two months after either solstice.

The thermometer whose bulb was planted eight feet deep descended to 42° on the 16th February 1816, but stood at $42\frac{1}{2}$° on the 11th February 1817. It rose to $51\frac{1}{2}$° on the 11th September 1815, fell to 50° on the 14th September 1816, and mounted again to 51° on the 20th September 1817. This thermometer had, therefore, a range of only $9\frac{1}{2}$°, the medium temperature being $46\frac{3}{4}$°, and the extremes of heat and cold occurring nearly three months after the solstice of summer and of winter.

These observations are quite satisfactory, and exhibit very clearly the slow progress by which the impressions of heat or cold penetrate into the ground. It will not be far from the truth to estimate the rate of this penetration at an inch every day. The thermometers hence attained their maximum at different periods, though in a tolerably regular succession. The mean temperature of the ground, however, seemed rather to increase with the depth; but this anomaly evidently proceeded from the coldness of the two successive summers, and particularly that of 1816, which occasioned such late harvests and scanty crops. Thus the thermometer of one foot indicated the medium heat of only 43°·8 during the whole of the year 1816. But it will be satisfactory to exhibit the leading facts in a tabular form. The following are the mean results for each month, only those for December 1817 are supplied from the corresponding month in 1815.

	1816.				1817.			
	1 foot.	2 feet.	4 feet.	8 feet.	1oot.	2 feet.	4 feet.	8 feet.
January......	33°·0	36° 3	40°·7	43°·0	35°·6	38° 7	40° 5	45°·1
February ...	33 ·7	36 ·0	39 0	42 ·0	37 ·0	40 ·0	41 ·6	42 ·7
March	35 ·0	36 ·7	39 ·6	42 ·3	39 ·4	40 2	41 ·7	42 ·5
April.......	39 ·7	38 ·4	41 ·4	43 ·8	45 ·0	42 4	42 ·6	42 ·6
May	44 ·0	43 ·3	43 ·4	44 0	46 ·8	44 ·7	44 ·6	44 ·2
June	51 ·6	50 0	47 ·1	45 ·8	51 1	49 ·4	47 ·6	47 ·8
July	54 ·0	52 ·5	50 ·4	47 ·7	55 ·2	55 ·0	51 ·4	49 ·6
August..... ..	50 ·0	52 ·5	50 ·6	49 ·4	53 ·4	53 ·9	52 ·0	50 ·0
September. .	51 ·6	51 ·3	51 ·8	50 ·0	53 ·0	52 7	52 ·0	50 ·7
October... .	47 ·0	49 ·3	49 ·7	49 ·6	45 ·7	49 ·4	49 ·4	49 ·8
November.. .	40 ·8	43 ·8	46 ·3	45 ·6	41 ·0	44 ·7	47 ·0	47 ·6
December....	35 ·7	40 ·0	43 ·0	46 ·0	37 ·9	40 ·8	44 ·9	46 ·4
Mean of whole year.	43 ·8	44 ·1	45 ·1	46 ·9	44 ·0	45 ·9	46 ·2	46 ·6

If the thermometers had been sunk considerably deeper, they would no doubt have indicated a mean temperature of 47°·7. Such is the permanent temperature of a copious spring which flows at a short distance, and about the same elevation, from the side of a basaltic or greenstone rock. Profuse fountains and deep wells, which are fed by percolation through the crevices of the strata, furnish the surest and easiest mensuration of the temperature of the earth's crust. The body of water which bursts from the caverns of Vaucluse, and forms almost immediately a respectable and transclucid river, has been observed not to vary in its temperature by the tenth part of a degree, through all the seasons of the year. It is, therefore, an object highly important for scientific travellers to notice the precise heat of springs in favourable situations, as they issue from their rocky beds. Such observations would generally afford the medium temperature of any climate. It is only requisite to exclude the superficial and the thermal springs, which are not difficult to distinguish.

It must, however, be recollected that at considerably greater depths a higher temperature is found. This was first observed in very deep mines, and was by some ascribed to the heat of the miners' candles and of their bodies, or to the sudden evolution of the latent heat of air extricated by its condensation in such confined spaces. But the temperature has been found to be too high for such causes; and the great increase of heat observed in the waters of Artesian wells, according to their profundity, as was ably pointed out by Arago, is a strong proof of the existence of a source of temperature within the earth itself, independent of solar influence. That this cause, however, does not affect the temperature of the outer crust of our earth is obvious from the steadiness of mean temperature in different places, which Arago has shown, over Europe at least, to have been for some centuries, as nearly as we can judge from the freezing of certain rivers, lakes, and seas in winter, about what it is still found to be. It is, no doubt, the effect of radiation, and of the movements of the atmosphere, and of the ocean which have combined to produce the steadiness of the mean temperature.

Mayer's rule for calculating the mean temperature of any place.

From a comparison of meteorological observations made at distant points on the surface of our globe, the celebrated astronomer Professor Mayer of Göttingen has endeavoured to discover an empirical law which connects the various results. Round the pole, the mean temperature he assumes

to be at the precise limit of freezing, since the fields of ice accumulated in that forlorn region seem at this present period neither to increase nor diminish. But under the equator the medium heat on the level of the sea Bouguer estimated at 84½° of Fahrenheit, or 29 centesimal degrees, the division of the thermometric scale which is the best suited to philosophical purposes. At the middle point, or the latitude of 45° the temperature is found to be about 14½° centigrade. From that centre the heat diminishes rapidly northwards, and increases with equal rapidity towards the south. Hence the mean temperature of any place, at the level of the sea, is calculated in centesimal degrees, by multiplying the square of the cosine of the latitude into the constant number 29; or it is found by multiplying the supplemental versed sine of double the latitude into 14½°. The variation of temperature for each degree of latitude is hence denoted centesimally by half the sine of double the latitude; being in fact this quantity diminished in the ratio of 58, the double of 29, to 57·3, the length of an arch equal to the radius. From these data the following table is computed; in which are likewise annexed the corresponding degrees of Fahrenheit's, with the successive differences.

Lat.	Centesimal.	Dif.	Fahrenheit	Dif.	Lat.	Centesimal.	Dif.	Fahrenheit.	Dif.	Lat.	Centesimal.	Dif.	Fahrenheit	Dif.
0	29°·00	·00	84°·2	·00	30	21°·75	·43	71°·1	·77	60	7°·25	·44	45°·0	·79
1	28·99	·01	04·2	·02	31	21·31	·44	70·3	·79	61	6·82	·43	44·3	·78
2	28·96	·03	84·1	·05	32	20·86	·45	69·5	·81	62	6·39	·43	43·5	·77
3	28·92	·04	84·0	·07	33	20·40	·46	68·7	·83	63	5·98	·41	42·8	·76
4	28·86	·06	83·9	·11	34	19·93	·47	67·9	·84	64	5·57	·41	42·0	·74
5	28·78	·08	83·8	·13	35	19·46	·47	67·0	·85	65	5·18	·39	41·3	·71
6	28·68	·10	83·6	·18	36	18·98	·48	66·2	·86	66	4·80	·38	40·6	·68
7	28·57	·11	83·4	·20	37	18·50	·48	65·3	·87	67	4·43	·37	40·0	·67
8	28·44	·13	83·2	·23	38	18·01	·49	64·4	·88	68	4·07	·36	39·3	·65
9	28·29	·15	82·9	·27	39	17·50	·49	63·5	·88	69	3·72	·35	38·7	·63
10	28·13	·16	82·6	·30	40	17·01	·49	62·6	·89	70	3·39	·33	38·1	·60
11	27·95	·18	82·3	·32	41	16·52	·49	61·7	·90	71	3·07	·32	37·5	·57
12	27·75	·20	82·0	·36	42	16·02	·50	60·8	·90	72	2·77	·30	37·0	·54
13	27·53	·22	81·6	·40	43	15·52	·50	59·9	·91	73	2·48	·29	36·5	·52
14	27·30	·23	81·1	·42	44	15·01	·51	59·0	·91	74	2·20	·28	36·0	·50
15	27·06	·24	80·7	·44	45	14·50	·51	58·1	·92	75	1·94	·26	35·5	·47
16	26·80	·26	80·2	·47	46	13·99	·51	57·2	·92	76	1·70	·24	35·1	·43
17	26·52	·28	79·7	·50	47	13·49	·50	56·3	·91	77	1·47	·23	34·6	·41
18	26·23	·29	79·2	·52	48	12·98	·51	55·4	·91	78	1·25	·22	34·2	·40
19	25·93	·30	78·7	·54	49	12·48	·50	54·5	·90	79	1·05	·20	33·9	·36
20	25·61	·32	78·1	·57	50	11·98	·50	53·6	·90	80	·86	·19	33·6	·34
21	25·28	·33	77·5	·60	51	11·49	·49	52·7	·89	81	·71	·17	33·3	·31
22	24·93	·35	76·9	·63	52	10·99	·50	51·8	·90	82	·56	·15	33·0	·27
23	24·57	·36	76·2	·65	53	10·50	·49	50·9	·88	83	·43	·13	32·8	·23
24	24·20	·37	75·6	·67	54	10·02	·48	50·0	·87	84	·32	·11	32·6	·20
25	23·82	·38	74·9	·68	55	9·54	·48	49·2	·86	85	·22	·10	32·4	·18
26	23·43	·39	74·2	·70	56	9·07	·47	48·3	·85	86	·14	·08	32·3	·15
27	23·02	·41	73·5	·72	57	8·60	·47	47·5	·84	87	·08	·06	32·2	·11
28	22·61	·42	72·7	·74	58	8·14	·46	46·6	·83	88	·04	·04	32·1	·07
29	22·18	·43	71·9	·76	59	7·69	·45	45·8	·81	89	·01	·03	32·0	·05
										90	·00	·00	32·0	·01

This table, and the formula on which it is calculated, though once supposed to afford a pretty accurate idea of the mean temperature of different latitudes at the level of the sea, can now only be received as an ingenious though erroneous speculation: for the researches of later observers have shown that it accords not with observations either in high latitudes, or in regions 70° or 80° W. or E. of the meridians of Paris and London. At the time the astronomer Mayer published his formula, the mean temperature of scarcely three or four points on the globe were accurately ascertained: his formula is therefore founded on very imperfect data, and the subsequent labours of travellers and navigators have demonstrated the fallacious grounds from which it was deduced. We may also remark that Mayer was misled by Bouguer's too high estimate of the equatorial mean temperature, which is assumed to be 24° of Réaumur; but the more accurate determinations of Humboldt make it no more than 22° Réaumur, which is equivalent to 81°·5 Fahrenheit. Among the earliest to afford more correct data we must reckon British navigators and scientific travellers. Humboldt, in discussing the difference of terrestrial temperature, says—"To begin with the extreme north, I shall here mention a man in the first place whom the dangerous occupation of whale fishing has not prevented from carrying on the most refined meteorological observations. Scoresby has for the first time determined the mean temperature of the polar seas, which he has ascertained between the volcanic island of Jan Mayen and that part of East Greenland discovered by himself. Parry, Sabine, and Franklin have for several years been employed in investigating the temperature of the atmosphere and the sea in the polar regions; they have penetrated to Port Bowen and Melville Island, therefore nearly to 75° N. Lat., and they have in this arduous task displayed a perseverance of which we scarcely find a parallel in the history of human exertions and struggles against the elements."

Humboldt also pays a high compliment to the exertions of Captain Weddell, who has overthrown a prejudice that was even sanctioned by the illustrious Cook, viz., that the south polar ice renders the antarctic far less accessible than the arctic seas. Since Humboldt's memoir was written, the discoveries of Sir James Ross far in the antarctic regions have confirmed that observation. The information afforded by the arctic voyages are so important and well established, that we hesitate not to give a summary of their observations on the mean temperature of high northern latitudes.

Climate.

In Scoresby's *Arctic Regions* the mean temperature of the atmosphere of the Greenland seas, about Lat. 78° N., as deduced from 18 whale-fishing voyages, is for the month of April 14°·2 Fahr., for June 31°·4, for July 37°, or for the three warm months 26°·275, while, from fair data, he calculates the mean annual temperature of that latitude at no more than 17°·0. In his "Greenland Voyage" of 1822, alluded to by Humboldt, he found the mean temperature for the five months in which he navigated above Lat. 65° thus: April 32°·22, May 21°·42, June 32°·975, July 34°·30, August 35°·247, giving a mean temperature for the whole of 32°·231.

In Sir Edward Parry's two winter sojourns in the arctic regions we have still more decisive proofs of the fallacies of Mayer's formula. The following table of mean temperature is from the account of his third voyage, p. 71.

Months.	Melville Island, Lat. 74½°. 1819-20.	Winter Island, Lat. 66¼°. 1821-22.	Igloolic, Lat. 69⅓°. 1822-23.	Port Bowen, Lat. 73¼°. 1824-25.
October ...	− 6·46	+ 9 51	+ 9·79	+10·85
November	−23·60	+ 4·75	−22·37	− 5·00
December	−24·79	−15·94	−30·80	−19 05
January ...	−33·09	−25·96	−20·07	−28·91
February..	−35·19	−27·97	−23·41	−27·32
March	−21·10	−14·64	−22·75	−28·37
Mean ..	−24·04	−11·71	−18·27	−16·30

The mean temperature for all the months of the year at Port Bowen and its vicinity, was found to be no more than +10·01. In the perilous sojourn of four successive winters by Sir John Ross in Boothia Felix, Lat. 70°, we have the results of observations made continuously for each month of two successive years, 1830, 1831, and the annual mean temperature for each is +2·38 and +4·91.

In Captain Sir John Franklin's journeys to the shores of the American Arctic Ocean, the mean temperature of Fort Franklin, Lat. 65°·12, during two years is thus given—

		1825-26.	1826-27.
SPRING,......	March to May, ...	+14 43	+13·67
SUMMER,..	..June to August, ...	+50·40	
AUTUMN,..	September to November,..	+20·00	+20·25
WINTER,....	December to February, ..	−16·81	−16·40
	Mean...........	+11·46	

The mean temperature for each month of 1826 at Fort Franklin is thus given in his second expedition—

January..	−23·78
February	−12·70
March...	− 8·26
April...	+15·21
May..	+36·35
June..	+48·00
July...	+52·10
August..	+51·09
September......................................	+39·18
October...	+24·07
November	− 3·01
December..	− 7·42

A comparison of all these observations shows an increasing degree of cold as the longitude increases from the meridian of western Europe.

These observations on mean temperature in North America and its seas, compared with observations made in Europe, sufficiently show that some other coefficients than latitude and elevation above the sea must affect mean temperature. In fact, ever since meteorological observations began to be made with comparable thermometers, this became obvious; but it has been very apparent within the last few years, when we had obtained accurate registers of the heat of various parts of Asia, and of certain intertropical countries. The comparison of numerous such registers from various parts of the new and of the old continent, together with his own very extensive and accurate investigations of atmospheric temperature in various parts of the northern Temperate and Torrid Zones, proved to the illustrious Alexander von Humboldt, that no empirical formula will enable us to ascertain the law which regulates the mean temperature of the surface of our globe; and that we must collect the facts by multiplied and accurate observation in each locality. His philosophical views on this subject were first published in an admirable essay in the third volume of *Mémoires de la Société d'Arceuil.* He there showed that the very striking difference in mean temperature observed in large tracts of country under the same latitude, and at the same elevation above the sea, could not arise from the trifling influence of mere local peculiarities, but must depend on more general causes; as the form of continents, the nature of their surface, and especially on their size, position, and proportion to the adjacent seas.

As above two-thirds of the surface of our globe are covered by water, and as a transparent body like water and an opaque one like the land absorb and radiate the solar heat with very different facility, when falling on them at similar angles, it is obvious that the relative proportion of land and water at any part of the earth's surface must greatly modify the mean temperature of that region. The radiation of heat from rough and smooth surfaces towards a cloudless sky is very different; and the opaque, rough surface of the land will cool more rapidly than the surface of the sea by radiation. The comparatively smaller portion of the ocean covered with ice and snow than of the land will also produce some difference of mean temperature in places under the same latitude.

The difference between land and water in receiving and transmitting heat constitutes the difference between an insular and a continental climate. Water is not so soon heated by the summer sun as land, therefore the air over it is cooler in summer; and as the land cools faster than the sea in winter, the warmer sea air mitigates the cold of that season. Compare, for instance, the mildness of the climate of the British Isles with that of Sweden or the north of Germany, under the same parallels. This effect is further increased by the oceanic currents that carry the waters of warmer regions to our shores, in that remarkable deviation of the Gulf stream that sets across the Atlantic from Newfoundland to the western shores of Europe.

Laying aside hypothetical speculation, this distinguished philosopher undertook a very careful discussion of his own observations, and those of other meteorologists. His first difficulty was in obtaining the true *mean temperature* of any locality. He found that the usual method of taking half the sum of the maxima and minima of the day and night, or of the summer and the winter, would not give the true daily or annual mean temperature. But repeated observation led him to the important conclusion, "that the thermometer at the moment of sunset in every season indicates very nearly the daily mean temperature." Humboldt's observations on this point were chiefly made between 46° and 48° N. Lat.; and there is strong reason to believe that the same holds good in other latitudes—a circumstance which will mightily abridge the labour and greatly facilitate the acquisition of those important results. Humboldt finds that in western Europe the mean temperature of latitudes 30°, 40°, 50°, 60° are respectively 70°·5, 63°·1, 50°·2, and 40°·6 Fahr.; but in eastern America, under the same parallels, are 60°·9, 54°·5, 42°, 38°. Over the tropical Atlantic the lines of equal temperature are nearly parallel to the equator. On the other hand, proceeding east from Europe the lines of equal temperature bend toward the south; showing that Europe enjoys a higher mean temperature than either eastern America or eastern Asia.

Humboldt conceived the beautiful idea of representing on a chart of the world these variations of mean temperature,

by lines passing through places possessing the same annual mean temperature, which he denominates *isothermal lines*. A specimen of such isothermals is given in Plate CLXXIII.

He has given a summary of his observations on mean temperature in the following table for the northern hemisphere, divided into 6 isothermal bands. The degrees of heat are reduced from Humboldt's centigrade scale to that of Fahrenheit. This table not only gives the annual mean temperature, but that of the four seasons, considering December, January, and February as the three winter months. The prefixed asterisk (*) indicates those places where the mean temperature has been most accurately observed. The maxima and minima of the warmest and coldest months are also given:—

Isothermal Bands.	Names of Places.	Position.			Mean Temp. of the Year.	Distribution of Heat in the different Seasons.				Maximum and Minimum.	
		Lat.	Long.	Height in Feet.		Mean Temp. of Winter.	Mean Temp. of Spring.	Mean Temp. of Summer.	Mean Temp. of Autumn.	Mean Temp. of Warmest Month.	Mean Temp. of Coldest Month.
		° ′	° ′		°	°	°	°	°	°	°
Isothermal Bands from 32° to 41°.	Nain	57 8	61 20W	0	26·42	−0·60	23 90	48 38	33·44	51 80	—11·20
	*Enontekies	68 30	20 47 E	1356	26·96	+0·68	24·98	54·86	37·32	59·54	— 0·58
	Hospice de St Gothard	46 30	8 23 E	6390	30·38	18·32	26·42	44·96	31·82	46·22	15·08
	North Cape	71 0	25 50 E	0	32·0	23·72	29·66	43·34	32·08	46·58	22 10
	*Uleo	65 3	25 26 E	0	35·08	11·84	27·14	57·74	35 96	61·52	7·70
	*Umeo	63 50	20 16 E	0	33·26	12·92	33·80	54·86	33 44	62·60	11·48
	*St Petersburg	59 56	30 19 E	0	38 84	17·06	38 12	62·06	38·66	65·66	8·60
	Drontheim	63 24	10 22 E	0	39·92	23·72	35·24	61·24	40·10	64·94	19·58
	Moscow	55 45	37 32 E	970	40·10	10·78	44·06	67·10	38.30	70·52	6·08
	Abo	60 27	22 18 E	0	40·28	20·84	38·30	61 88	40·64	—	—
Isothermal Bands from 41° to 50°.	*Upsal	59 51	17 38 E	0	42·08	24·98	39·38	60·26	42·80	62·42	22·46
	*Stockholm	59 20	18 3 E	0	42·26	25 52	38·30	61·88	43·16	64·04	22 82
	Quebec	46 47	71 10W	0	41·74	14 18	38 84	68·00	46·04	73·40	13 81
	Christiania	59 55	10 48 E	0	42·8	28 78	39·02	62·60	41·18	66·74	28·41
	*Convent of Peyssenburg	47 47	10 34 E	3066	42·98	28·58	42·08	58·46	42·98	59·36	30·20
	*Copenhagen	55 41	12 35 E	0	45·68	30·74	41·18	62·60	48·38	65·66	27 14
	*Kendal	54 17	2 46W	0	46·22	30·86	45·14	56·84	46·22	58·10	34·88
	Malouin Islands	51 25	59 59W	0	46·94	39·56	46·58	53·06	48·46	55·76	37·40
	*Prague	50 5	14 24 E	0	49·46	31·46	47·66	68·90	50·18	—	—
	Göttingen	51 32	9 53 E	456	46·94	30·38	44·24	64·76	48·74	66·38	29·66
	*Zurich	47 22	8 32 E	1350	47·84	29 66	48·20	64·04	48·92	65·66	26·78
	*Edinburgh	55 57	3 10W	0	47·84	38·66	46·40	58·28	48·56	59 36	38·30
	Warsaw	52 14	21 2 E	0	48 56	28·76	47·48	69 08	49·46	70·34	27·14
	*Coire	46 50	9 30 E	1876	48·92	32·36	50·00	63·32	50 36	64·58	29·48
	Dublin	53 21	6 19W	0*	49·10	39·20	47·30	59·54	50·00	61·16	35·42
	Berne	46 5	7 26 E	1650	49·28	32·00	48·92	66·56	49·82	67·28	30·56
	*Geneva	46 12	6 8 E	1080	49·28	34·70	47·66	64·94	50 00	66·56	34·16
	*Manheim	49 29	8 28 E	432	50·18	38·80	49 64	67·10	49·82	68·72	33·44
	Vienna	48 12	16 22 E	420	50·54	32 72	51·26	69·26	50·54	70 52	26·60
Isothermal Bands from 50° to 59°.	*Clermont	45 46	3 5 E	1260	50·00	34·52	50·54	64·40	51·26	66·20	28·04
	*Buda	47 29	19 1 E	494	51·08	33·98	51·08	70 52	52 34	71·60	27·78
	Cambridge, (U.S.)	42 25	71 3W	0	50·36	33·98	47·66	70·70	49 82	72·86	29·84
	*Paris	48 50	2 20 E	222	51·08	38·66	49 28	64·58	51·44	65 30	36 14
	*London	51 30	0 5W	0	50·36	39·56	48·56	63·14	50·18	64·40	37·76
	Dunkirk	51 2	2 22 E	0	50·54	38·48	48·56	64·04	50·90	64·76	37·75
	Amsterdam	52 22	4 50 E	0	51·62	36·86	51·62	65·84	51·62	66·92	35·42
	Brussels	50 50	4 22 E	0	51·80	36·68	53·24	66·20	51·08	67·28	35·60
	*Franeker	52 36	6 22 E	0	51·80	36·68	51·08	67·28	54·32	69·08	32·90
	Philadelphia	39 56	75 16W	0	53·42	32·18	51·44	73·94	56·48	77·00	32·72
	New York	40 40	73 58W	0	53·78	29·84	51·26	79·16	54·50	80·78	25·34
	*Cincinnati	39 6	82 40W	510	53 78	32·90	54·14	72·86	54·86	74·30	30·20
	St Malo	48 39	2 1W	0	54·14	42·26	52·16	66·02	55·76	66·92	41·74
	Nantes	47 13	1 32W	0	54·68	40 46	54·50	68·54	55·58	70·52	39·02
	Pekin	39 54	116 27 E	0	54·86	26·42	56·30	82·58	54·32	84·38	24·62
	*Milan	45 28	9 11 E	390	55·76	36·32	56·12	73·04	56·84	74·66	36·14
	Bourdeaux	44 50	0 34W	0	56·48	42·08	56·48	70·88	56·30	73·04	41·00
Isothermal Bands from 59° to 63°.	Marseilles	43 17	5 22 E	0	59·00	45·50	57·56	72·50	60·08	74·66	44·42
	Montpellier	43 36	3 52 E	0	59 36	44·06	56 66	75·74	60·98	78·08	42·08
	*Rome	41 53	12 27 E	0	60·44	45·86	57·74	75·20	62·78	77·00	42·26
	Toulon	43 7	5 50 E	0	62 06	48·38	60·80	75·02	64·40	77·00	46·40
	Nangasacki	32 45	129 55 E	0	60·80	39·38	57·56	82 94	64·22	86·90	37·40
	*Natchez	31 28	90 30W	180	64·76	48·56	65·48	79·16	66·02	79·70	46·94
Isothermal Bands from 68° to 77°.	*Funchal	32 37	16 56W	0	68·54	64·40	65·84	72·50	72·32	75·56	64·04
	Algiers	36 48	3 1 E	0	69·98	61·52	65·66	80·24	72·50	82·76	60·08
Isothermal Bands above 77°.	*Cairo	30 2	31 18 E	0	72·32	58·46	73·58	85·10	71·42	85·82	56·12
	*Vera Cruz	19 11	96 1W	0	77·72	71·96	77·90	81·50	78·62	81·86	71·06
	*Havaña	23 10	82 13W	0	78·08	71·24	78·98	83·30	78·98	83·84	69·98
	*Cumana	10 27	65 15W	0	81·86	80·24	83·66	82 04	80·24	84·38	79·16

Humboldt's isothermal lines are drawn on what is termed an *equatorial* projection; and a first glance will show that they are neither parallel to each other, nor to the lines marking degrees of latitude. In Europe their summit is convex; but over Asia and America their summits are concave, and distinctly indicate the existence of two meridians of extreme cold in the northern hemisphere (the extremities of which will represent the poles of greatest cold), on both sides of which the mean temperature is higher than on those meridians. The poles of greatest cold would seem to be about 70° or 80° to the W. and the E. of the meridians of Paris and London, and about the 80° of N. latitude. This equatorial projection appears to have led Berghaus and others into the erroneous supposition that the isothermal lines formed isolated bands around each pole of greatest cold; whereas they form continuous bands, including both poles of cold, as is well seen in the isothermal charts of Professor Dove of Berlin, which are on the *polar* projection. (See Plate CLXXIV., which is copied from his work.)

The influence of oceanic currents on mean temperature was also pointed out by Humboldt; especially of his "Peruvian current," which carries the gelid waters from the frozen shores of the southern Victoria Land to the western coasts of Chile and Peru, and shows itself by the lower temperature of its waters far to the west of the Gallapagos Islands, in the equatorial Pacific Ocean; and of the longer known "Gulf stream" of the Atlantic, which brings the warm waters of the torrid zone along the eastern coasts of North America; and, where met by the polar current off the banks of Newfoundland, transports a portion of their warmth to the western shores of Europe, and often rejects on the western isles of Scotland, and the Orkneys, the seeds of the *Dolichos* or *Mucuna urens*, of the *Mimosa scandens*, and of other West Indian plants. The Gulf stream gives warning to the judicious mariner of his approach to the continent of America, by the superior temperature of its waters; and Humboldt mentions, that the Peruvian current has been found, off the coast of Peru, to have a temperature of no more than from 60° to 67° Fahr., while the sea just beyond the current raised the thermometer to 80°. Such currents, when extensive, must materially affect the heat of the superincumbent air; and thus we can understand how mean temperature must be locally affected by the direction of great oceanic currents.

It is well known that the heat of the atmosphere diminishes as we ascend mountains, and that, in every climate, there is a point where frost will be perpetual. The mean temperature of any place must therefore be materially affected by its level above the sea. This point of perpetual congelation may, in general terms, be said to diminish in altitude from the equator to the poles. At one time it was imagined that this diminution was uniformly according to latitude; and philosophers sought out a mode of calculating the point of perpetual congelation for each degree of latitude. The best known of these methods was that of Kirwan of Dublin. He conceived that if the point of congelation at the equator and its mean temperature were known, as well as the mean temperature of the given latitude, we could discover the point of congelation at that latitude by a simple equation. Thus, take the excess of both mean temperatures above the freezing point of water—and as this corrected mean temperature at the equator is to the point of perpetual congelation, so is the corrected mean temperature of the latitude to its point of congelation. But this ingenious speculation supposes a uniform depression of that point from the equator to the poles—which is not found to be the fact—and has led to as erroneous conclusions as the formula of other philosophers, who believed that the question might be determined by diminishing the mean temperature of any place by 1° Fahr. for every 300 feet of elevation. Upon these erroneous principles it has even been imagined that we could determine the height of mountains in any latitude, by the computed height of perpetual congelation in that latitude. Thus, when it was first announced that several peaks of the Himalaya range attained an elevation of from 25,000 to 27,000 feet, the accuracy of the observations was called in question; because in that latitude, it was contended that the snow line was not higher than 11,500 feet, and but a small part of these summits was veiled in perpetual snow; consequently their real heights could not possibly be more than a mile higher than the lower limit of snow, or in all from about 16,000 feet. But trigonometric measurements by several observers have since put their vast elevation beyond all doubt; and, what is still more remarkable, it has been proved that the snow line on their southern declivities lies 4000 feet lower than on their northern flanks. The explanation of this singular fact is supplied by Humboldt. The first cause is, that the air from the Indian ocean comes to the southern declivities of the Himalayas loaded with moisture which it deposits on the lofty summits with which it first comes into contact. But, in the second place, on the northern side of this vast aerial rampart, the powerful radiation of heat from the dry elevated table-lands of central Asia, situated below the almost parallel chains of the Himalayas, the Zungling and the Himmelsgebirge ranges of Klaproth, causes streams of dry warm air to ascend on the northern flanks of those mountains, and thus elevates the limit of perpetual snow. The happy effect of these circumstances has been pointed out by Humboldt—"Millions of men of Thibetian origin occupy populous towns, in a country where fields and towns would, during the whole year, have been buried in snow if these table-lands had been less continuous and less extensive."

Places which have the same annual mean temperature may differ materially in the difference of the mean temperature of their winter and summer. This, as well as the influence of the *cold meridians*, is well seen in the following table of Humboldt, in which he compares Europe with eastern America:—

Isothermal Lines of	Cisatlantic Region. Long. 1° W. and 17° E.			Transatlantic Region. Long. 58° to 72° W.		
	Mean Temperature.			Mean Temperature.		
	Winter.	Summer.	Dif.	Winter.	Summer.	Dif.
68°	50°·0	80°·6	21°·6	53°·6	80°·6	27°·0
59	44·6	73·4	28·8	39·2	78·8	39·6
50	35·6	68·0	32·4	30·2	71·6	41·4
41	24·8	60·8	36·0	14·0	66·2	52·2
32	14·0	53·6	39·6	1·4	55·4	54·0

The table shows the increase of the difference between the winters and summers, from the parallels of 28° and 30° to the parallels of 55° and 65° N. Lat. The increase or difference is more rapid in the transatlantic region; but it is remarkable that in both the divisions of the annual temperature between winter and summer is such that upon the isothermal line of 32° the difference of the two seasons is about double of that upon the isothermal line of 68°.

If, instead of the mean temperature of the seasons, we take that of the coldest and warmest month, and if we take places lying in the same climatic region and compare them with those in other regions, the difference becomes still more conspicuous; as, for instance, the region of western Europe with the region of eastern America, or of eastern Asia. The general principle in each region is that the differences increase from the equator to the pole; but, in certain situations this ratio is modified by the direction of the prevailing winds, and of oceanic currents, and by an insular climate. Thus, with us the breezes from the S.W., sweeping over the Atlantic, moderate the heat of our summer, and the severity of our winter; the oceanic current from Newfoundland certainly tends also to mitigate the vigour of our cold season; and from these causes, the climate of Britain is

more temperate than that of the same latitudes of continental Europe. The influence of similar causes in other places is indicated in the last column of this table.

Places.	Lat.	Mean Temperature. Coldest Month	Mean Temperature. Warmt Month.	Diff.	Observations.
Cumana	10° 27′	80°·1	84°4	4°·3	Uninterrupted trade winds
Pondicherry	11 55	76 1	91 4	15 3	Monsoons, radiation from sand
Manilla	14 36	68·0	86·9	18 9	Monsoons
Vera Cruz ..	19 11	70·0	81 7	11·7	North winds in winter
C Français..	19 46	77·0	86 0	9·0	Uninterrupted trade winds
Havaña	23 10	70·0	83 8	13 8	North winds in winter
Funchal	32 37	64·0	75 6	11·6	Insular climate
Natchez	31 38	46 9	78 8	31·9	Transatlantic Region, Interior
Cincinnati...	39 6	29·6	74·4	44·8	Same system of climate
Pekin	39 54	24·8	84·2	59 4	Eastern Asiatic Region
Philadelphia	39 56	29 8	77·0	47·2	Transatlantic R. Eastern Coast
New York...	40 40	25 3	80 8	55·5	Same system of climate
Rome	41 53	42·1	77·0	34 9	Cisatlantic Region
Milan.........	45 28	33 8	55 2	21·4	Same Region, Interior
Buda	47 20	27 7	71·6	43·9	Interior
Paris	48 50	35·1	69·8	34 7	Nearer the Western Coast
Quebec	46 47	14·0	73 4	59·4	Transatlantic R. Eastern Coast
Dublin	53 21	37·6	60·3	22·7	Western Europe, Insular Climate
Edinburgh ..	55 58	38·3	59 4	21·1	The same
Warsaw.. ...	52 15	27 1	70 3	43 2	Interior of Europe
Petersburg	59 56	8 6	65·7	57·1	Eastern Europe
North Cape	71 0	22·1	46·6	24·5	Insular and Coast Climate

The subject of isotherms has, since the publication of Humboldt's papers, been ably taken up by Professor Dove of Berlin, who has added much to our knowledge of the circumstances by which climate is modified. We have already noticed his polar projection of isothermal lines; and he has also given us a series of normal and abnormal isotherms in his very valuable publications on the distribution of terrestrial temperature. He has contributed not only extended annual isothermal charts, and for the four seasons, but also a series of isotherms for every month of the year. His observations on monthly mean temperature are the result of the discussion of registers kept at 700 stations. His fifth memoir contains those made at 230 new stations; the diurnal variations were collected from 29 stations; and since the publication of his fifth dissertation he has availed himself of the observations made at St Helena, the Cape of Good Hope, Madras, Australia, Hobarton in Van Diemen's Land, and Philadelphia in North America. The intervals between the stations have been filled up from the journals of 27 scientific voyages in the intervening seas. The scientific labour of Professor Dove has been immense, and the results highly interesting. He has also given illustrations of the annual variations of atmospheric pressure, and pointed out their bearings on climate. Dove's valuable charts were published by the Academy of Sciences of Berlin. A translation of this work by Mrs Sabine, with very valuable remarks by Colonel Sabine, has appeared in Britain, under the auspices of the British Association.

M. Dove has pointed out more clearly than had been previously done, the importance to determination of climate, of attention to the *annual* variations of atmospheric pressure; and expresses his surprise, that while *daily* barometric observations have been needlessly marked, so little attention has been paid to the *annual* fluctuations of the instrument. The *diurnal* variation had exhibited great regularity and distinctness in tropical America, and had attracted attention in Europe; but it seems strange that no remark was excited by the fact that barometric pressure was not found to diminish from winter to summer with increasing heat; and the *annual* variations scarcely excited attention.

The observations of Prinsep in Hindustan pointed out that there was a great difference between barometric variations in India and in tropical America; proving that there was in India a very marked *annual* variation; but it was erroneously supposed that this phenomenon did not extend beyond the tropics, and that it was an immediate consequence of the monsoons. The laudable investigations ordered by the Russian government made us acquainted with the meteorology of Siberia; and it was found, that north of the Himalaya, the supposed limit of the monsoon variations, the annual barometric variations are seen on a vast scale, extending even to the shores of the Icy Sea, a greatly diminished atmospheric pressure takes place in summer over the whole continent of Asia, and must produce an influx of denser air from all sides. This is the cause of the prevailing W. winds of Europe, the N. winds of the Frozen Ocean, and the E. winds that prevail on the E. coasts of Asia, and the S.W. monsoon of Hindustan. These facts, and their bearings on climate, have been discussed by Dove with much ability in several memoirs in the Berlin Transactions for 1852, and in Pogendorff's Annalen (58 and 77). The observations made by the British in India, the Cape of Good Hope, in Australia, and especially at Hobarton in Van Diemen's Land, he considers as of particular value; as enabling us to generalize atmospheric phenomena by a comparison of the southern with the northern hemisphere. The following is an abstract of his deductions from his multiplied investigations on this subject:—

1. Both in the north temperate and torrid zones the elasticity of aqueous vapour in the air increases with the temperature. In the region of the monsoons this increase is greatest near their northern limit, as in China and Hindustan. No such increase has been observed in the S. hemisphere. The curve of this elasticity has, however, a less convex summit in the region of monsoons than just beyond it; the elasticity continuing nearly the same throughout the rainy monsoon. Near the equator, the convex curve of the N. hemisphere is first flattened, and then transformed into the concave curve of the S. hemisphere; but in the Atlantic this transition takes place somewhat farther N. of the equator. The annual variation in the torrid zone is generally considerable at all places where equatorial currents prevail when the sun's altitude is greatest, and polar currents when the sun's altitude is least. It is inconsiderable wherever the direction of the wind is either comparatively constant throughout the year, or where its changes are opposite to that above described. In the last mentioned regions, the rate of decrease of the mean annual tension of aqueous vapour, with increasing distance from the equator, is more rapid than in the first class.

2. Over Europe and Asia the pressure of dry air decreases from the colder to the warmer months; and everywhere in the temperate zone has its minimum in the warmest month.

3. On comparing the annual variation of pressure of dry air in northern Asia and Hindustan with that of the Indian Ocean and Australia, we must conclude that something more takes place than a simple periodical transfer of the same mass of air in the direction of the meridian between the north and south hemisphere. From the extent of the phenomenon in the northern hemisphere, we must infer, that with the diminished pressure a *lateral overflow* takes place; and that this is the case is proved by the fact that, at Sitka, on the N.W. coast of America, the pressure of the dry air *increases* from winter to summer. It is improbable that the *overflow* takes place only to the east, but probably also to the west; and on this supposition the small amount of diminution of pressure of the dry air from winter to summer in Europe may arise, not solely from the moderate amount of the difference of

temperature in the hotter and colder seasons, but also from the *lateral afflux of air* in the upper regions of the atmosphere tending to compensate the pressure lost by expansion by heat. As at the northern limit of the monsoons at Chusan and Pekin the annual variation of pressure of dry air is not considerable, while, at the northern limit of the trade winds at Madeira and the Azores in the Atlantic it is very small, it is probable that there is in the torrid zone also a lateral overflow in the upper regions of the atmosphere, from the region of the monsoons to that of the trade winds.

4. From the combined action of the variations of aqueous vapour and of dry air we now derive immediately the periodic variations of the whole atmospheric pressure. As the height of the barometric column is the result of this combination, it may be considered as the result of two forces, one the pressure of dry air, the other the elasticity of vapour; and we can understand that, as with increasing heat the air expands and rises higher, and as its upper portion overflows laterally, while at the same time the increase of heat augments evaporation, and thus increases the quantity of aqueous vapour in the atmosphere, so it follows that the periodic variations of barometric pressure should not everywhere bear a simple obvious ratio to the periodic changes of temperature.

5. Throughout Asia, the increase with heat of the elasticity of vapour is never sufficient to compensate the diminished pressure of dry air; and the annual variation of barometric pressure is, therefore, everywhere represented, in accordance with the law of pressure of dry air, by a curve having its lowest point in July. The Russian observations at Yakoutsk, Udskoi, and Minsk, show this to be true up to the Okhotsk Sea on the east, and to the Frozen Ocean on the north. A tendency to these conditions is perceptible on the meridian of Petersburg, and becomes more conspicuous on approaching the Ural range. On the Caspian, and in the Caucasus, it is very distinctly marked; its limits run south from the western shores of the Euxine to Syria, Egypt, and Abyssinia, where it is found also to prevail. Towards the confines of Europe the general maximum is in September or October, the barometric pressure increasing rapidly from July to those autumnal months, towards the latter part of which a slight convexity or secondary minimum is observed; but beyond the Urals the curves become uniformly concave, with a single summer minimum and winter maximum, which holds throughout the rest of Asia. The little difference between the curve at Madras and Manilla, and the yet considerable curve at Nangasaki in Japan, show that the region in question extends beyond the eastern coast of Asia; at higher latitudes, it is bounded by Kamtschatka. The observations made by the British at Aden show that its western limit extends far in the direction of Africa.

6. In middle and western Europe the annual barometric variation is a decrease from the month of January to spring, and the minimum is in April; it then rises slowly but steadily to September, and rapidly sinks to November, when it usually has its minimum. In summer the increased evaporation more than counterbalances the loss by expansion, probably from a lateral overflow in the upper regions received from Asia. At Sitka the whole annual curve is convex, a result only found in Europe at considerable elevations, where it is the consequence of the expansion of the whole superincumbent mass of the atmosphere.

7. The region of great annual variation on the Asiatic side of the globe, when the monsoons prevail, extends much farther north in the northern than in the southern hemisphere; the variation has its maximum at Pekin, while at Hobarton, at nearly the same distance from the south side of the equator, it is trifling. The reverse is the case generally in the region of the trade winds, and in the Atlantic; for then the annual variation, though nowhere great, is decidedly more on the south than on the north of the equator, as is shown by the results of observations at the Cape of Good Hope, at St Helena, and Ascension Isle, Rio Janeiro, and Pernambuco, compared with the West Indies and the southern parts of the United States. Hence we find but small differences in annual variation between places in the southern Atlantic and southern Pacific in the same latitudes; while we find great inequalities between the N. Pacific and its eastern coasts and the very trifling variation observed in the north Atlantic. The explanation of this latter fact is evidently from the lateral overflow already noticed.

8. It is known that during the eruption of the Souffrière in St Vincent in 1812, volcanic ashes fell on the decks of vessels in large quantities more than 300 miles to the eastward of the volcano, and consequently were carried in the upper currents of the air in a direction against that of the trade winds; and in the eruption of the Coseguina, in central America, in January 1835, volcanic ashes not only fell in Jamaica, a distance of 800 miles to the *east*, but also fell on the decks of ships in the Pacific Ocean 700 miles *westward* of the volcano. The inference is, therefore, that in the higher regions of the atmosphere between the tropics, the aerial currents are not always in the same direction as the lower currents or *trades*, but sometimes is in the opposite, sometimes in the same direction. M. Dove has applied his comparison of the barometric relations of the region of the monsoons to that of the trade winds. Thus, if we suppose the upper portion of the air over Asia and Africa to flow off laterally, and if this take place suddenly, it checks the course of the upper or counter-current above the trades, and breaks into the lower current. An E. wind coming into a S.W. current must necessarily produce a rotatory movement of the air in a direction opposite to the apparent movement of the sun. A rotatory storm from S.E. to N.W. in the trade current would, on this theory, be the result of the encounter of two masses of air impelled against each other at many places in succession, as explained by Dove in his memoir on the "Law of Storms." Thus, the West Indian hurricanes, and the Chinese typhoons, occur near the lateral confines on each side of the great atmospheric expansion. The rarer occurrence of rotatory storms in the S. than the N. tropical Atlantic, arises from the more equal distribution of the periodic diminution of atmospheric pressure in the former than in the latter.

9. It is sufficiently obvious, that the irregular distribution of the land and the sea, which produces the abnormal variations in the form of the isothermal lines, is also the principal cause of the movements of the atmosphere. Thus the monsoons are but a modification of the trade winds, for the cause of which we must look beyond the N. tropic. The form of the Asiatic continent produces the great thermic expansion of the summer air over the interior of the old world, and presents all the characteristic marks of the region of calms, being a centre to which all the adjacent masses of air are drawn. Thus the subtropical atmospheric zone does not, as it were, uninterruptedly encircle the globe. The region over which the heated air ascends, does not therefore move N. or S. parallel with the sun's change of declination, but has rather a fluctuating movement, the fixed point of which is the West Indies, and the maximum of oscillation is over India. The northern excursion of this aerial movement is greater, as we have said, in the northern than in the southern hemisphere. The atmospheric relations of Europe, especially in summer, are therefore essentially of a secondary nature, and we must regard the small alteration in the atmospheric pressure over Europe in the course of the year as a secondary result, of which the explanation would have been exceedingly difficult, without a knowledge of the observations on atmospheric pressure from Asia and Australia.

Climate.

The horary variations of the barometer attracted the attention of Humboldt, and he gave the results in the volume of his travels published in 1825. *1st,* He proved that they are perceptible everywhere, to the height of 12,000 feet above the sea. *2d,* They consist of two ascending and two descending movements daily; the maximum in the morning is between 8½ and 10½ o'clock; the minimum of the afternoon between 3 and 5; the maximum of the evening between 9 and 11, and the minimum of the night between 3 and 5 o'clock. *3d,* In the temperate zone, the periods of maxima and minima are nearer to the passing of the sun over the meridian in winter than in summer by 1 or 2 hours. *4th,* In the torrid zone the times of maxima and minima are the same at the level of the sea, and at 8500 feet above it; but this does not appear to hold in the temperate zone. *5th,* The oscillations are very small about the time of maxima and minima. *6th,* For 15° N. and S. of the equator in the Atlantic and adjacent regions, gales, tempests, and earthquakes do not interrupt the periodicity of these diurnal variations, but on the Indian continent and coasts the rainy monsoons do so, though they do not on the Indian Ocean. *7th,* The diurnal variations are different in different months, and decrease as the latitude augments. The morning maxima is a little higher than that of the evening. *8th,* No observation yet made indicates a sensible influence of the moon on the oscillations of the atmosphere. Those attributed to the moon seem to be owing to the sun, not as a gravitating but as a calorifying body.

The following Tables show the Horary Variations between Lat. 25° S., and Lat. 55° N. from the Level of the Sea to 8500 feet of elevation.

TORRID ZONE.

PLACES OF OBSERVATION.	Minima of the Night.	Maxima of the Morning.	Minima of the Day.	Maxima of the Evening.	Mean extent of Oscillations in 100ths of a millimetre.	OBSERVERS.
Equatorial Atlantic Ocean	4^h	10^h	4^h	10^h	...	Lamanon and Monges.
Equatorial America, between Lat. 23° N. and 12° S. to 1500 toises of height	4½	9¼	4½	11	2·55	Humboldt and Bonpland.
Payta (Peru), Lat. 5° 6′ S.	3	9	3½	11¼	3·40	Duperrey.
Guayra, Lat. 10° 36′ N.	...	9½	3½	10	2·44	Boussingault & Rivero.
Bogota, Lat. 4° 35′ N., height 1366 toises	4	9	4	10	2·29	
Indian and African Seas, Lat. 10° N. 25° S.	4	8½	4	11	...	Horsburgh.
Equatorial Pacific Ocean	3½	9¼	4	10½	...	Langsdorff and Horner.
Sierra Leone, Lat. 8° 30′ N.	5	9½	3¾	10	...	Sabine.
Mysore, Lat. 14° 11′ N., height 400 toises (rainy season)	5	10½	4	10½	...	Kater.
Pacific Ocean, between Lat. 24° 30′ N. and 25° S.	3½	9½	3½	9¾	...	Simonoff.
Macao, Lat. 22° 12′ N.	5	9	5	10	...	Richelet.
Calcutta, Lat. 22° 34′ N.	6	9¼	6	10	...	Balfour.
Equinoctial Brazil, at Rio Janeiro, (Lat. 22° 54′ S.) and at the missions of the Coroatos Indians	3	9¼	4	11	2·34	Dorta, Freycinet, Eschwege.

TEMPERATE ZONE.

PLACES OF OBSERVATION.	Minima of the Night.	Maxima of the Morning.	Minima of the Day.	Maxima of the Evening.	Mean extent of Oscillations in 100ths of a millimetre.	OBSERVERS.
Las Palmas (Great Canary), Lat. 28° 8′ N.	...	10^h	4^h	11^h	$1{\cdot}10^h$	De Buch.
Cairo, Lat. 30° 3′	5^h	10	5	10½	1·75	Coutelle.
Toulouse, Lat. 43° 34′ (mean of 5 years)	...	8½ 10	5½ 2½	11	1·20	Marque Victtor.
Chambery, Lat. 45° 34′, height 13 toises	...	7½ 10	3 2	...	1·00	Billiet.
Clermont-Ferrand, Lat. 45° 46′, height 210 toises	...	8½ 9	4 3	10 9	0·94	Ramond.
Strasburg, Lat. 48° 34′, (mean of 6 years)	5	8½	3½	9½	0·80	Herren Schneider.
Paris, Lat. 48° 50′, (mean of 9 years)	...	9	3	..	0·72	Arago.
La Chapelle, near Dieppe, Lat. 49° 55′	...	9	3	...	0·36	Nell de Bréautté.
Königsberg, Lat. 54° 42′, (mean of 8 years)	...	8½	2½	10	0·20	Sommer & Bessel

Calculation of the effects of the sun's rays.

The variations of the superficial temperature of our earth are produced by the influence of solar heat. These superficial impressions are all produced, either directly or through the intervention of the atmosphere, by the action of the solar rays. It may be calculated from experiment, that the entire and unimpaired light of a vertical sun will communicate one centesimal degree of heat every hour to a sheet of water of a foot in thickness. Consequently, since the surface of a sphere is four times that of its generating circle, such a sheet of water, spread over

the whole of the globe, would receive six degrees of heat every day. But the very inferior capacity of the atmosphere for heat, being estimated as equal to that of a body of water about twelve feet in depth, if the aerial mass finally received and retained all the calorific impressions, it would every day have its temperature raised half a degree, and therefore augmented to $182\frac{1}{2}°$ in the course of a whole year. This annual accession of heat, however, is quickly dispersed by the mobility of the fluid medium, and gradually absorbed into the earth, or more quickly diffused through the waters of the ocean, which, besides, occupy at least three-fourths of the whole surface of our globe The luminous matter communicated by the incessant shining of the sun, whether received on the ground or intercepted in its passage through the air, would hence be capable of communicating one centesimal degree of heat to the body of the earth in the space of 1323 years; a quantity too small, perhaps, to be yet perceived, though its influence may be afterwards detected by very delicate observations.

It is easy to demonstrate, from the laws of optics, that the quantity of light which falls on a horizontal surface must be proportional to the sine of its obliquity. Hence the aggregate light received under the equator at either equinox is to what would accumulate during 24 hours, if maintained at its highest intensity, as the diameter to the circumference of a circle. This daily accession of heat, confined to the mass of atmosphere, would, therefore, in that climate and season, amount to 633,000 parts of a degree. At the pole itself, during the complete circuit of the sun in midsummer's day, the measure of heat would be about a fourth part greater, or 797,000 parts; the continued endurance of the sun above the horizon more than compensating for the feebleness of his oblique rays.

In general, the quantity of light received at any place from the sun in the space of one day is denoted by the product of the sine of the semidiurnal arc, or the distance from noon to the time of sunset, into the cosines of the latitude and declination, joined to the product of that arc itself into the sines of the latitude and declination: the latter part of the expression being considered as additive or subtractive, according as the declination lies on the same or on the opposite side of the latitude. Hence, at Edinburgh, in the latitude of 56°, the heat collected during one day at the summer solstice is 307,000 parts, but at the solstice of winter only 166,000.

If a current of air from the equator, having the ordinary temperature of 27°·5 C., were supposed to travel to the pole, from which an equal and contrary current would consequently flow towards the equator, each journey would transport 55° of heat. Between two and three such journeys performed every year would therefore be sufficient to disperse the whole accumulation of 138°. This only requires the existence of a wind advancing northwards at the rate of 46 miles every day. It is not necessary even that the wind should either continue permanent or blow directly north. The same effect would be produced if it were to blow indifferently to every point of the compass, and only at the rate of three miles an hour; a supposition which agrees tolerably with actual observation.

The circulation excited in the body of our atmosphere thus prevents the heat shed by the sun on different parts of the earth's surface from an excessive accumulation. In proportion as the equatorial regions grew warmer from the predominance of illumination, the polar wind would rush with more rapidity, till it had tempered the excess. This balance of the accession, and the consequent dispersion, of heat, has probably been long attained, and it now regulates the gradation of climates in successive latitudes.

The equilibrium of temperature preserved over the globe by the circulation of the atmosphere is not, however, very quickly produced. Hence the remarkable increase of heat which takes place during the summer months in the higher latitudes. But within the arctic circle, another powerful agent of nature is constantly tempering the inequality of the seasons. The vast beds of snow or fields of ice which cover the land and the sea in those dreary retreats, absorb, in the act of thawing or passing again to the liquid form, all the surplus heat collected during the continuance of a nightless summer. The rigour of winter, when darkness resumes her tedious reign, is likewise mitigated by the warmth evolved as congelation spreads over the watery surface.

Of the light received from the sun, a considerable portion is always detained and absorbed in its passage through the atmosphere. Even a vertical ray, shot through the clearest air, will lose more than the fifth part of its intensity before it reaches the surface of the earth. In most cases, the loss which light will suffer in the shortest transit through the atmosphere may be estimated at one-fourth of the whole. But the oblique rays must undergo a much greater absorption. If, from their slanting course, they have to encounter twice the number of aerial particles, their intensity must be reduced to $\frac{9}{16}$ths, or the square of three-fourths; and if they describe triple the vertical tract, only $\frac{27}{64}$th parts, or the cube of three-fourth, will reach the ground. In general, if the tracts of light follow an arithmetical progression, the diminished force with which it escapes and arrives at the ground will form a decreasing geometrical progression. To determine the train of aerial particles which the oblique rays of the sun must traverse in their passage through the atmosphere, is a nice problem, which requires a skilful application of the integral calculus. Without stopping to engage at present in the details of this intricate investigation, it may suffice to remark, that, in general, the length of the tract is nearly in the inverse ratio of the sine of the sun's altitude. But the following table, to every five degrees, is calculated from rigorous formulæ, the length of oblique tract being reduced to the standard of air uniformly dense. These quantities again are diminished in the ratio of the sine of obliquity, to express the calorific action which those enfeebled and slanting rays finally exert at the surface of the earth.

Sun's Altitude.	Measure of Atmospheric Tract.	Intensity of the Light transmitted.	Calorific Action at the Surface.
90°	1·000	·750	·740
85	1·004	·749	·747
80	1·015	·747	·735
75	1·035	·742	·717
70	1·064	·736	·691
65	1·103	·728	·660
60	1·154	·718	·609
55	1·220	·704	·577
50	1·305	·687	·526
45	1·413	·666	·454
40	1·554	·640	·411
35	1·740	·606	·348
30	1·995	·563	·282
25	2·359	·507	
20	2·905	·434	·214
15	3·841	·331	·148
10	5·610	·199	·086
5	10·450	·050	·035
0	37·850	·00002	·004

It hence appears that, even when the sky is most serene, only one-half of the sun's light can reach the surface of the earth from an altitude of 25°, or one-third from that of 15°, and that, if the obliquity of the rays were increased to 5°, no more than the twentieth part of them would actually be transmitted. The annual quantity of light which

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Influence of the sun's rays upon seas and lakes.

The light which at last gains the surface being there absorbed and converted into heat, is, in this form, profusely delivered to the ambient air, or more feebly conducted downwards into the body of the earth. But the rays which fall on seas or lakes are not immediately arrested in their course; they penetrate always with diminishing energy, till, at a certain depth, they are no longer visible. This depth depends, without doubt, on the clearness of the medium, though probably not one-tenth part of the incident light can advance five fathoms in most translucid water. The surface of the ocean is not, therefore, like that of the land, heated by the direct action of the sun during the day, since his rays are not intercepted at their entrance, but suffered partially to descend into the mass, and to waste their calorific power on a liquid stratum of ten or twelve feet in thickness.

But the surface of deep collections of water is kept always warmer than the ordinary standard of the place, by the operation of another cause, arising from the peculiar constitution of fluids. Although these are capable, like solids, of conducting heat slowly through their mass, yet they transfer it principally in a copious flow by their internal mobility. The heated portions of a fluid being dilated, must continue to float on the surface; while the portions which are cooled, becoming consequently denser, will sink downwards by their superior gravity. Hence the bed of a very deep pool is always excessively cold, since the atmospheric influences are modified in their effects by the laws of statics. The mean temperature of the climate is not communicated by these variable impressions; every change to warmth being spent on the upper stratum, while every transition to cold penetrates to the bottom, which thus experiences all the rigours of winter, without receiving any share of the summer's heat. But, if the beds of profound bodies of water remain perpetually cold, their surface undergoes some variety of temperature, and is generally warmer than the average weekly or monthly heat of the air.

These principles are confirmed by observations made on our own lakes, and strikingly exemplified in those of Switzerland, which have a depth proportioned to the stupendous altitude of their encircling mountains. It appears, from the careful observations of Saussure, that the bottoms of those majestic basins, whether situated in the lower plains or embosomed in the regions of the upper Alps, are almost all of them equally cold, being only a few degrees above the point of congelation. That accurate observer found the temperature of the Lake of Geneva, at the depth of 1000 feet, to be 42°, and could discover no monthly variation under 160 feet from the surface. In the course of July he examined the Lakes of Thun and Lucerne; the former at the depth of 370, and the latter at that of 640 feet, had both the temperature of 41°, while the superficial waters indicated respectively 64° and 68½° by Fahrenheit's scale. The bottom of the Lago Maggiore, on the Italian side of the Alps, was a little warmer, being 44° to the depth of 360 feet, while the surface was almost as high as 78°. Barlocci has since found that the Lago Sabatino, near Rome, at the depth of 490 feet, was only 44½°, while the thermometer, dipped at the surface, marked 77°.

Through the friendship of Mr James Jardine, civil engineer, we are enabled to give the results of his observations on some of the principal Scottish lakes, which, as might be expected from him, were conducted with the most scrupulous accuracy. The instrument which he employed for exploring the temperature at different depths was free from the ordinary objections; being a register thermometer, let down in a horizontal position, which could acquire the impression in not many seconds, and might be drawn up leisurely, without risk of subsequent alteration. It would appear that the variable impressions of the seasons do not penetrate more than 15 or 20 fathoms; that below this depth an almost uniform coldness prevails. Thus, in the deepest part of Loch Lomond, on the 8th September 1812, the temperature of the surface was 59°·3 of Fahrenheit; at the depth of 15 fathoms, 43°·7; at that of 40 fathoms, 41°·3; and from that point to about 3 feet from the bottom, at 100 fathoms, it decreased only the fifth part of a degree. Again, on the preceding day, the superficial water of Loch Katrine being at 57°·3, the thermometer, let down 10 fathoms, indicated 50°·6; at the depth of 20 fathoms it marked 43°·1; at the depth of 35 fathoms it fell to 41°·1; and on the verge of the bottom, at 80 fathoms, it had only varied to 41°. At the same place, on the 3d September 1814, the heat of the surface was 56°·4; at the depth of 10 fathoms, 49°·2; at that of 20 fathoms, 44°; at that of 30 fathoms, 41°·9; and at that of 80 fathoms, 41°·3.

Hence it is that, even in the northern latitudes, the deep lakes are never, during the hardest winters, completely frozen over. But if the same water be let into a shallow basin, it will, in a rigorous season, be chilled thoroughly, and converted into ice. This may even happen when spread above the surface of salt water, which is always considerably denser. Thus, frost takes no effect on Loch Ness, nor on the river of that name, which, in a rapid course of a few miles, discharges the surplus water into the sea. But in very severe winters a sheet of ice appears formed along the shore; the impressions of cold being almost wholly expended on the accumulation of fresh water, since the chilled portions of this, which continually descend, are stopped in their progress by the greater density of the recumbent sea-water.

The seas and the ocean itself obey the same law of the distribution of heat, only the difference of temperature experienced by sounding in the Mediterranean is less conspicuous than in the fresh-water lakes. Saussure found that the temperature at the bottom, in the Gulfs of Nice and of Genoa, at the depths of 925 and of 1920 feet, was the same, or 55°·8, the heat of the superficial water being about 69°. But the mean temperature, or that of the body of the land on the same parallel of latitude, is 59°. The smallness of the diminution here observed may perhaps be attributed to the effect of evaporation in such hot confined bays, the water at the surface being thus rendered salter, and consequently disposed, by its acquired density, to sink into the colder mass below.

In open seas, and in damper climates, the depression of temperature is greater in the inferior strata. This difference becomes augmented in proportion to the extreme variation of the seasons. Lord Mulgrave, on the 4th September 1773, in the latitude of 65° north, drew up water from the depth of 4100 feet, which he found to have the temperature of 40°, while the thermometer, dipped at the surface, stood, on the 19th June, at 55°. In the later experiments of Sir James C. Ross, the oceanic temperature at vast depths was found to remain stationary at about 40° Fahr. In the antarctic seas, in the year 1840, he found, when the surface temperature was 32°, at 400 fathoms it was 38°·8; at 600 fathoms it was 39°·8; and in December of 1841, in the S. Atlantic, when

the surface was at 53°, at the depth of 1050 fathoms, the register thermometer just indicated 40°, and sank no lower at greater depths. In the following year, he found, a little to the north of Ascension Island, when the surface temperature was 42°, at 600 fathoms it stood just at 40°, and sank no lower when let down to the enormous depth of 4600 fathoms, 27,600 feet, or above 5 miles. In the still deeper soundings of Captain Denham in 1852, at a depth of 46,236 feet, or above $8\frac{3}{4}$ miles, the temperature was still 40°.

A like gradation of temperature is produced by the alternating influence of the seasons in deep and stagnant masses of air. When this active fluid is confined in profound caverns, opening to the sky without being much exposed, and either perpendicular or gently inclined, its lower strata become intensely and permanently cold. The mild air of summer floats motionless at the mouth of the pit; but, in winter, the superior air, cooled many degrees perhaps below the freezing point, and therefore greatly condensed, precipitates itself continually to the bottom.

This fact takes place in most caverns, and in draw-wells which are left uncovered. Saussure found, on the 1st of July, when the thermometer in the shade stood at 78° of Fahrenheit, that a cave in the Monte Testaceo, a small hill in the vicinity of Rome, formed entirely by the enormous accumulation of broken pottery, had the temperature of 50°; and two other caves in the same porous mass were cooled to 44°. On the 9th July, when the external air was at 61°, the cave of St Marino, at the foot of a sandstone hill about 2080 feet above the level of the sea, indicated only $44\frac{1}{2}$°, which is 8° below the mean temperature of the soil in that situation. In the grotto of Ischia, and in the caves of Cesi and of Chiavenna, the thermometer marked likewise $44\frac{1}{2}$°; but in the caves of Caprino, on the borders of the Lake of Lugano, it stood at different times of the year at 37° and 42°; and in those of Hergisweil, near Lucerne, the heat of the interior on the 31st of July was only $39\frac{1}{2}$°.

But this phenomenon is still more striking in certain peculiar circumstances. The famous Swedish mine of Dannemora, which yields the richest iron ore in the world, presents an immense excavation, probably two or three hundred feet in depth. On the occasion of some repairs which suspended the usual labours, the basin appeared some years since full of water, with huge blocks of ice floating in it. The silver mine of Königsberg, in Norway, has for its main shaft a frightful open cavern, perhaps three hundred feet deep and thirty feet wide, of which the bottom is covered with perpetual snow. Hence, likewise, on the sides of Ætna and of the mountains in Spain, the collected snows are preserved all the year in caves and crevices of the rocks, from which natural stores the muleteers carry down, during summer, to the villages and the cities of the plain, a material so necessary to comfort in those parched climates.

Absolute quantity of heat the same at every elevation.

Such is the disposition induced in a confined column of air; but in a free atmosphere the gradation of temperature is exactly reversed, the lower strata being invariably warmer than the upper. This most important fact in meteorology and physical geography was thought sufficiently explained, in the infancy of physical science, from the proximity of the heat supposed to be reflected by the surface of the earth. But it were idle to attempt any serious confutation of such crude ideas. The true cause of the cold that prevails in the higher regions of the atmosphere is undoubtedly the enlarged capacity which air acquires by rarefaction. From the unequal action of the sun's rays, and the vicissitudes of day and night, a quick and perpetual circulation is maintained between the lower and the upper strata; and it is obvious that, for each portion of the air which rises from the surface, an equal and corresponding portion must likewise descend. But that which mounts up, acquiring an augmented attraction for heat, has its temperature proportionally diminished; while the correlative mass falling down, carries its share of heat along with it, and, again relaxing its attraction, seems to diffuse warmth below. A stratum at any given height in the atmosphere is hence affected both by the passage of air from below and by the return of air from above, the former absorbing a portion of heat, and the latter evolving it. But the mean temperature at every elevation is on the whole still permanent, and consequently those disturbing causes must be exactly balanced, or the absolute measure of heat is the same at all heights, suffering merely some external modification from the difference of capacity in several portions of the fluid with which it has combined. That temperature is hence inversely as the capacity of air having the rarity due to the given altitude.

Investigation of the increased capacity of rarefied air.

It only remains, therefore, to discover the capacity of air, or its attraction for heat under successive pressures, or at different degrees of rarity. But this problem requires a very nice investigation, and appears incapable of being resolved by any direct procedure. If the elaborate experiments of Dr Crawford and others on the capacity of air in its ordinary state gave such erroneous results, what hope could be formed of ascertaining even its minute shadings, by any similar plan of operation? But, independently almost of any theory, a simple method occurs for conducting this research. A delicate thermometer, suspended within the receiver of an air-pump, indicates a decrease of temperature as the process of rarefaction advances; and, on stopping this operation at any stage, the thermometer will slowly regain its former state. If now, when the equilibrium is restored, the air be suddenly readmitted, the dilated portion which had remained in the receiver liberates the heat absorbed by it during the progress of rarefaction. The thermometer accordingly rises quickly through a certain space, then becomes for a short while stationary, and afterwards slowly subsides. But the instrument does evidently not measure the whole of the heat thus evolved; a great part of it being spent in warming up to the same point the internal surface of the receiver. This action, however, is merely superficial, since its effect appears to be momentary. Consequently, the internal surface of the receiver, with that of the plate on which it stands, as penetrated by the sudden impression to a certain very minute depth, forms a constant film of matter, which as well as the body of air itself, draws its supply from the extricated heat. Under the same receiver, therefore, although the air will not seize the whole of the heat disengaged in the act of admission, it must always retain a proportional share of it. A series of experiments, at successive degrees of rarefaction must hence discover, if not the absolute, yet the relative changes of the air's capacity for heat.

Details of the experiment.

To institute this inquiry with the desired success, an excellent and powerful air-pump was used, having a receiver of the very largest dimensions, of an oblong spheroidal form, approaching, however, nearly to the globular, and with a narrow bottom. The apparatus being placed in the middle of a close room, which had a steady temperature, a thermometer with a slender stem, open at top, and a small bulb of extreme sensibility, was fixed in a vertical position, a few inches above the centre of the plate. Having replaced the receiver, and allowed it to stand some time, one-fifth of the air was now extracted from under it; and, after a considerable interval, the cock was suddenly opened, to restore the equilibrium; when the mercury of the thermometer, which had been stationary, mounted up very rapidly 3·0 centesimal degrees, from which point it afterwards slowly descended.

The temperature of the room having been regained, two-fifths of the air in the receiver were then extracted; and after some lapse of time, the external communication being repeated, the thermometer rose instantly 5·3 centesimal de-

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grees. On extracting three-fifths of the internal air, the corresponding ascent of the thermometer, at the restoration of the equilibrium, was 7·0 of those degrees; and, when the contents of the receiver had been rarefied five times, the heat evolved, on the re-admission of the air, amounted to 8·0 degrees. The rate of progressive effect was thus evidently diminishing. On pushing the rarefaction as far as it was really practicable, or till the residual air had become rarefied about 300 times, the change indicated by the thermometer did not reach to more than 8·3.

But, to determine the absolute quantity of heat which is disengaged in the transition of air from a rarer to a denser state, it becomes necessary to ascertain what part of it was consumed on the sides of the receiver. By varying the size of the receiver, and consequently altering the proportion between its surface and its contents, some light may be thrown on this question. Another similar receiver was therefore provided, having half the former dimensions; and with this the same set of experiments was repeated. Its included air being reduced successively to the density of four-fifths, three-fifths, two-fifths, and one-fifth, and then rarefied as much as possible, the thermometer mounted each time through the shorter spaces of 1·8, 3·2, 4·2, 4·8, and finally 5·0 centesimal degrees. These quantities evidently follow the same proportion as the former, of which indeed they are only three-fifths. But the smaller receiver, having, under the fourth part of the surface of the larger, only the eighth part of its contents, exposes comparatively twice the extent of surface. The rise of temperature which its included air exhibits must consequently be the same as what would have obtained within the larger receiver, if, while its capacity remained the same, its surface had been actually doubled. If we suppose the air to hold one part of the heat, while two parts and four parts are respectively expended on the insides of the receivers, the results would correspond with observation; for the whole quantity evolved being in both cases the same, the air under the larger receiver would retain one-third, and under the smaller receiver only one-fifth; the impressions being thus in the ratio of five to three. The same conclusion may be obtained somewhat differently. If the heat spent on the inside of the larger receiver had been spread over twice the surface, it would have raised the temperature only 1°·5; but this mounted really to 1°·8, and therefore the difference ·3 was the effects of 1°·8 derived from the contained air. Of the heat thus shared between the air and the doubled surface, one part was hence retained and five communicated. Consequently, to obtain the true results, it is only necessary to multiply the second set of quantities by five, or the first set by three. If no waste, therefore, took place against the inside of the receiver, the heat evolved in the passage of air from the densities of four-fifths, three-fifths, two-fifths, one-fifth, and extreme rarefaction, to its ordinary state, would be 9, 16, 21, 24, and 25 centesimal degrees.

Inferences.

It is not difficult to discover the law of this progression. They are obviously formed by the successive addition of the odd numbers 9, 7, 5, 3, and 1; and are, consequently, the excesses of the square of 5 above the squares of 4, 3, 2, and 1. Wherefore, if the square of the density be taken from unity, the remainder, multiplied by 25, will express in centesimal degrees the rise of temperature which accompanies the return of the air to its ordinary state.

The numbers thus obtained, however, do not still express the final results. If the restoration of four parts of the air included under the receiver to their usual density, disengage heat sufficient to raise the temperature of the whole five parts 9 degrees, its real measure must have been $11\frac{1}{4}$ degrees, or the former augmented in the ratio of 4 to 5. For the same reason, if three-fifths, two-fifths, and one-fifth of the air in the transition of density, evolve portions of heat which would elevate the temperature of the mass 16, 21, and 24 degrees, the actual quantities are $26\frac{2}{3}°$, $52\frac{1}{2}°$, and 120°, or those numbers multiplied by 5, and divided by 3, 2, and 1.

General conclusion.

These conclusions are easily reduced to formulæ. Let θ denote the density of the air, and $25\,(1-\theta^2)$ will express, in centesimal degrees, the elevation of the thermometer which would follow the re-admission of the air, if none of the heat were spent on the inside of the receiver. Consequently, $25\left(\frac{1-\theta^2}{\theta}\right)$, or $25\left(\frac{1}{\theta}-\theta\right)$, will exhibit on the same scale the whole quantity of heat evolved in the restoration of density. The last formula is extremely simple, implying that 25, multiplied into the difference between the density of air and its reciprocal, will represent the measure of heat due to the change of condition. This result may be either additive or subtractive; it may express the heat emitted in the condensation of air, or the heat absorbed during its opposite rarefaction.

Application of the formula.

Thus, the heat extricated from air which has its density doubled is $25°\,(2-\frac{1}{2})$, or $37\frac{1}{2}°$; and the same quantity is withdrawn, either when this air recovers its former density, or when air of the ordinary state expands into double its volume. Hence the copious heat extricated by the sudden compressiou of air. If it were condensed thirty times, the heat discharged would amount to $25\left(30-\frac{1}{30}\right)$, or 749°, which is more than sufficient for the inflammation of fungous or soft substances. On this principle are constructed the pneumatic matches invented by Mollet of Lyons, which produce their effect by the momentary action of a small syringe.

But, to discover the relative capacity or attraction which air of a given density has for heat, it would be necessary to know the extent of the natural scale, or the position of the absolute zero. The conclusions, however, from different data, are not very constant; yet several experiments appear to fix nearly the point from which the infusion of heat commences at 750 centesimal degrees below congelation. On this supposition, therefore, air which is rarefied thirty times has its capacity doubled, the heat contained in it being dilated only fifteen times. For the same reason, air sixty times rarer than ordinary acquires a triple attraction for heat, which, in this union, becomes attenuated only twenty times. But these inferences are merely speculative, and the law of the gradation of temperature in the atmosphere is quite independent of the existence of an absolute term of heat.

The last formula now investigated has been already laid before the public, without any explication, however, or indeed indication, of the process by which it was discovered. The experiments on which it rests were begun many years since, and have been repeated with every precaution. But the mean results only are retained; and, for the sake of simplicity, a few slight modifications have been introduced, to adapt the apparatus to more convenient proportions. Though it was impossible to blow a receiver that should have *exactly* half the dimensions of another, nothing seemed easier, from the general mode of investigation, than to apply the minute corrections which any small deviations of size or form required. The mixture of obscure and intricate computations has been thus avoided.

Since the absolute quantity of heat contained in every part of any vertical column of the atmosphere has been shown to remain unchanged, this formula must likewise represent the diminution of temperature in the higher strata corresponding to the decreased density of the air at different elevations. The same formula will determine the measure and gradation of this effect. Reckoning the density of the air at the surface of the earth unity, the difference between the density at any given altitude and its reciprocal, being multiplied by 25, will express the mean diminution of tem-

perature in centesimal degrees; or if 45 be employed as the multiplier, the product will exhibit the same result in degrees of Fahrenheit's scale.

This very simple deduction from theory is amply confirmed by numerous and extensive observations. But a few leading facts will perhaps be deemed sufficient for exemplification.

Examples of the application of the formula

According to Lasius, the same barometer which, at Goslar, an ancient town seated in the bosom of the Hartz Forest, stands at 29,500 inches, would fall to 26,444 on the top of the Brocken, in that mining district. This gives ·896 for the density of the air on the summit, the reciprocal of which is 1·116; but $1·116-·896=·22$, and $·22 \times 25° = 5°·5$, the calculated difference of temperature. The actual difference is very nearly the same, being only 5°·2; as we had once an opportunity ourselves of observing, having found the temperature of a copious spring at Goslar to be eight centesimal degrees, while that of the noted Hecken-Brunnen, or *Witch-Well*, on the summit of the Brocken, was only 2°·8.

Saussure, whose accuracy always inspires confidence, found that, while at his villa of Conche, near Geneva, the barometer stood at 28·500, another similar instrument fell to 25·165 on the top of the mountain of Nant Bourant. The diminished density of the air at this elevation was, therefore, ·890; the difference between which and its reciprocal 1·123 being multiplied by 25°, gives 5°·82. But a thermometer buried a whole night at two feet deep in that lofty station marked only 12°·75, while it indicated 6°·25 more, or 19°, a few days afterwards, when sunk to the same depth at Conche. The discrepancy here is thus less than half a degree.

to the temperature of the ground;

On the top of a higher mountain, the Chapieu, the same observer found the ground, at a depth of two feet, to be colder by 6°·44 than at Conche; but the corresponding density of the air and its reciprocal were ·872 and 1·147; consequently, $2° \times ·275 = 6°·87$.

While the barometer at Conche stood at 28·500 inches, the mercurial column was only 19·836 inches on the summit of Mont Cervin, a still loftier mountain. The density of the air at this elevation was therefore ·696, which being taken from its reciprocal 1·437, leaves ·741 to be multiplied by 25°, including 18°·52 as the diminution of temperature. The actual medium difference ascertained from corresponding thermometrical observations, made at depths in the ground from one to three feet, on the top of Mont Cervin and at Conche, was 18°·25, almost exactly the same.

Such is the nice agreement on the whole, between theory and observation, with regard to the decrease of the mean temperature in the higher regions of the atmosphere. This gradation of cold varies, however, to a certain extent with the seasons. Since the heat derived from the sun is chiefly accumulated at the surface of the earth, the changes of temperature which take place through the year in the elevated strata of our atmosphere must evidently be less than what are experienced below. The lofty tracts of air, remote from the primary scene of action, preserve nearly an equable temperature, and scarcely feel the extreme heat of summer or winter's frost. In ascending the atmosphere, the decrease of warmth is hence more rapid in the fine season, and more slow in the darkened period of the year. In many places, it will not be far from the truth, perhaps, to assume 30° for the multiplier during the summer months, and only 20° during those of winter.

and to that of the atmosphere.

Thus General Roy, a diligent and experienced observer, found, in the month of August, the air on the top of Snowdon was, in the course of a whole day, at an average, 7·2 centesimal degrees colder than on Caernarvon quay; but the difference between the density at that elevation and its reciprocal, or between ·878 and 1·139, being only ·261, would require nearly 28 for the multiplier.

In the early part of September, the same observer noticed the centesimal thermometer to stand 10 degrees lower on the top of Ben Lawers than at Weem, the relative density of the air at that height being ·868. The difference from its reciprocal is ·284, which would hence require to be multiplied by 35 to give the actual diminution of temperature.

Again, Saussure found, on his visit to Mont Blanc, the air on its summit to be 31 centesimal degrees colder than at Geneva. The relative density was ·592, which being taken from its reciprocal 1·689, leaves 1·097; consequently the multiplier required is 28.

This ingenious philosopher passed several days encamped on the Col du Géant, where he found, from the mean of eighty-five observations, the temperature of the air to be only 4°·54, or 20°·3 colder than at Geneva; but the relative density of that elevated stratum and its reciprocal were ·704 and 1·420; the difference of which, or ·716, would require to be multiplied by $28\frac{1}{2}$ to indicate the diminished temperature.

The observations made on the decreased temperature of the higher regions of the atmosphere by the ascension of balloons, appear generally to indicate rather a slow rate of diminution; but it should be recollected that those daring aerial flights have seldom been performed except in the fine season of the year. Besides, the car, the balloon, and its cordage, will not immediately acquire the temperature of the elevated strata, but continue for a considerable time to diffuse a sensible portion of heat. A memorable example, however, is entirely conformable to the general principle. Charles, the first who ascended the atmosphere by means of a balloon filled with hydrogen gas, found, on the 1st of December 1783, the thermometer depressed 11 centesimal degrees at the greatest elevation, the column of the barometer having sunk from 29·24 to 20·05 inches. This would require a multiplier less than 20.

Origin of glaciers.

The curve of perpetual congelation must evidently rise higher during the tide of summer, and again descend in the winter months, thus oscillating between certain limits of elevation. The intervening belt is narrow under the equator; but it enlarges to a very considerable extent in the higher latitudes. On the breadth of this zone, where frost holds a doubtful reign, depends the formation of *glaciers* along the flanks of the snowy mountains. The fields of snow which are alternately melted and congealed, become at last changed by this process into ice, often grouped and fashioned by such irregular action into the most fantastic shapes. In its native seat, this icy belt acquires continual additions to its height, till the accumulating pressure urges it downward, and at last precipitates its fragments to a lower level. In its new position, below the inferior boundary of congelation, the enormous pile suffers, on the whole, a very gradual thaw, which is sometimes protracted for several centuries. Meanwhile, in the higher magazine, another belt is again slowly collecting, which will in due time repeat the succession, and maintain the perpetual circle of production and decay.

Within the tropics, the zone of undecided frost is so very narrow, that scarcely any trace of a glacier has been ever observed. But as that zone enlarges in the higher latitudes, the appearance of vast glaciers constitutes a very striking feature in the aspect of the lofty mountains. They occur frequently along the sides of the Pyrenees, but they are still more conspicuous in the recesses of the central chain of the Swiss Alps. Glaciers are likewise seen as far north as the verge of the arctic circle. Along the western shore of Norway and the coast of Lapland, stretching onwards to the promontory of the North Cape, huge masses of glacier ice descend from the cliffs, or against the precipitous sides of the mountains, almost to the surface of the ocean.

Climate is affected by the intensity of solar light, or what

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has been termed *insolation*. This influence was not much remarked until of late years. The effect of light on the colour of plants, indeed, attracted the attention of philosophers in the last century, especially of Ingenhouz and Sennebier; and practically, the effect of *etiolation*, or blanching of vegetables growing in darkness, was known to gardeners. But the effects of light on animals attracted little attention. Some had remarked the comparative rarity of bodily defects in the natives of hot climates where the light is strong; but the experiments of Dr W. F. Edwards on tadpoles proved that light exerts considerable influence on the animal frame. He showed, that if one portion of the same brood be exposed to light, while another portion was suffered to live in darkness, while every other circumstance was the same in each, that the change to the perfect frog took place far sooner in those exposed to light than in those kept in darkness, the latter arriving almost to the size of their parents before the change took place. Instruments, therefore, for measuring the degree of solar light form now part of a meteorological apparatus. Two instruments of this sort are chiefly employed, the actinometer and the photometer of Professor Leslie. The former consists of a thermometer with a large oblong bulb, and filled with a dark coloured fluid. As it has no fixed point, it is reduced for each observation to a zero by means of a screw acting on the elastic extremity of the bulb, formed of a slip of caoutchouc; the instrument, in a case covered by a glass, is exposed to the direct rays of the sun, and its rise then noted. It affords comparative indications of the intensity of solar light.

Photometer.

For measuring the intensity, or at least the calorific action of light, no instrument is so finely adapted, by its peculiar delicacy, as the *Photometer*, which consists of a *Differential Thermometer* inclosed in a thin pellucid case, and having one ball made of black and the other of clear glass. It will besides admit of some variety in its form and construction, and may be rendered on the whole very commodious and portable. Yet, owing to a combination of circumstances, this elegant instrument has only been partially and reluctantly admitted; and the philosophic world has still to discharge an act of justice, by receiving it into the favour and distinction which it so well deserves. Some, indeed, affecting to display superior sagacity, have taken the trouble to remark that it was only a species of thermometer, and not strictly a photometer, since it measures heat and not light. But what does the thermometer itself indicate, except *expansion?* As heat is measured by the expansion it occasions, so light is determined by the intensity of the heat which, in every supposition, invariably accompanies it. What other mode, after all, could be imagined for detecting the presence of light? How can an unknown quantity be expounded, but in terms of one already known?

Importance of that instrument.

The photometer is adapted for a variety of important meteorological researches. If such instruments, in the hands of skilful observers, had been dispersed to the remote regions of the globe, we should ere now have obtained a body of precise facts, highly instructive in themselves, and calculated to illustrate the nature of different climates. Meanwhile, we shall endeavour to state the general consequences which may be drawn from even a scanty range of photometrical observations.

The direct and absolute action of the sun's rays on the photometer, at the elevation of 30°, may be reckoned in this climate at 120 millesimal degrees. The effect is produced by the incidence of a pencil of light, which has for its base a circle of the same diameter as the black ball, but modified and regulated in its amount by the subsequent dispersion of the accumulated heat from the whole surface of the sphere, which is four times greater than that of the generating circle. If a thin disc were, therefore, substituted instead of the ball, and presented to the perpendicular rays of the sun, the impression would be doubled, or raised to 240°; or if the emission of heat from the posterior surface of the disc were prevented, the calorific effect would amount by this accumulation to 480°, or 86° on Fahrenheit's scale. Such is the rise of temperature which a dark surface of dry mould, sloping at an angle of 30°, yet exactly fronting the sun, might acquire under a diaphanous shell of glass, if scarcely any portion of the heat were supposed to be conducted downwards into the mass of the earth. But since the rays of light which traverse the atmosphere under an obliquity of 30° have, in comparison with perpendicular beams, their force diminished in the ratio of 750 to 563; the action of a vertical sun, through a thin capsule of glass, might heat up a dark horizontal surface, 113° by Fahrenheit's scale. On removing the glass cover, this effect, in a calm still air, would be reduced about two-thirds, or to $75\frac{1}{2}$°.

Calorific action of the rays in different circumstances.

It is obvious that the accumulated effect of the incident rays much increase in proportion as the conducting power of the medium is diminished. Hence, at an elevation of three miles and a half, where the density of the atmosphere is reduced to one-half, the heat communicated would, on this account alone, augment from $75\frac{1}{2}$ to 83 degrees. But the effect would be further increased, from the smaller absorption of heat in its passage to the surface. Under the equator, the whole accumulated action would, therefore, amount to 96 degrees. All travellers, accordingly, complain of the scorching rays which the sun darts from a dark azure sky on the summits of lofty mountains. Yet the contrast is more striking in the higher latitudes. Thus, in the middle parallel of 45°, the action of the sun at the summer solstice would excite a heat of 69° at the level of the sea, and of 90° at an elevation of three miles and a half; but at the winter solstice it would communicate only 17° below, and 46° at the altitude assumed. Saussure was accordingly very much struck with the force and brilliancy of the sun-beams on the top of Mont Blanc.

It might easily be computed that, on the supposition of a perfect calm, the surface of the earth under the equator, will, at the medium of a year, have its temperature raised 12°; and that, in the latitude of 45°, the mean annual impression would be only 5°. But, of the whole of the light received, the calorific action on a black mould, whether emitted from the sun or shed indirectly by the sky, may be deduced from the indication of the photometer. It is only required to diminish the power of the sun's rays in the ratio of the sine of their obliquity, and to reduce the action of the light reflected from the canopy of clouds to one-half, or what is due to the medium inclination of 30°, then to multiply the sum of these quantities by eight, and divide by three, or to take two-thirds of the quadrupled effect. Thus, suppose, while the sun's altitude is 40°, that the photometer marks 155°, which it very seldom ever reaches in this climate, and that it indicates only 20° if merely screened from the direct action of the sun. Now, 155° multiplied by the sine of 40° makes 87°·8, which is augmented to 97°·8 by the addition of the half of 20°; and this number again being increased in the ratio of 3 to 8, gives finally 261 millesimal degrees, or 47° on Fahrenheit's scale. When the sun is obscured in clouds, the reflected light, from a dappled sky, will sometimes in summer affect the photometer to the extent of 50°. This corresponds to a heat of 16° of Fahrenheit communicated to the ground. During the fine season the photometer seldom in cloudy weather indicates less than 15°, which is equivalent to an impression of 6° on the embrowned surface of the earth. While the sun is enveloped in clouds, if the rest of the sky assumes a fine azure hue, the photometer will only mark 10°. But in the gloomy days of winter, the minute portion of light which pierces through the congregated mass of clouds will scarcely affect the photometer 5°, or excite a heat of 2° by Fahrenheit on the ground.

These augments of temperature are communicated to the ground unimpaired, only in the case, however, of a perfect calm. The agitation of the atmosphere will scatter the heat before it has accumulated. When the wind creeps along the surface of the earth at the rate of eight miles in the hour, it diminishes the calorific action of the light from the sun and from the sky one-half; but if it sweeps with a velocity of 16, 24, or 32 miles in the hour, it will reduce the whole effect successively to the third, the fourth, or the fifth of its standard. The impression made on the ground seldom, therefore, exceeds the third part of the computed measure, and often will not amount to one-fifth.

Effect on the ground diminished by wind;

The simplest and most accurate method of examining the temperature acquired during the day on the surface of the earth, is to employ a differential thermometer of the pendant kind, about one or two feet in length, and having its lower ball surmounted by a small cylindrical cavity supporting the coloured liquor. This instrument being suspended or held in a vertical position, the lower ball resting on the ground, will evidently mark, by its movable column, the difference between the temperature of the surface and that of the ambient air. In this way, we have found, during the summer months in this climate, that the ground was, by Fahrenheit's scale, generally two or three degrees warmer than the air near it in cloudy weather, and perhaps ten or fifteen degrees warmer when the sun shone powerfully upon it. But, under similar circumstances, the effect varies very considerably, according to the nature of the surface. While fresh ploughed land, for instance, indicates an increased temperature of perhaps 8°, a grass plot close beside it will scarcely show a difference of 3°. Nor is this distinction owing to any greater absorption of light by the black mould; the reflection from the surface, in both cases, being extremely small. A thin layer of hay, whether spread on the naked soil or on the green turf, will betray the same diminished effect. The fibres of the grass exposing a multiplied surface to the contact of the air, the greater portion of the heat is hence dissipated before accumulation. A corresponding effect has been remarked with respect to the impressions of cold. Thus, in the neighbourhood of Edinburgh, after a long tract of rigorous weather, the frost was found to have penetrated thirteen inches into the ground in a ploughed field, but only eight inches in one piece of pasture ground, and four inches in another. But, in some of the streets of that city, the frost had descended even below two feet, so as to begin to affect the water-pipes. The greater density and solidity of the pavement had no doubt conducted the frigorific impressions more copiously downwards, while the loose and spongy blades of grass had mostly scattered and wasted those impressions in the open field. This consideration, it is obvious, might lead to very important practical results.

and varies with the quality of the surface.

The unequal action of light at the surface of the earth, whether produced by the various obliquity of the sun's rays, the different inclination of the horizon, or the alternating succession of day and night, is attempered, we have seen, by the actual flow of the heated portions of the atmosphere. Between the poles and the equator, a perpetual circulation of air is maintained, which confines the accumulating effects of heat within narrow limits. The prevalence, on the whole, of northerly winds in this hemisphere during summer, and of southerly winds in winter, tends likewise to mitigate the extreme impressions of hot and cold. But a current of warm air, excited at first by the presence of the sun, continues to rise from the ground, and occasions the descent, therefore, of an opposite current of cold air, which, as the equilibrium of temperature is not soon restored, may be protracted through a great part of the night. The combined influence of these currents is hence continually exerted in cooling down the surface of the earth; but their activity being the greatest while the solar beams fall most copiously, the accumulation of heat is checked in little more than an hour after mid-day, while its further dissipation is prolonged through the whole of the night, sun-rise being generally the moment when the ground is coldest.

Circulation of air between the poles and the equator;

Such a concatenated system of aerial currents might hence appear sufficient to explain the gradation and general balance of temperature which prevails on the surface of our globe. An horizontal stream of air must evidently cause the flow of an opposite one, since the action must be the same on every part of the same parallel of latitude. The difference of the temperature of the surface from that of the ambient air will maintain the constant play of an ascending and a descending current. In clear and calm weather, this interchange between the higher and lower strata of the atmosphere will be the most vigorous, owing then to the concentrated impression of the sun-beams. The perpetual commerce maintained in our atmosphere by the medium of these combined horizontal and vertical currents, forms no doubt an essential part of the system which attempers the constitution of this globe. But it is not the only mode by which nature seeks to preserve the harmony of her productions; and recent discovery has detected the existence of another auxiliary principle, extremely active, of most rapid and extensive influence, and continually at work, though subject to various modifications. To understand rightly, however, the operation of this principle, it will be necessary to recal the chief facts which have been disclosed relative to the propagation of heat.

Regulates the temperature of the globe.

It is well known that, though partial causes may disturb the equilibrium of temperature among bodies, there is a constant tendency to restore it again. Yet heat still remains in the state of combination, without ever assuming a distinct form. Its balance is, therefore, maintained by a very different process from that which establishes the equilibrium between the several communicating parts of a liquid. The substratum of heat is not passive, nor do the calorific particles themselves merely flow from their redundance towards another situation where they happen to be deficient. But since the presence of heat is invariably accompanied by corpuscular distention, that portion of the substance which loses it must successively contract, while the portion which gains it will in the same degree expand. The actual transfer of heat through any mass will hence give occasion to a connected series of minute internal contractions and expansions. To consider the subject more fully, we shall suppose the conducting substance to be, 1. a solid; 2. a liquid; and, 3. a gaseous fluid.

Propagation of heat;

1. When the surplus heat is conducted through a solid substance, a sort of alternating vermicular motion is excited along the whole train of communication. If heat were left to the energy of its own replusion, it would, like light, dart with a speed almost instantaneous. But the time consumed by those interior oscillatory movements retards immensely the rate of transmission. The quickness of the oscillations themselves depends on the elasticity of the conducting substance; but their energy and extent are proportioned to the extreme difference of temperature, and the shortness of the tract, modified essentially by the peculiar nature of the conducting substance. In equal circumstances, glass transmits heat faster than wood, and metal faster than glass. But, even in the same class of conductors, the effects are very different; thus, box delivers the impressions of heat more quickly than cork, and silver conveys them with greater rapidity than platinum.

1. Through solids;

2. When the conducting substance is a liquid. The ordinary transmission of heat through a solid is now greatly augmented, from the diffusion occasioned by the mobility of the affected portions of the medium. Below the freezing point, ice will conduct heat through its substance; but after it has melted into water, a new and powerful agency

2. Through liquids

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is brought into play. The liquid particles, as they become successively warmer, acquire a corresponding expansion, and, therefore, rise upwards and spread through the mass, *carrying* with them and dispersing the heat which they have received. This diffuse buoyancy will depend evidently on the dilatable quality of the liquid. It is greater in alcohol than in water, and in water than in mercury; it is even more active in hot than in cold water. Near the point of congelation, indeed, the joint conducting power of water is scarcely superior to that of mere ice. The actual flow of a liquid, by whatever cause it is produced, must evidently accelerate the dissipation of heat.

3. Through gaseous fluids;

3. When the medium of transmission is a gaseous substance, the heat is partly still conducted through the substance of the communicating mass, as if this were solid, and partly transferred by the streaming of the corpuscles, which come to be successively affected. But a new principle seems here to combine its influence, and the rate of dispersion in aeriform media is found to depend chiefly on the nature of the mere heated surface. From a metallic surface the heat is feebly emitted; but from a surface of glass, or still better, from one of paper, it is discharged with profusion. If two equal hollow balls of thin bright silver, one of them entirely uncovered, and the other closely enveloped in a coat of cambric, be filled with water slightly warmed, and then suspended in a close room, the former will only lose 11 parts of heat in the same time that the latter will dissipate 20 parts. Of this expenditure 10 parts from each of the balls is communicated in the ordinary way, by the slow recession of the proximate particles of air as they come to be successively heated. The rest of the heat, consisting of 1 part from the naked metallic surface, and of 10 from the cased surface, is propagated through the same medium, but with a certain diffusive rapidity, which in a moment shoots its influence to a distance, after a mode altogether peculiar to the gaseous fluids.

But those effects are modified by the different proximity of the air to the metallic surface. If the silver ball be covered with the thinnest film of gold-beater's skin, which exceeds not the 3000th part of an inch in thickness, the power of dispersion will be augmented from 1 to 7; if another pellicle be added, there will be a further increase of this power from 7 to 9; and so repeatedly growing, till after the application of five coats, when the repellent energy will reach its extreme limit, or the measure of 10.

The approximation of the metallic substratum thus evidently diminishes the power of the external pellicle in darting heat. No absolute contact exists in nature; but air must approach to a boundary of pellicle, or cambric, much nearer than to a surface of metal, from which it is always divided by an interval of more than the 500th part of an inch. A vitreous surface has very nearly the same property as one of cambric or paper: from its closer proximity to the recipient medium, it imparts its heat more copiously and energetically than a surface of metal in the same condition.

Performed by tremulous pulses.

By what process the several portions of heat thus delivered to the atmosphere shoot through the fluid mass, it seems more difficult to conceive. They are not transported by the streaming of the heated air, for they suffer no derangement from the most violent agitation of their medium. The air must, therefore, without changing its place, disseminate the impressions it receives of heat by a sort of undulatory commotion, or a series of alternating pulsations, like those by which it transmits the impulse of sound. The portion of air next the hot surface, suddenly acquiring heat from its vicinity, expands proportionally, and begins the chain of pulsations. In again contracting, this aerial shell surrenders its surplus heat to the one immediately before it, now in the act of expansion; and thus the tide of heat rolls onwards, and spreads itself on all sides.

But these pulsations are not propagated with equal intensity in all directions. They are most powerful in the perpendicular to the projecting surface, and diminish as they deviate from that axis in the ratio of the sine of the angle of obliquity.

Climate.

Nor are the vibratory impressions strictly darted in radiating lines, but each successive pulse, as in the case of sound, presses to gain an equal diffusion. Different obstructions may hence cause the undulations of heat to deflect considerably from their course. Thus, if a cornucopia, formed of pasteboard, present its wide mouth to a fire, a strong heat will, in spite of the gradual inflection of the tube, be concentrated at its narrow end; in the same way, probably, as waves flowing from an open bay into a narrow harbour, now contracted and bent aside, yet without being reflected, rise into furious billows.

But the same pulsatory system will enable the atmosphere to transmit likewise the impressions of cold. The shell of air adjacent to a frigid surface, becoming suddenly chilled, suffers a corresponding contraction, which must excite a concatenated train of pulsations. This contraction is followed by an immediate expansion, which withdraws a portion of heat from the next succeeding shell, itself now in the act of contracting; and the tide of apparent cold, or rather of deficient heat, shoots forwards with diffusive sweep.

That quality which enables a surface to propel the hot or cold pulses likewise fits it under circumstances to receive their impressions. If a vitreous or varnished surface emits heat most copiously, it will also, when opposed to the tide, arrest with entire efficacy the affluent wave; and if, on the other hand, a surface of metal sparingly parts with its own heat, it detains only a small share of each warm appulse, and reflects all the rest.

Pyroscope

Hence the construction of the *Pyroscope*, a delicate and valuable instrument, adapted to measure the warm pulses of air, or the intensity of the heat that darts continually from a fire into a room, which has been vaguely and inaccurately termed *radiant heat*. It is in fact only a modification of the *differential thermometer*, one of the balls being completely gilt with a thick gold or silver leaf. The *pyroscope* being placed at some distance from the fire, the hot pulses are mostly thrown back from the bright metallic surface; but on the naked glass ball they produce their full impression; and the same instrument will serve equally to indicate the pulsations excited from a cold surface. Thus, in a warm apartment, the pyroscope placed before a mass of snow, a block of ice, or even a pitcher of water from the fountain, will quickly intimate the chilling impressions propagated through the ambient medium. Nor has the brightness of the fire or the glare of the snow any sensible influence to affect the result; for, of the small portion of light transmitted, what falls on the diaphanous ball passes almost without obstruction, and what strikes the gilt ball, especially if this be covered with silver leaf, is nearly all reflected.

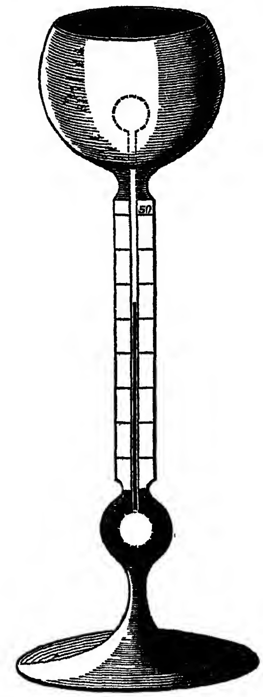
But the pyroscope, in its simple form, is scarcely calculated for making nice observations, when exposed out of doors to the agitation of winds and the effulgence of light. A greater share of this light will generally be detained by the gilt surface than what is absorbed in its passage through the diaphanous ball. On the other hand, all the effects on the instrument will be diminished by the rapidity of the circulation of the air.

Æthrioscope described.

The requisite adaptation is attained by adapting the pyroscope to the cavity of a polished metallic cup of rather an oblong spheroidal shape, the axis, having a vertical position, being occupied by the sentient ball, while the section of a horizontal plane passing through the upper forms the orifice. The cup may be made of thin brass or silver, either hammered or cast, and then turned and polished on a lathe; the diameter being from two to four inches, and the ec-

Climate.

centricity of the elliptical figure varied within certain limits according to circumstances. The most convenient proportion, however, is to have this eccentricity equal to half the transverse axis, and, consequently, to place the focus at the third part of the whole height of the cavity, the diameter of the sentient ball being likewise nearly the third part of that of the orifice of the cup.



The æthrioscope might be reduced to a compact form, having the lower ball encased by a hollow sphere of brass, composed of two pieces which screw together, while the upper ball occupies the focus of the cup, which needs scarcely be more than two inches wide.

This instrument, exposed to the open air in clear weather, will at all times, both during the day and the night, indicate an impression of cold shot downwards from the higher regions. Yet the effect varies exceedingly. It is greatest while the sky has the pure azure hue; it diminishes fast as the atmosphere becomes loaded with spreading clouds; and it is almost extinguished when low fogs settle upon the surface. The name Æthrioscope (from Αιθριος, *serenus, sudus, frigidus*) may, therefore, be justly appropriate to this new combination of the pyroscope. The sensibility of the instrument is very striking, for the liquor incessantly falls and rises in the stem with every passing cloud. But the cause of its variations does not always appear so obvious. Under a fine blue sky, the *æthrioscope* will sometimes indicate a cold of 50 millesimal degrees; yet on other days, when the air seems equally bright, the effect is hardly 30°. Particular winds at different altitudes seem to modify the result, and so perhaps may the transition from summer to winter. The pressure of hygrometric moisture in the air probably affects the indications of the instrument.

On replacing the metallic lid, the effect is entirely extinguished, and the fluid in the stem of the differential thermometer sinks to zero. A cover of pasteboard has at first precisely the same influence; but after it has itself become chilled by this exposure, it produces a small secondary action on the sentient ball, scarcely exceeding, however, the tenth part of the naked impression. A lid of glass or of mica intercepts the impressions like one of paper; for the admission of light has no deranging effect if the æthrioscope be rightly constructed and highly polished. The minute secondary action is almost extinguished, if screens of paper, glass, or mica, be held at some distance above the mouth of the instrument.

The climate of any region is greatly modified by the moisture or dryness of its atmosphere. This has an important influence on its vegetable productions. The modes and instruments employed in estimating this quality of the atmosphere are detailed under the articles Hygrometry and Physical Geography.

The quantity of rain which falls periodically in different countries has great influence on climate. As a general fact, the annual quantity of rain decreases from the equator towards the poles. It is greatest among mountains; but diminishes as we ascend lofty ridges, as the Andes or the Himalayas. For the instruments employed in determining this circumstance, and the inferences deduced from observation, see Physical Geography.

For the effect of climate on the geographic distribution of plants, see Botany, Part iii., where the subject is treated as fully as our limits admit. (J. L.) (T. S. T.)

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CALENDER.

Fig 1

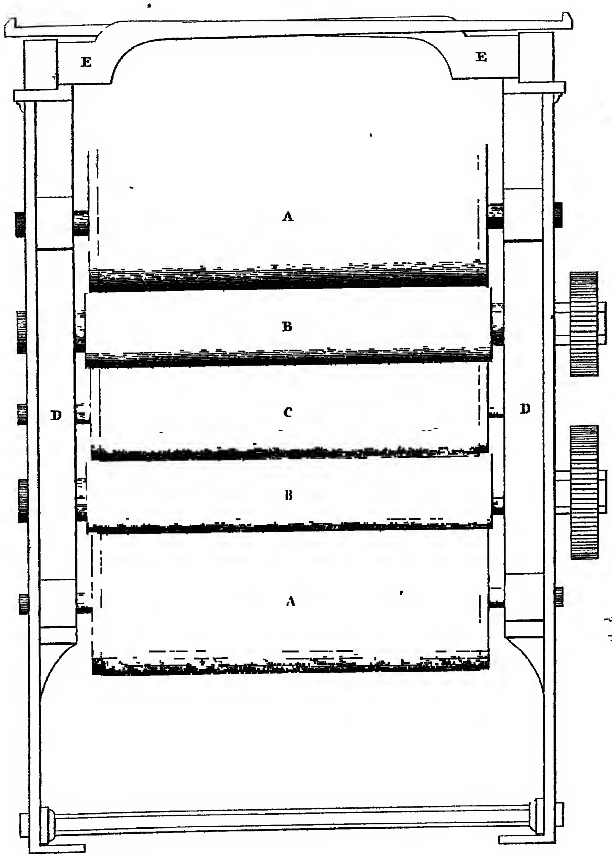


Fig 3

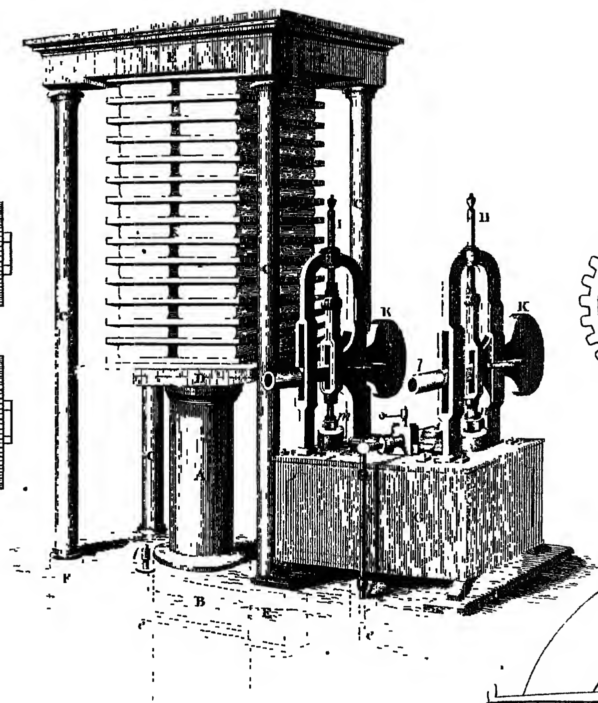
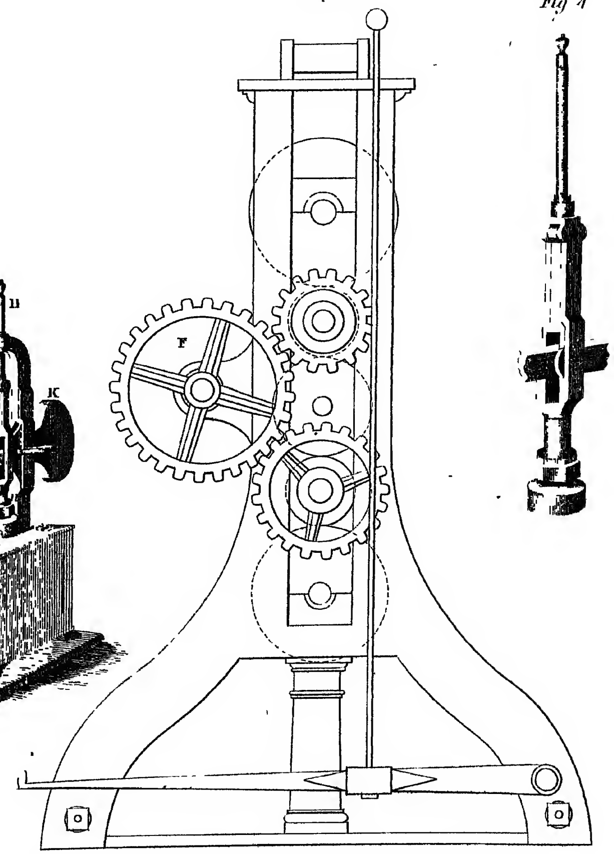


Fig 2

Fig 4



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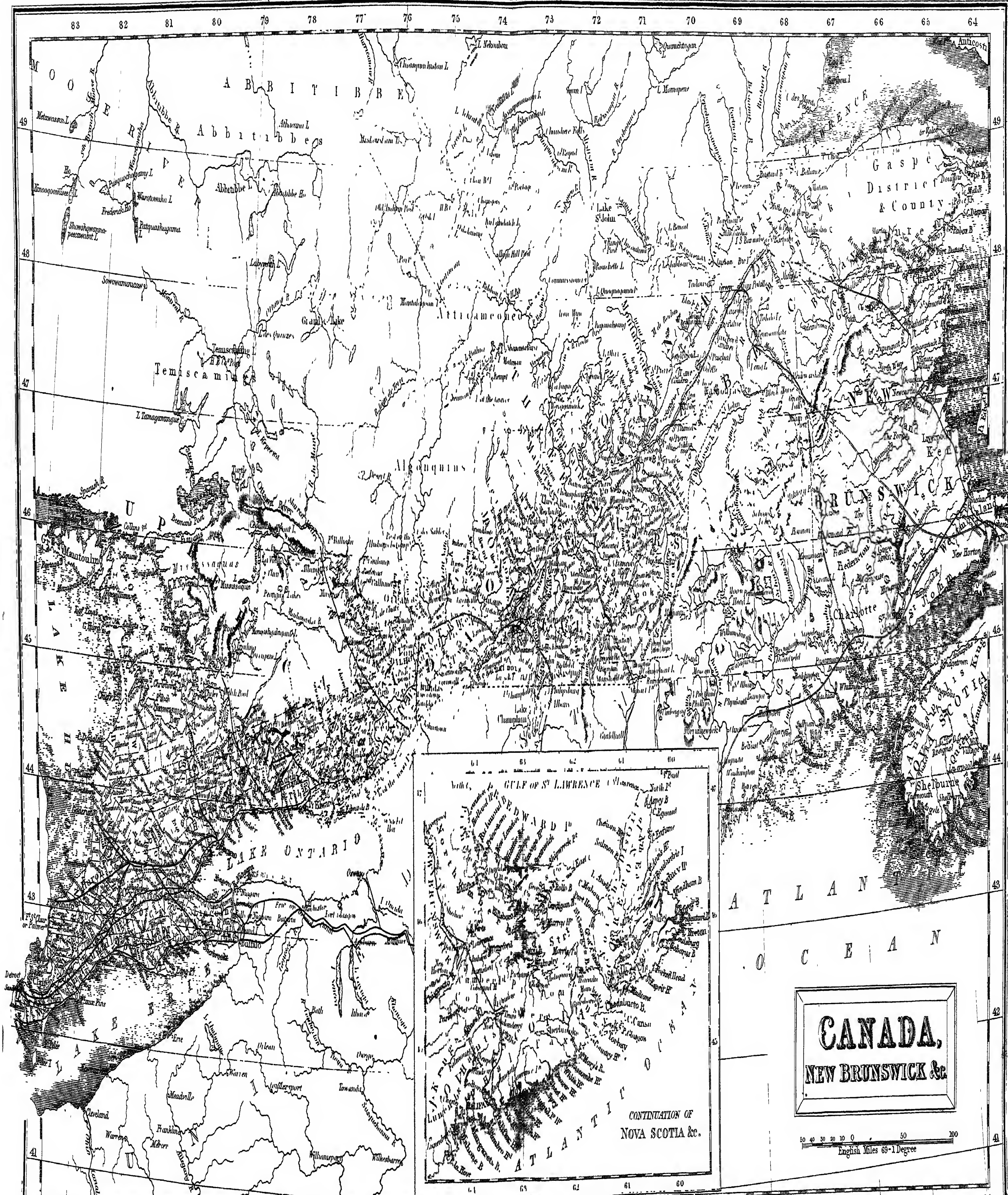

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CHART of ISOTHERMAL LINES, SHEWING THE MEAN ANNUAL TEMPERATURE OF THE DIFFERENT PARTS OF THE EARTH'S SURFACE. PLATE CLXIII.

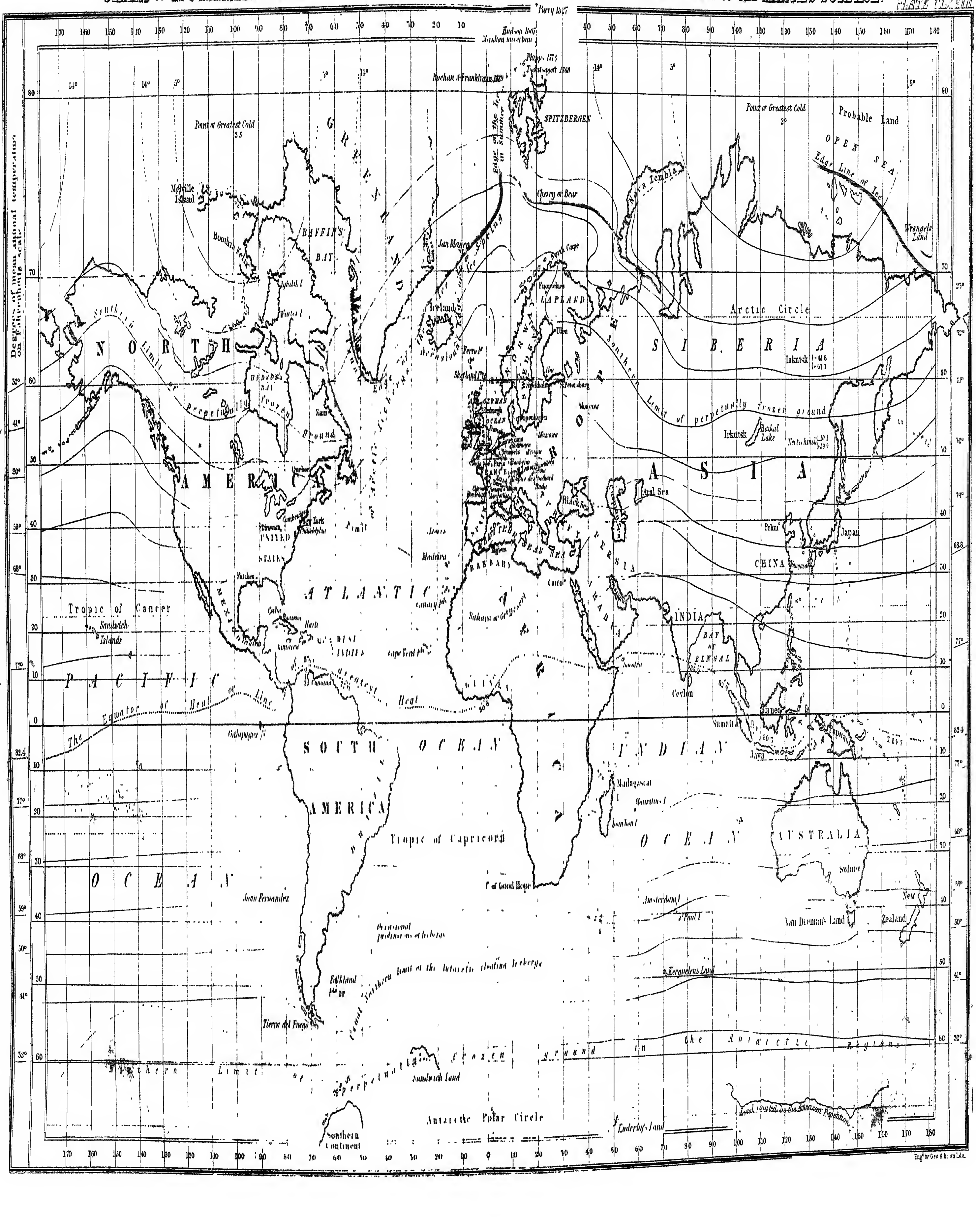
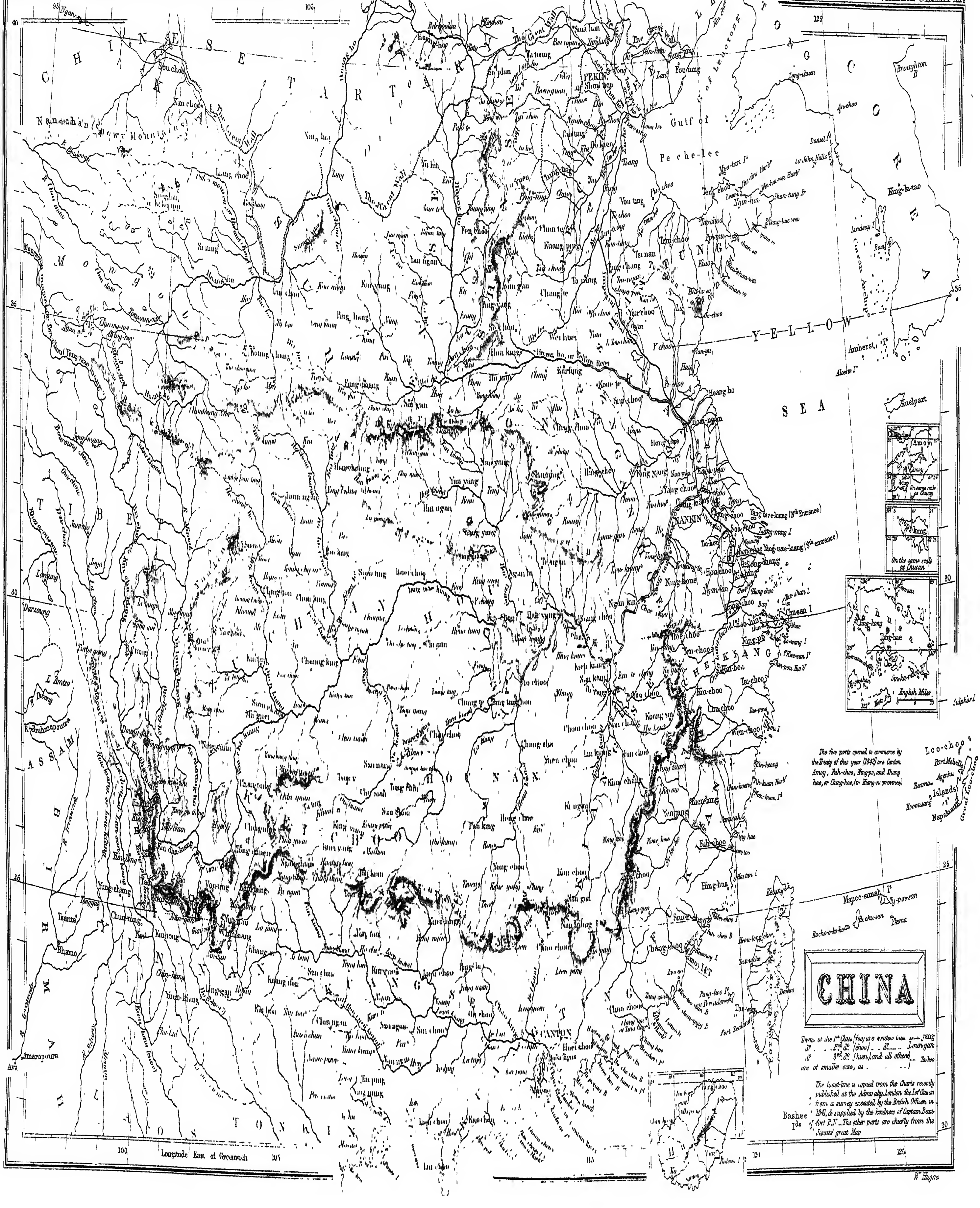


PLATE CLXIX-II.



W. Hughes

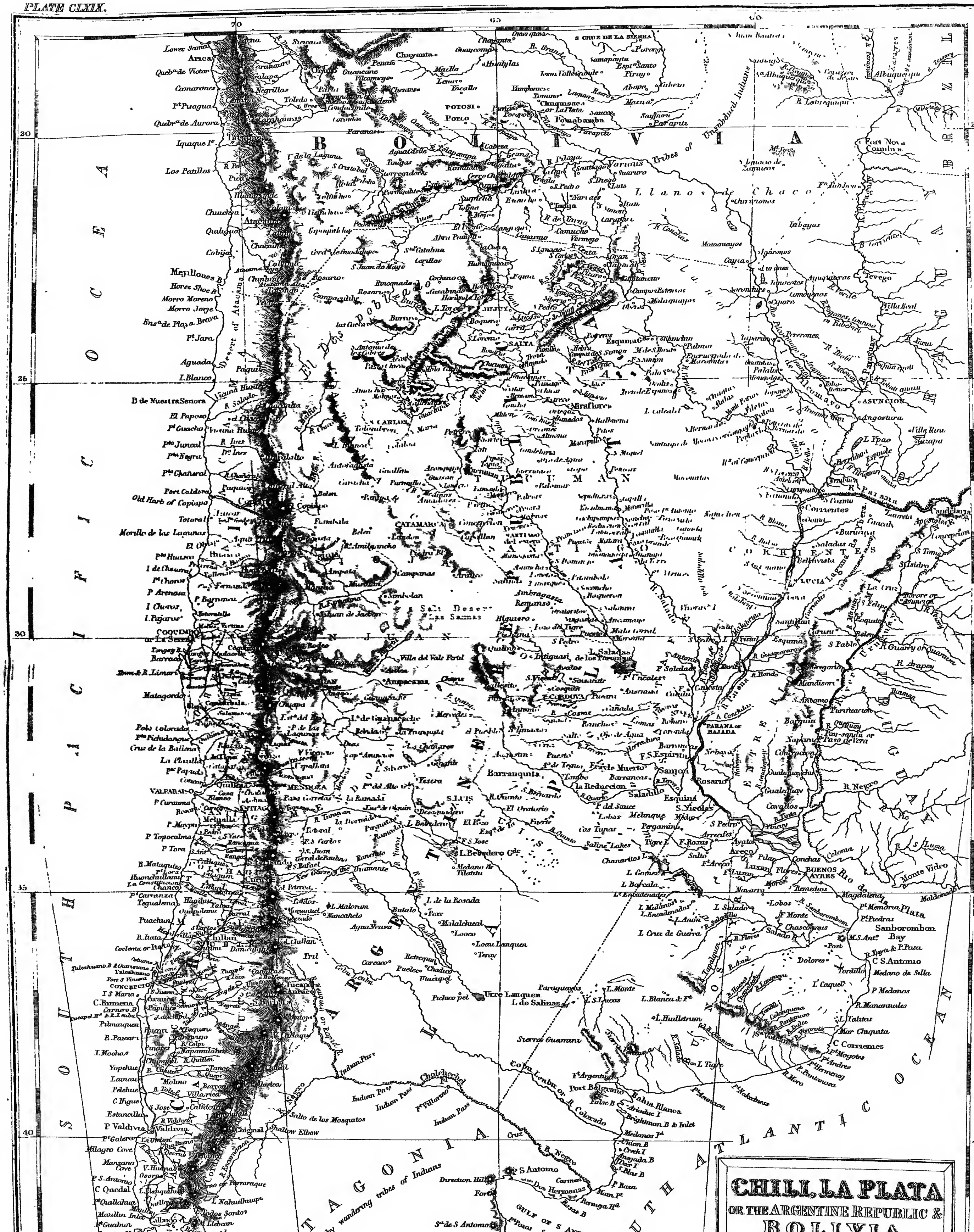


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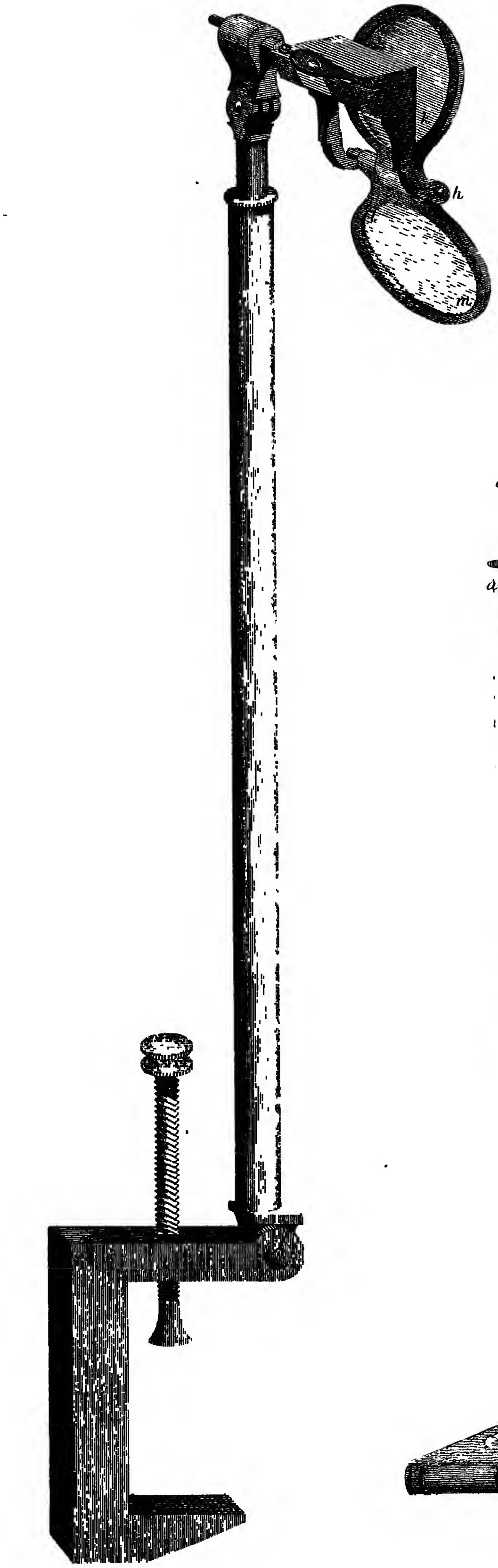
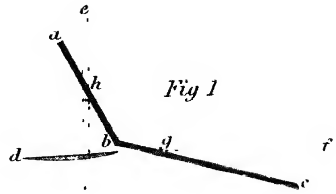
Fig 2





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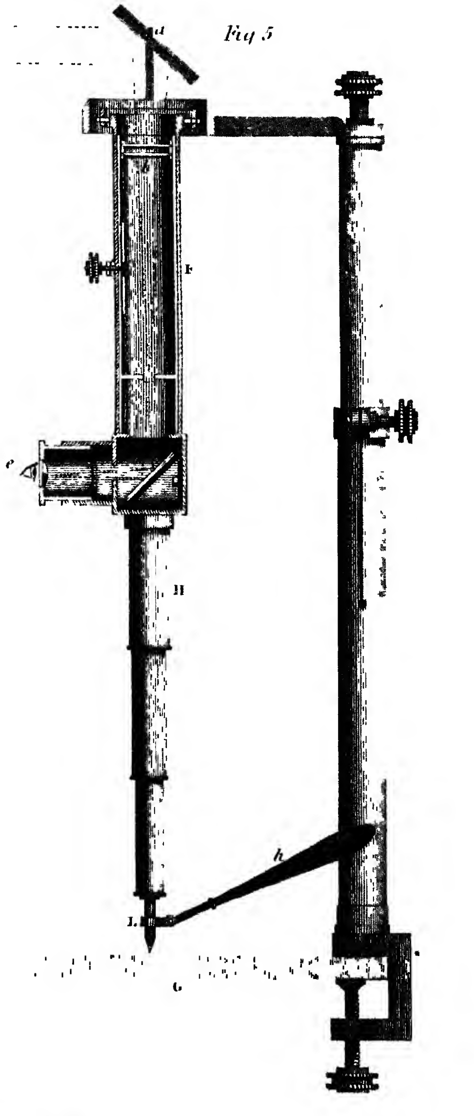

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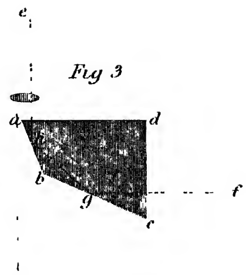

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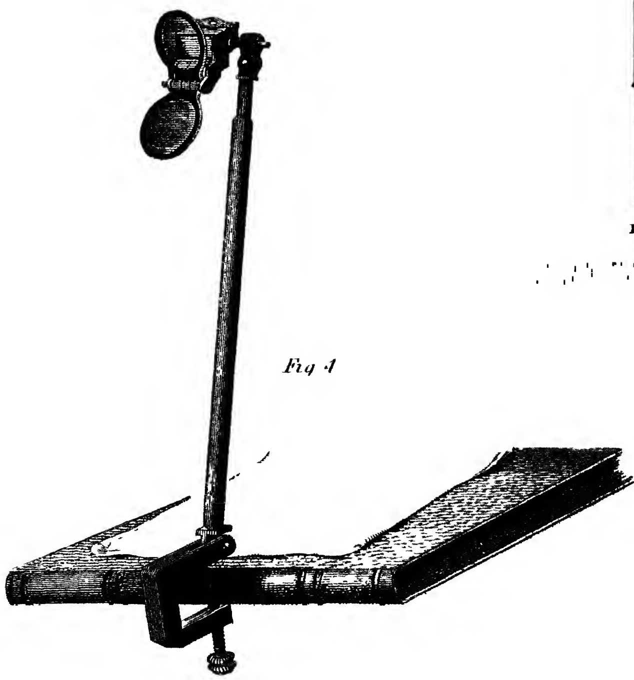

Fig 4

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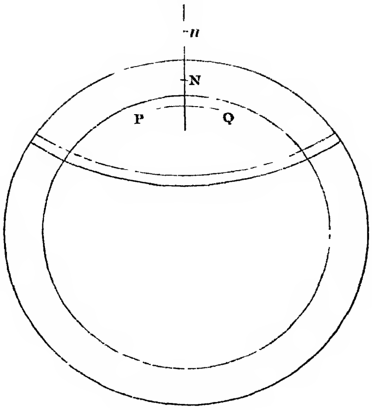
Fig 1



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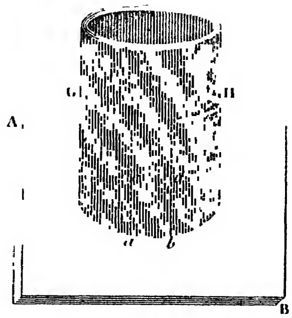

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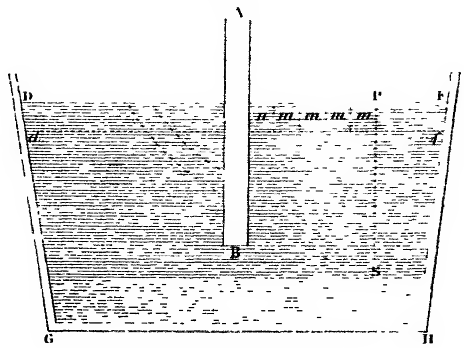

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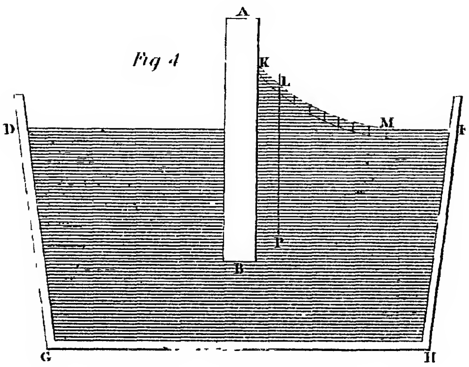

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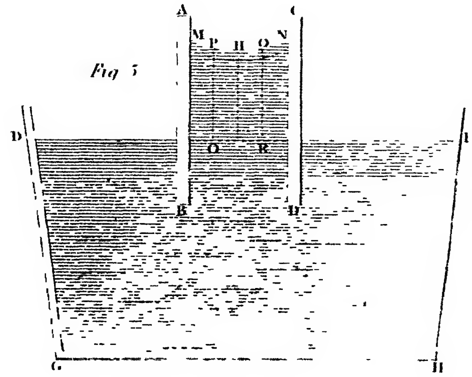

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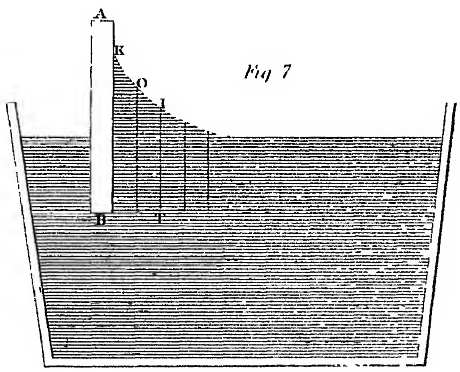

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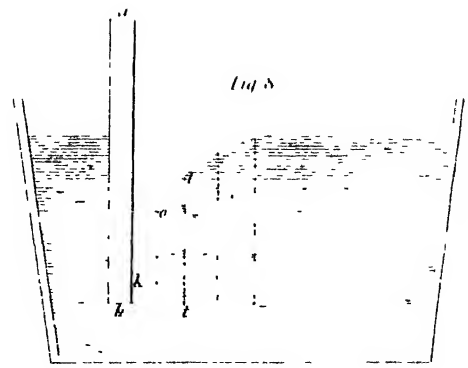

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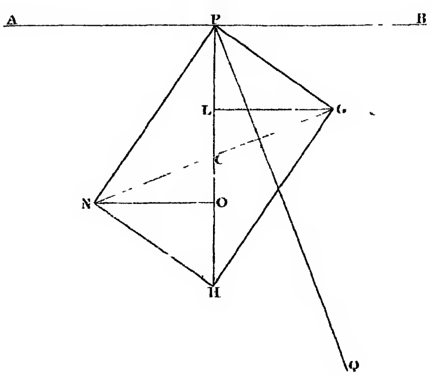

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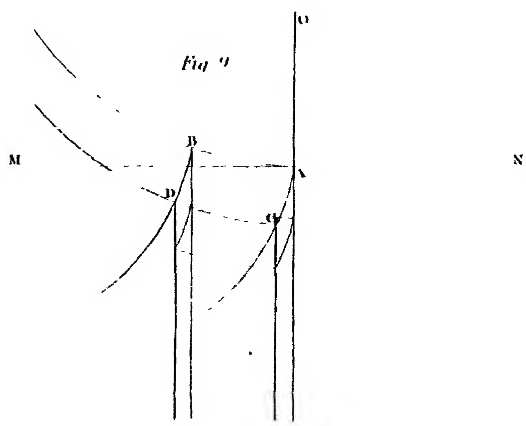

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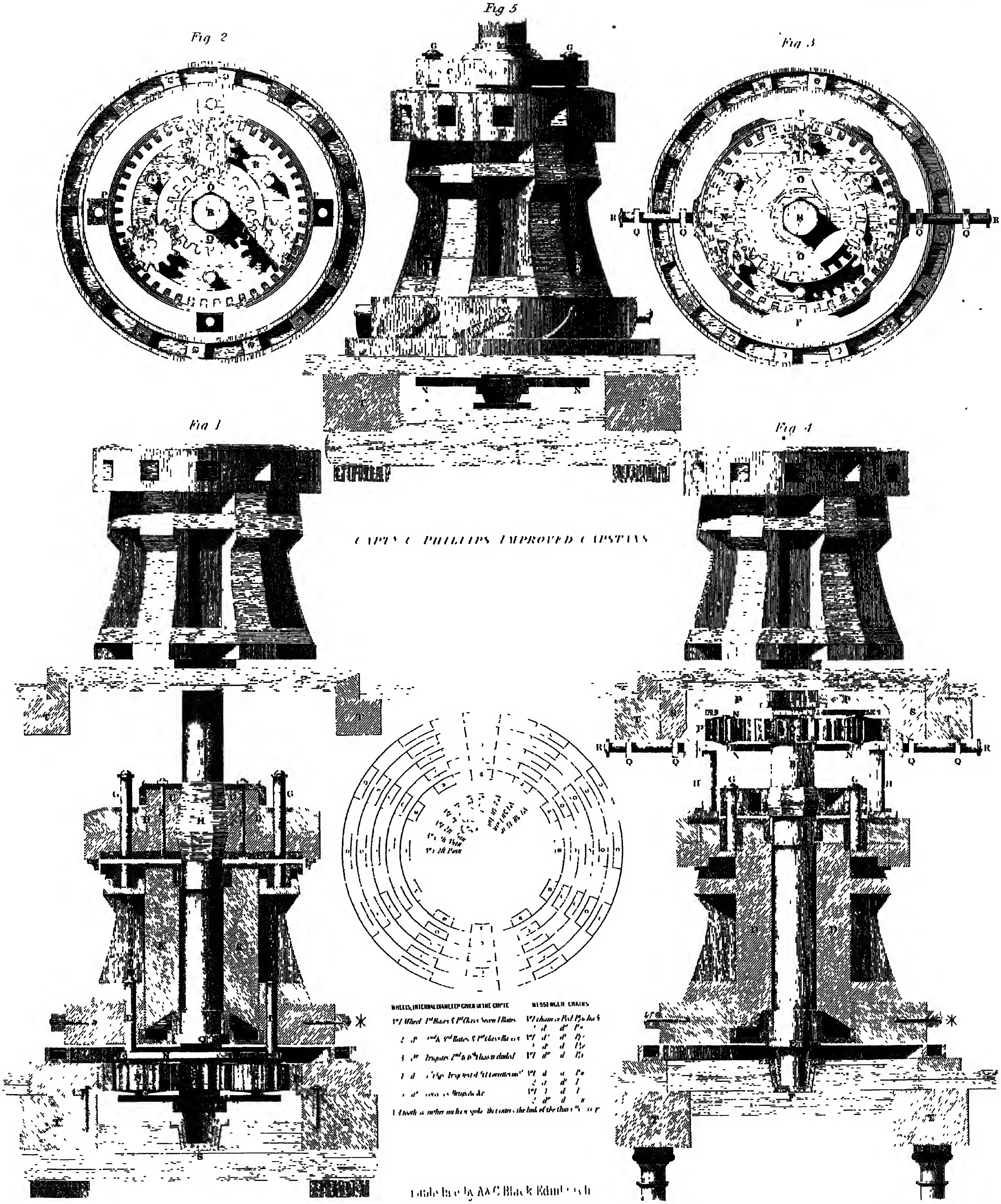

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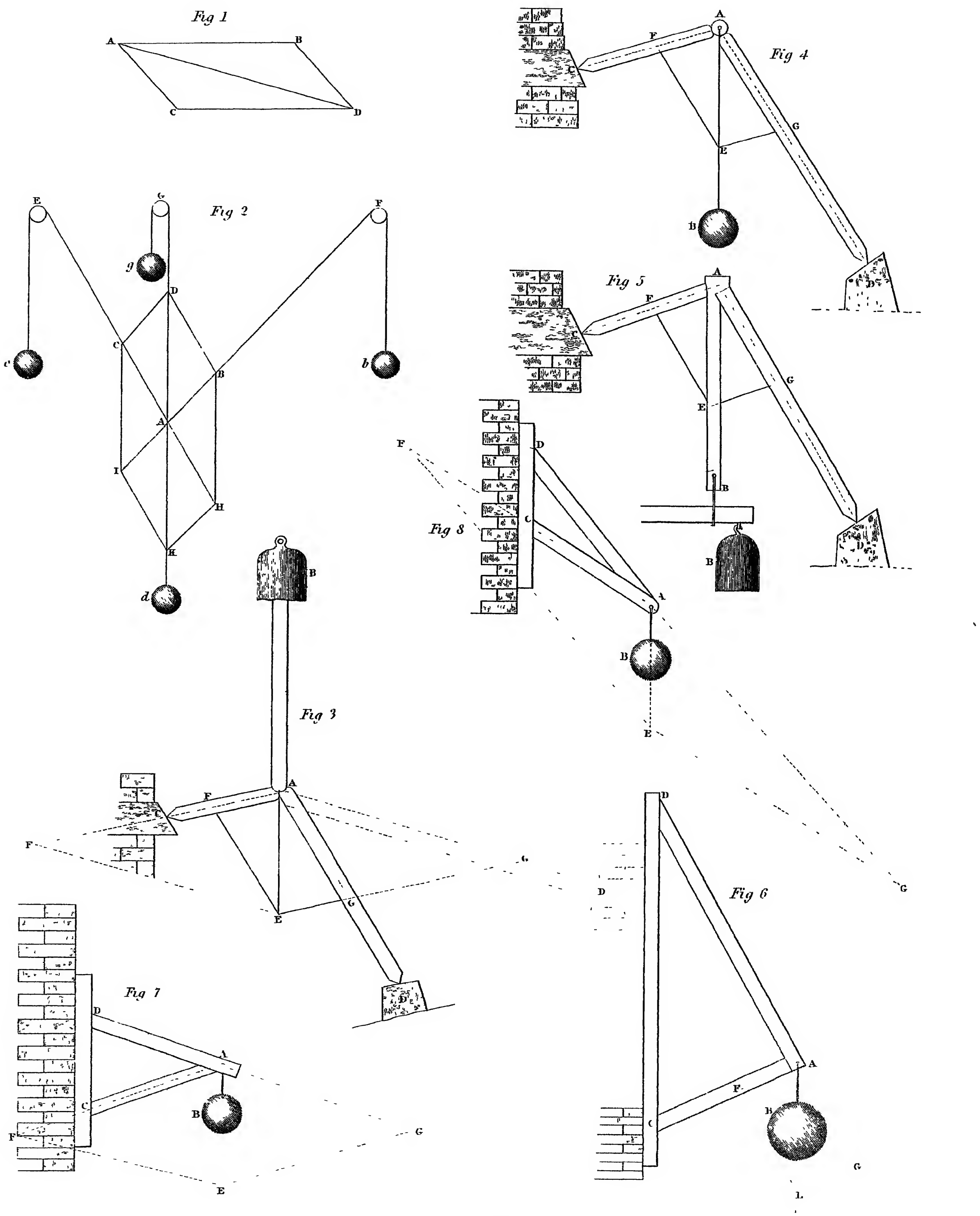

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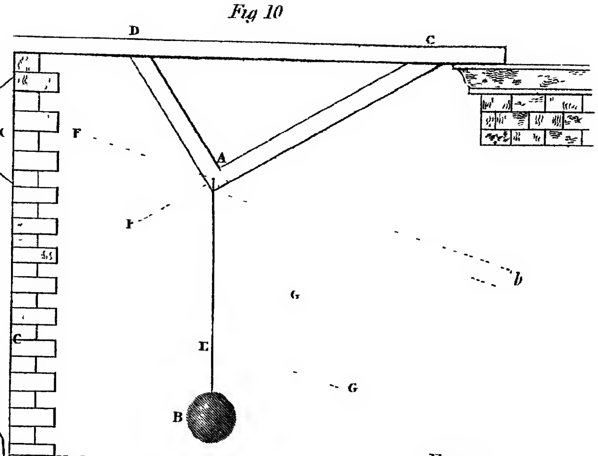

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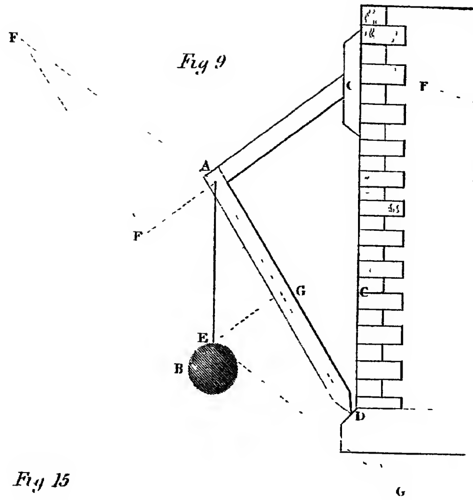

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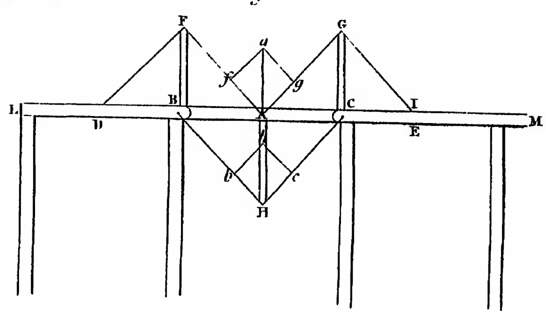

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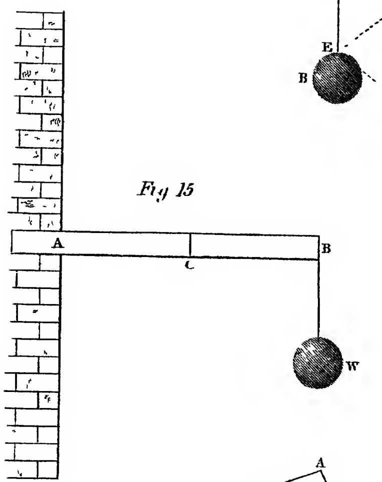

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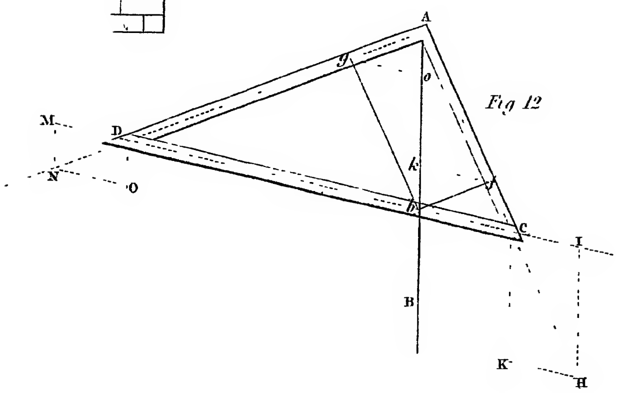

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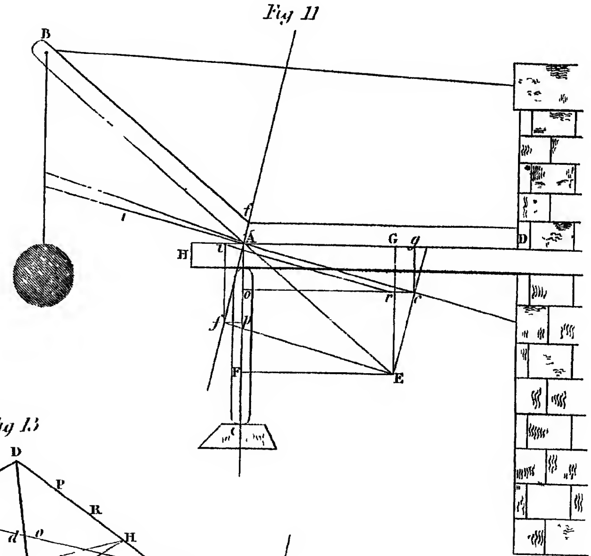

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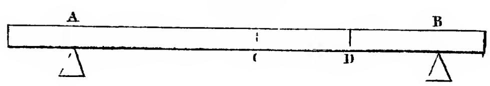

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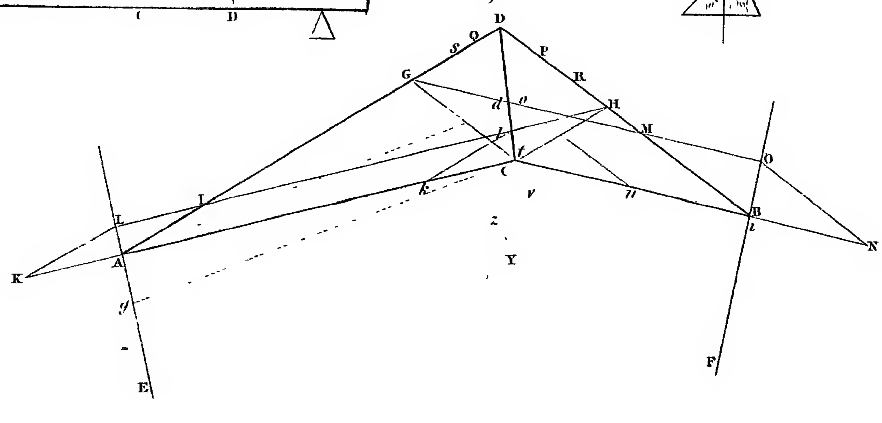

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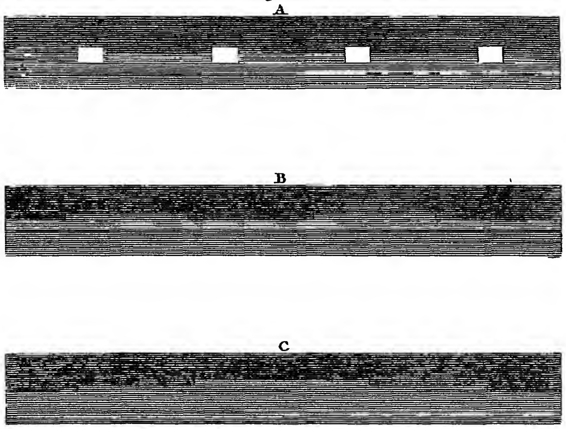
Fig 17



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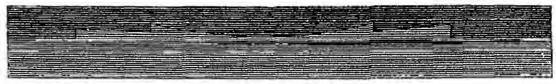

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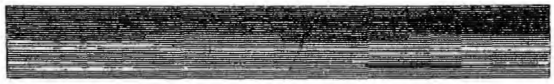

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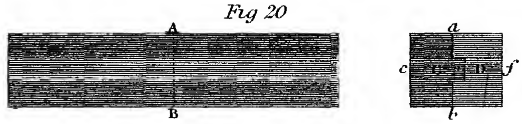

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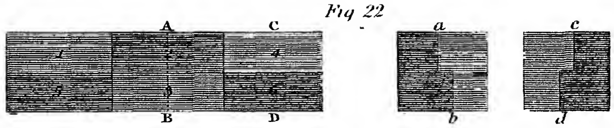

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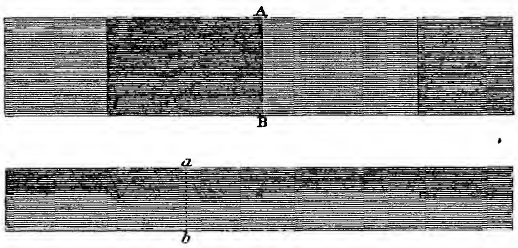

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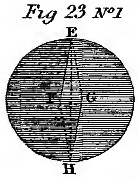
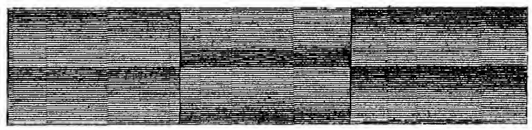


Fig 23 N°2



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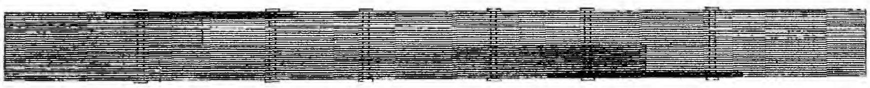

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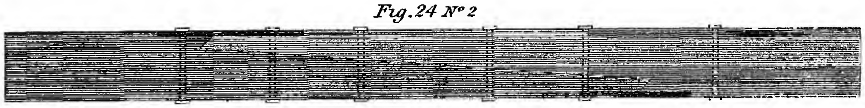

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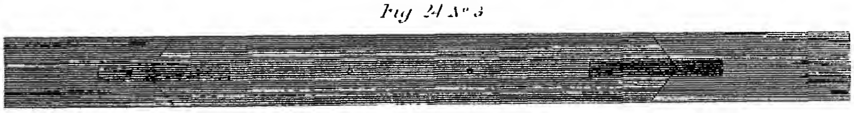

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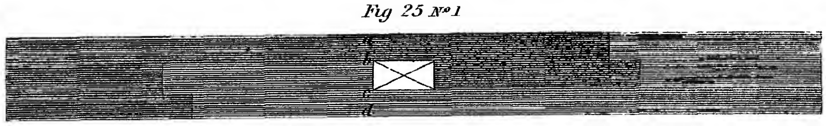

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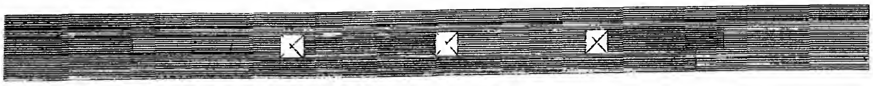

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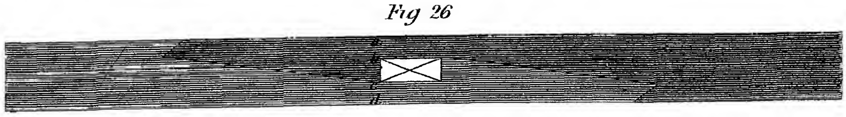

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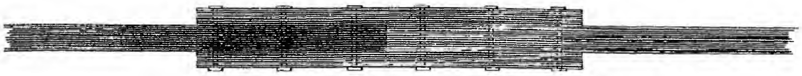
Fig 27



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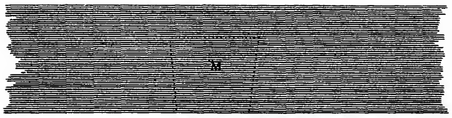

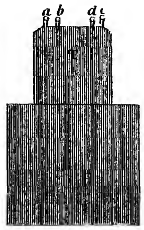

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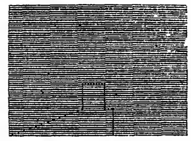

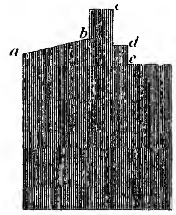

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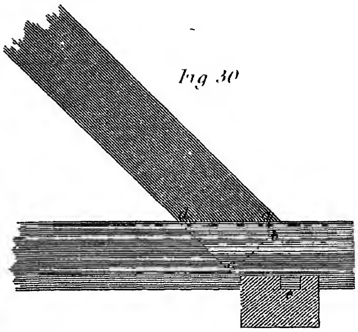

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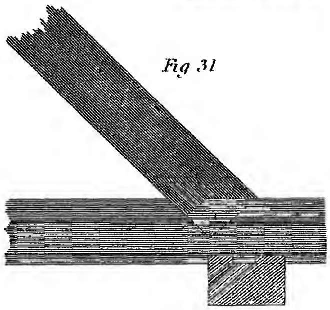

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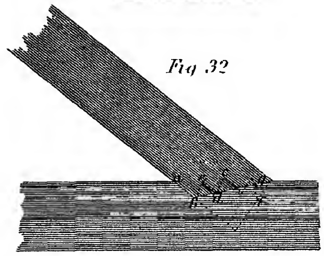

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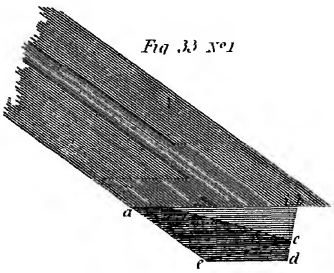

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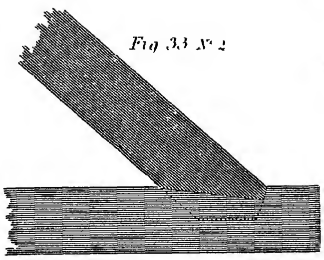


Fig 33 No 3

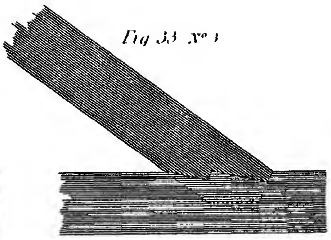


Fig 34

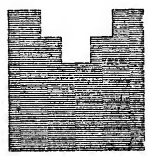


Fig 35 No 1

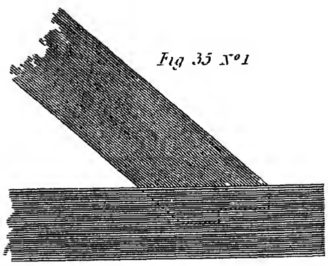


Fig 35 No 2

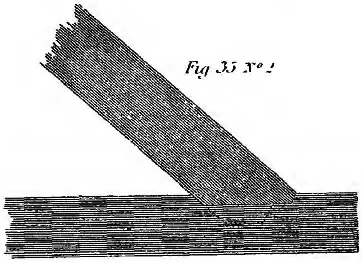
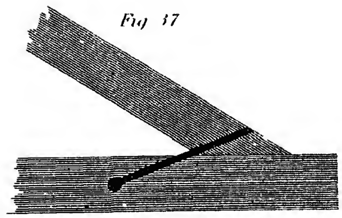


Fig 37



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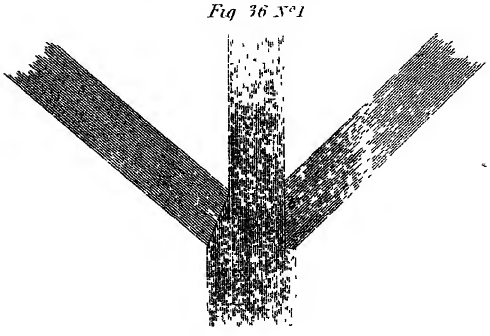

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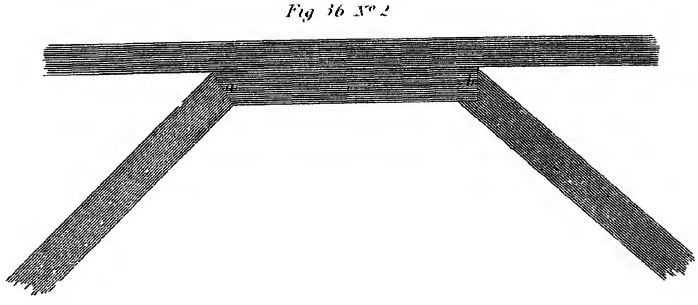

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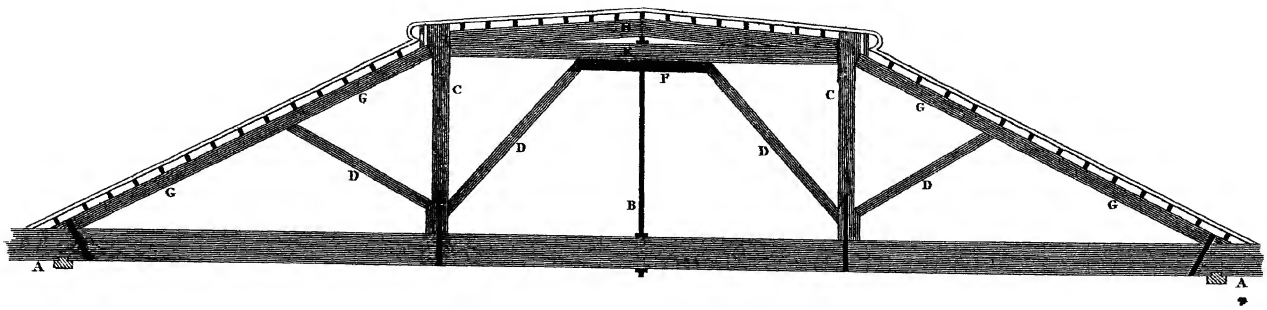
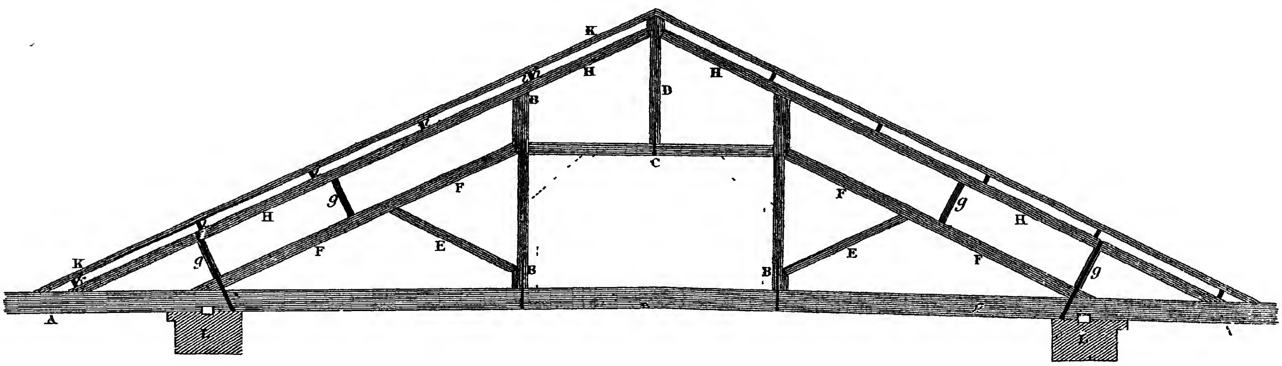


Fig 39



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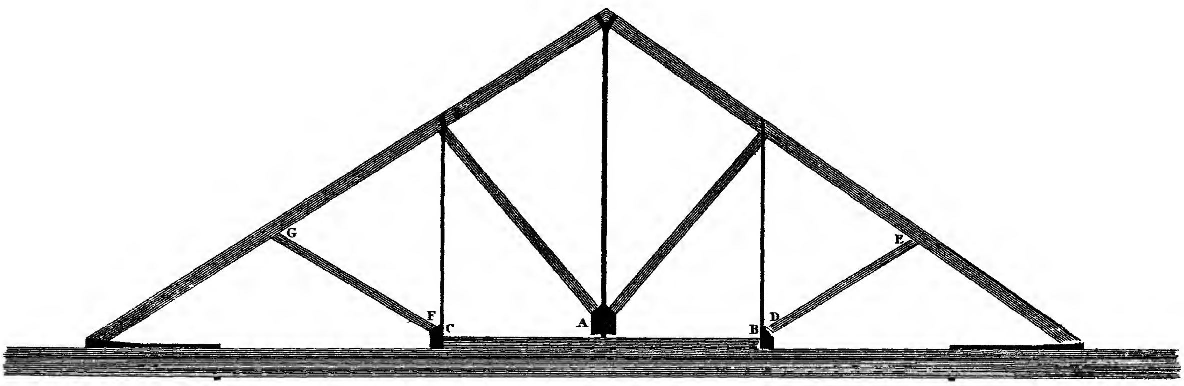

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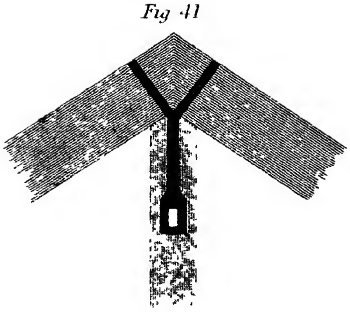

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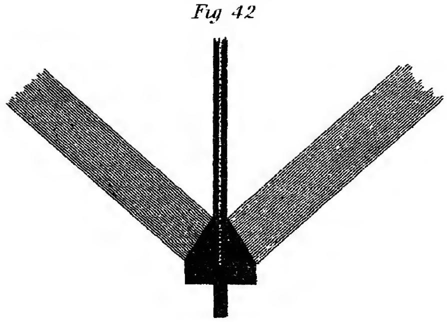

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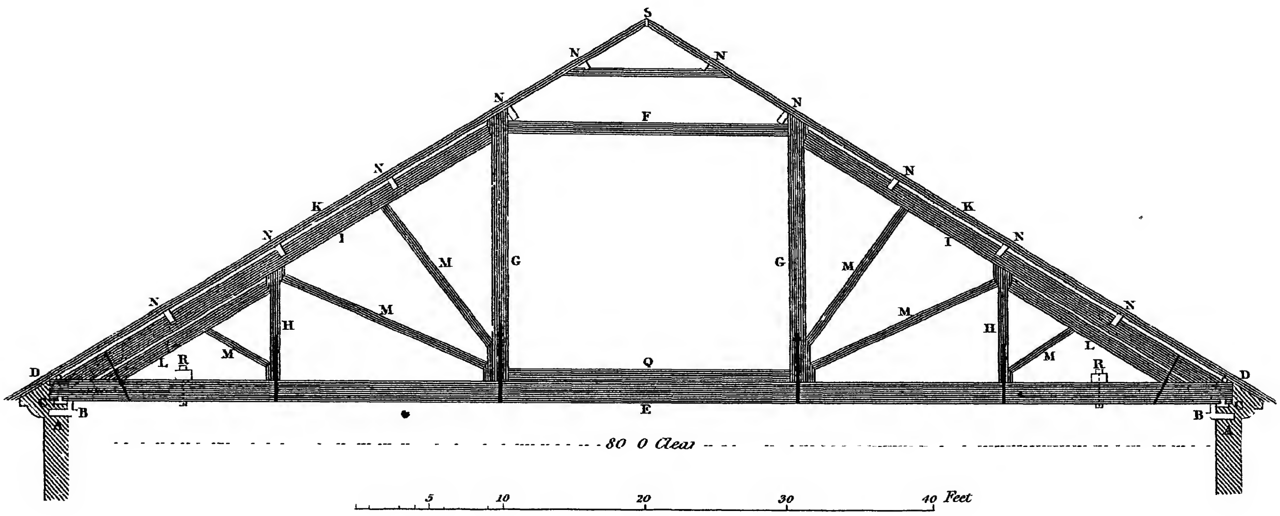

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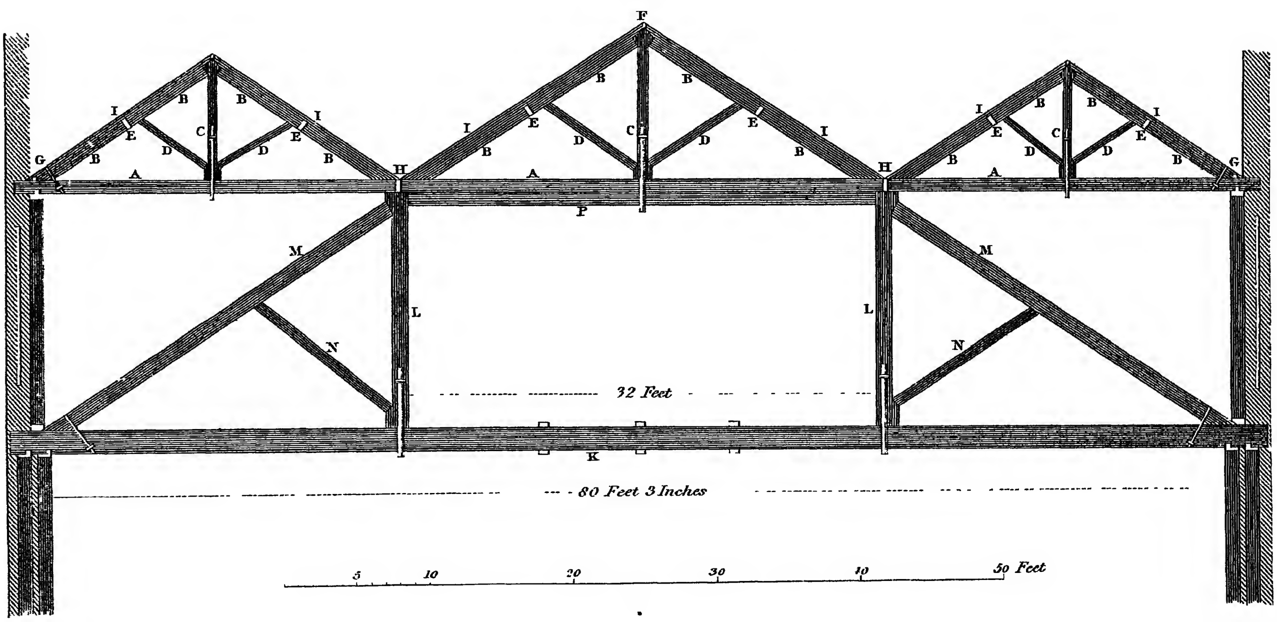

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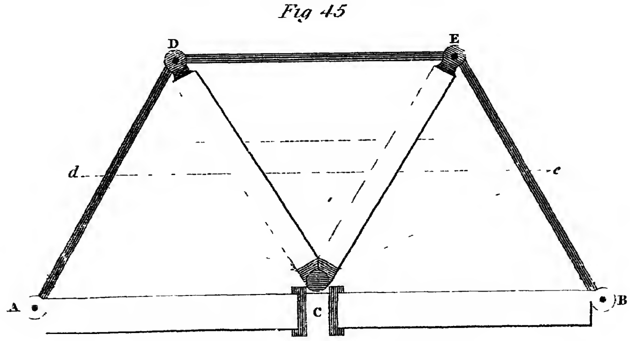

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PLATE CLXV.

Fig 1

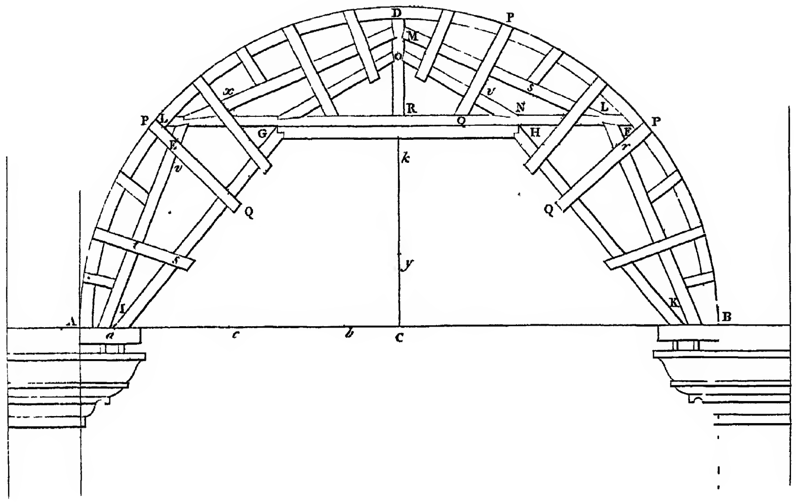

Fig 3

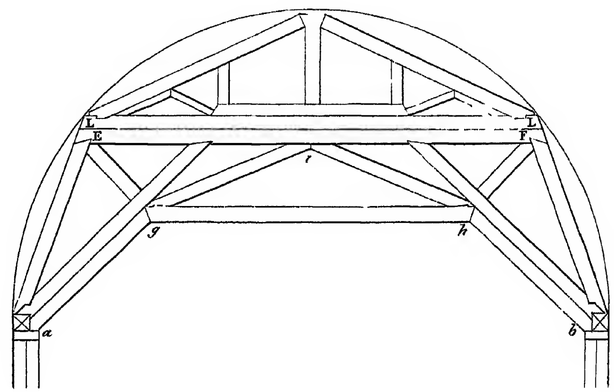

Fig 2. Nº 1

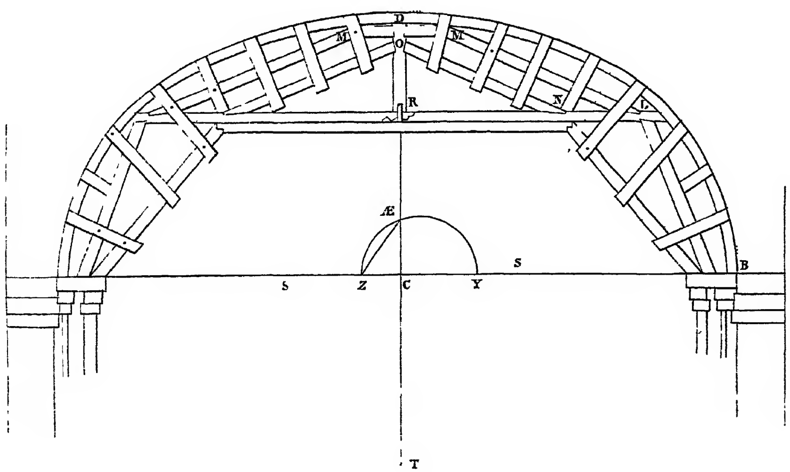

Fig 2 Nº 2

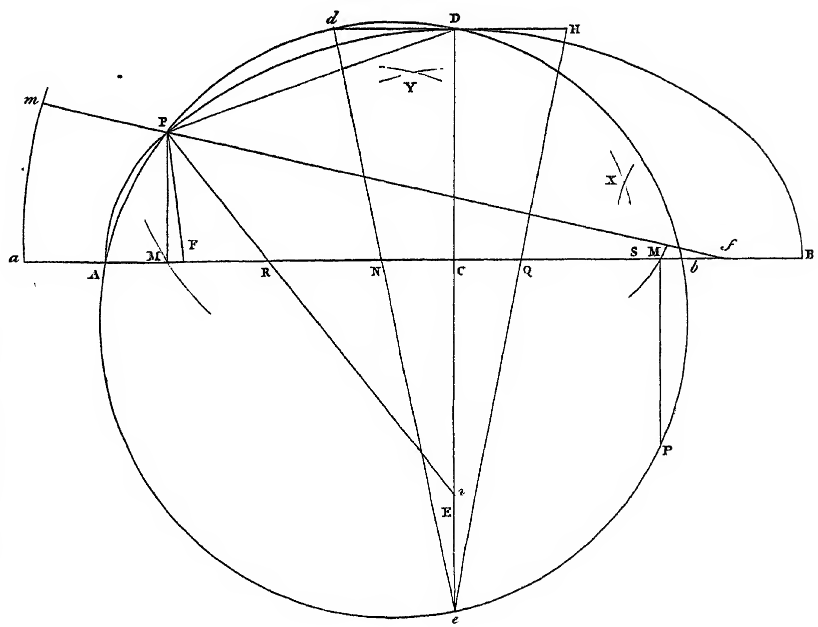

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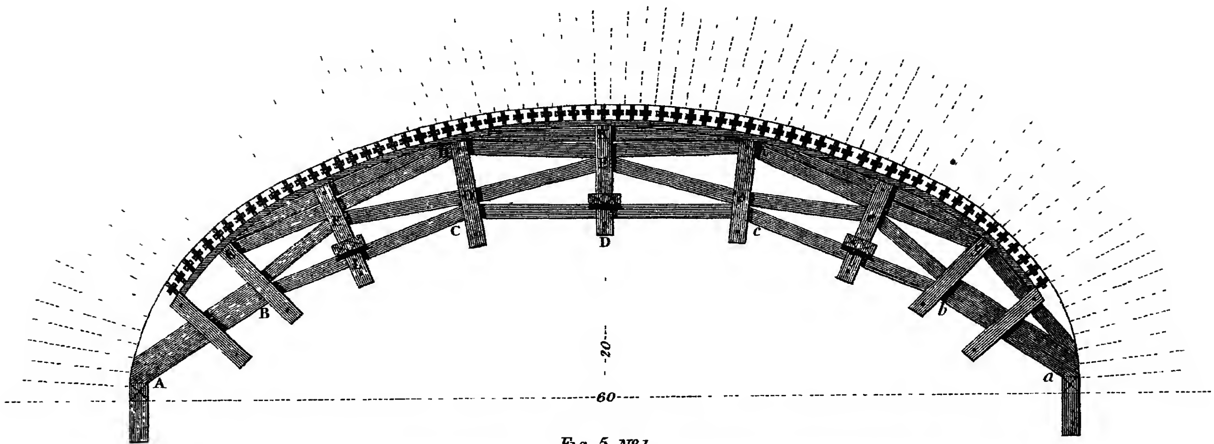
Fig 4



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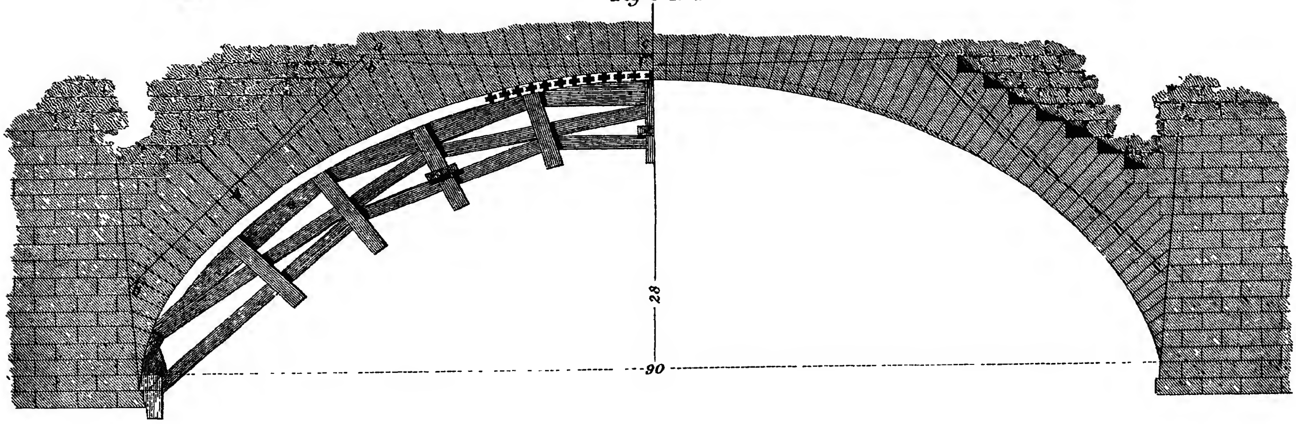

Fig 5 N° 2

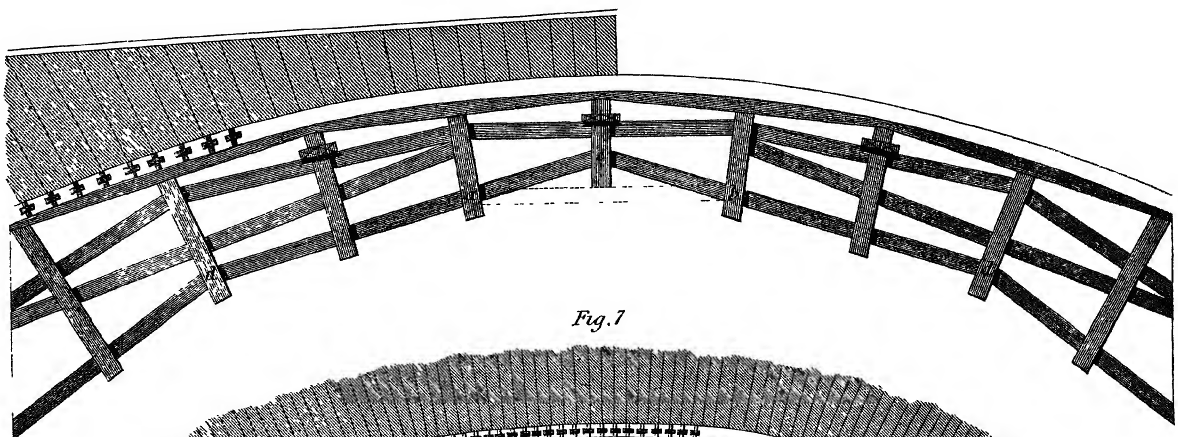

Fig.7

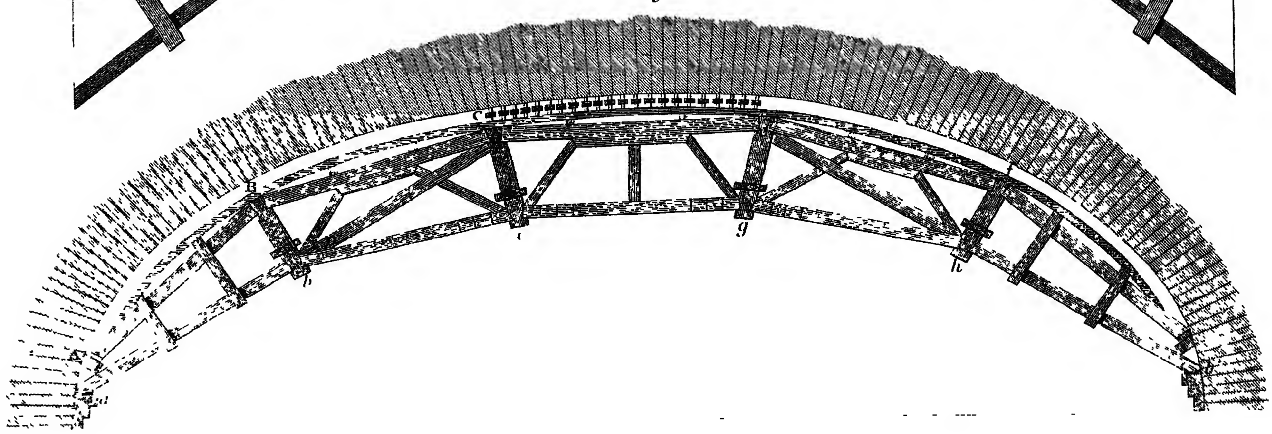

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Fig 6

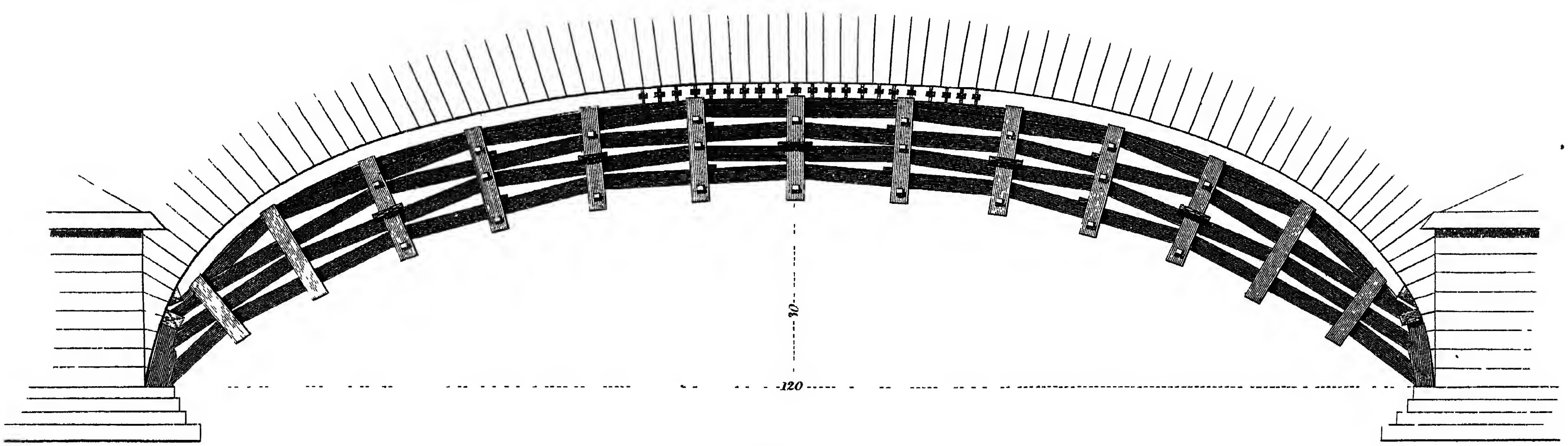
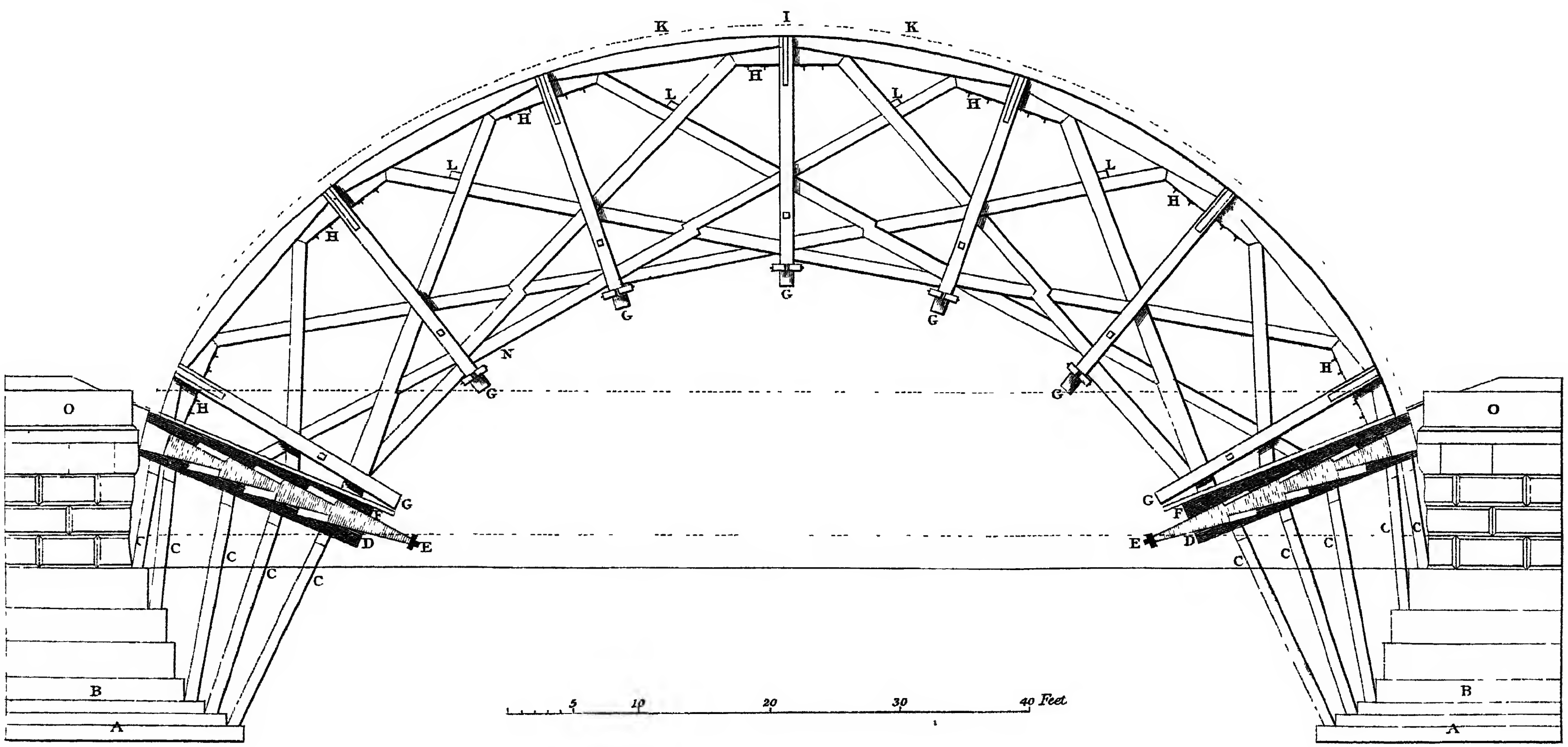
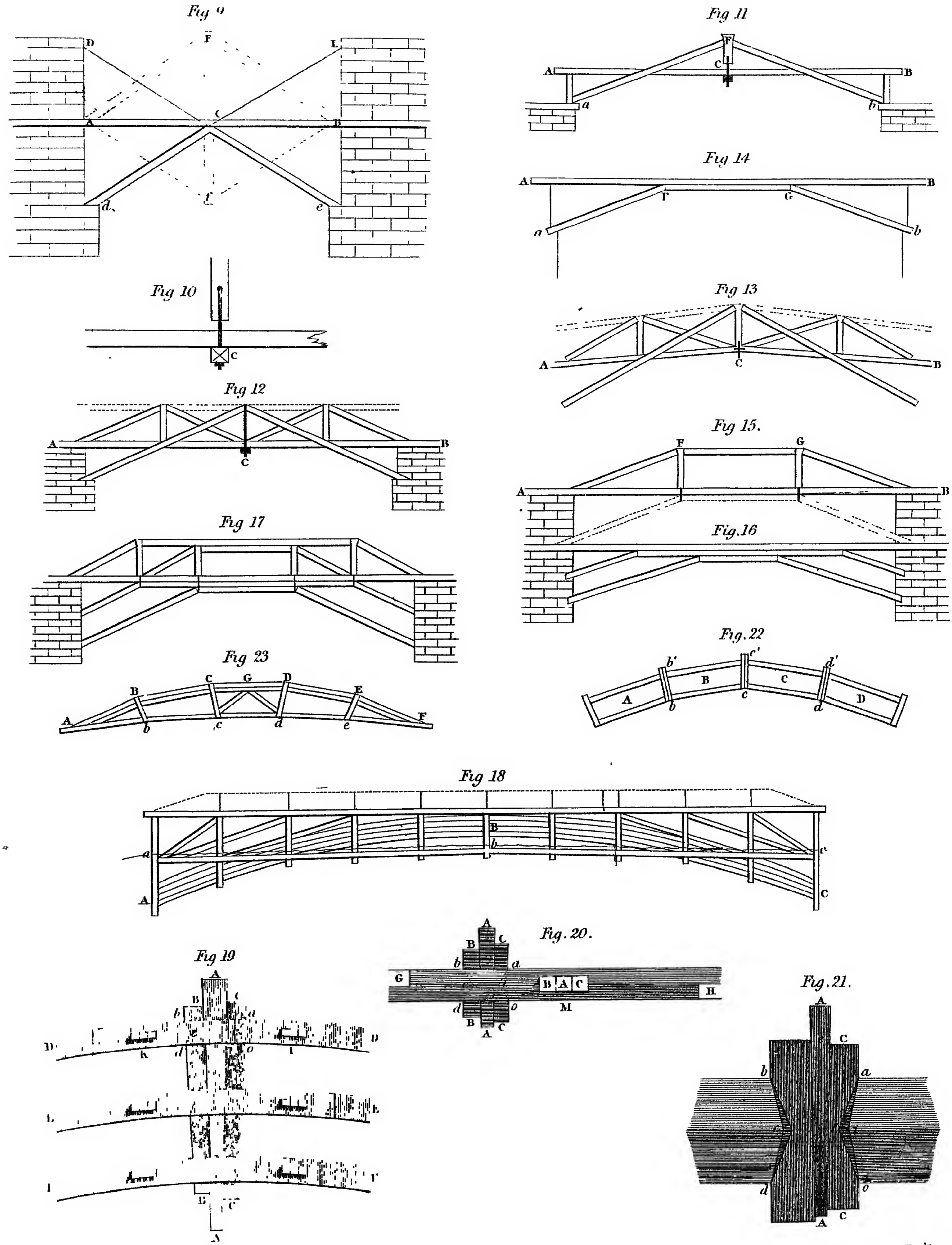


Fig 8





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THE 214 ELEMENTS OR KEYS

ELEMENTS OF I STROKE

1	一	ye	*one; alone, the chief, the same.*
2	丨	quan	*straight; perpendicular*
3	丶	choo	*a point, anciently a chief.*
4	丿	pei	*bent outwards, to arrive at*
5	乙	ye	*crooked, interrupted, one of the characters of the cycle*
6	亅	quay	*to drag with a hook, hooked*

OF II STROKES

7	二	ul	*the numeral* two
8	亠	too	*the summit or top of any thing*
9	人	jin	*a man, mankind*
10	儿	jin	*the ancient character for man.*
11	入	jee	*within, to enter to obtain.*
12	八	pa	*the numeral* eight; *opposite*
13	冂	keong	*a desart, far distant*
14	冖	mee	*to cover, the roof of a house*
15	冫	ping	*cold, frost an icicle*
16	几	kee	*something to support another, the legs of a stool.*
17	凵	kang	*a cavern, a cavity, opening &c.*
18	刀	tau	*to cut, a knife or sword*
19	力	lee	*strength, energy; exertion*
20	勹	pau	*an envelope, to wrap up.*
21	匕	pee	*a spoon, bamboo stick, to eat with*
22	匚	fang	*a square box, a chest*
23	匸	hee	*same as above, a receptacle*
24	十	shee	*the numeral ten*
25	卜	po	*to prophecy, to divine*
26	卩	tsee	*a finger joint; a knot*
27	厂	han	*a cavern, a shelter*
28	厶	tse'	*crooked.*
29	又	yeu	*to assist, again, and*

OF III STROKES

30	口	koo	*a mouth*
31	囗	wei	*an extended plain; something surrounding.*
32	土	too	*the earth, one of the five elements.*
33	士	tze	*a doctor, a learned man.*
34	夂	chee	*to follow*
35	夊	shuee	*to proceed slowly*
36	夕	sei	*the evening*
37	大	ta	*great; gross; the beginning*
38	女	neu	*a woman, a virgin.*
39	子	tse'	*a son or daughter; a name of great respect*
40	宀	mion	*a covering, a roof*
41	寸	tsnoi	*a measure of length or breadth, an inch*
42	小	siau	*little, slight, slender, narrow*
43	尢	wang	*deformed, crooked, a cripple*
44	尸	shee	*a dead corpse.*
45	屮	che'	*a bud, grass; plants.*
46	山	shan	*a hill, a mountain*
47	巛	chuyn	*a channel of running water.*
48	工	kung	*work, an artificer.*
49	己	kee'	*self, one's self, himself, herself.*
50	巾	kin	*a napkin.*
51	干	kan	*a shield, the border of a province.*
52	幺	yau	*slender, the sign of the future, shall.*
53	广	yen	*to protect, a shed.*
54	廴	jin	*a long journey, to continue on foot a long time*
55	廾	kung	*to join hands; the number twenty.*
56	弋	ye	*to dart; to throw; the head of an arrow*
57	弓	koong	*a bow.*
58	彐	kee	*genus, kind a hogs head.*
59	彡	shang	*feathers hair; fine in appearance.*
60	彳	chee	*to walk, a short step*

OF IV STROKES

61	心	sin	*the heart, the mind, desire.*
62	戈	ko	*a spear, a lance dart.*
63	户	hoo	*an inner door, to guard.*
64	手	shoo	*the hand, handicraft*
65	支	chee	*the branches of a tree*
66	攴	poo	*a slight stroke, to strike gently.*
67	文	wan	*beautiful, fair, good, excellent*
68	斗	tou	*a certain measure, a wine vessel*
69	斤	kin	*a weight of about 22 oz.*
70	方	fang	*square, right place, then*
71	无	woo	*the negative particle to want.*
72	日	jee	*the sun the day; perfect*
73	曰	yue'	*to say to speak to name.*
74	月	yue'	*the moon, the month.*
75	木	moo	*wood; a tree the stem of a tree.*
76	欠	kien	*to owe, to sigh.*

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THE 214 ELEMENTS OR KEYS

77	止	tcheo	to stop, to finish, to stand still
78	歹	tai	bad, evil vicious.
79	殳	shoo	to kill by a blow; a weapon
80	毋	woo	the negative particle, to prohibit
81	比	pee	to compare; to equalize
82	毛	mau	hair
83	氏	shee	a family name, an ancestor.
84	气	kee	air, breath, living principle
85	水	shwee	water, one of the elements
86	火	ho	fire, one of the elements.
87	爪	chau	nails; claws of animals
88	父	foo	a father, the chief of a house or family
89	爻	shean	to imitate; to keep company with
90	爿	tchuang	a particular kind of seat or bench
91	片	pien	a piece of wood; a splinter.
92	牙	ya	the teeth.
93	牛	neu	a cow.
94	犬	koon	a dog
	OF V STROKES		
95	玄	huen	darkish blackish
96	玉	yo	a gem, a king, precious stones.
97	瓜	qua	a melon; a cucumber
98	瓦	ngua	earthen vessels; tiles
99	甘	kan	sweet; pleasant, one of the five tastes
100	生	sung	to produce, life.
101	用	yung	to employ, to use.
102	田	tien	a cultivated field.
103	疋	pay	the foot; a lineal measure
104	疒	tsai	sickness, a sore or ulcer.
105	癶	pee	skin; the hairy side of a skin, a wound.
106	白	pee	white; clear; pure; serene.
107	皮	pe	the skin; to walk quickly.
108	皿	ming	dishes; vessels used for food.
109	目	mou	the eye.
110	矛	meu	a spear or lance
111	矢	tchee	straight; to point at an arrow.
112	石	shee	a stone; a rock.
113	示	shee	to admonish to instruct, to advise
114	禸	mieu	to creep; the mark of birds feet
115	禾	quo	grain; corn in the ear.
116	穴	sheu	a den or cave
117	立	hee	to erect, to build; firm.
	OF VI STROKES		
118	竹	tso	a reed or bamboo.
119	米	mea	raw, or unspun silk
120	糸	mee	rice or grain cleaned of the husk
121	缶	fou	earthen vessels of all kinds.
122	网	wang	a net of any kind.
123	羊	yung	a goat; a sheep
124	羽	yeu	wings of a bird, feathers.
125	老	lau	aged, a term of respect.
126	而	ul or yr	an expletive; locks of hair
127	耒	luy	the crooked handle of a plough.
128	耳	eul	the ear.
129	聿	yoo	a pencil or brush, like.
130	肉	yoo	flesh of any animal.
131	臣	tchun	a minister, a public steward.
132	自	tse	self, himself; from.
133	至	tchee	the extreme point to arrive at
134	臼	keu	a mortar.
135	舌	shea	the tongue
136	舛	tchuen	to disturb, to wander, to err.
137	舟	tchen	a ship; a boat
138	艮	kin	bound, limit; disobedience.
139	色	soo	blooming; a fine colour of the skin.
140	艸	tsao	plants; herbs; grass.
141	虍	hoo	a tiger.
142	虫	chung	an insect.
143	血	sheah	blood.
144	行	shing	to go; to do; to walk.
145	衣	ee	clothes; garments.
146	襾	ya see	to cover; west.
	OF VII STROKES		
147	見	kien	to see, to appear.
148	角	kion	a horn of animals
149	言	yen	words; to speak.
150	谷	koo	a valley; a spring, a channel of water.
151	豆	tou	leguminous plants; pulse
152	豕	tche	a hog; a sow
153	豸	lee	a reptile

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THE 214 ELEMENTS OR KEYS

154	貝	poci	*a pearl a shell: precious*
155	赤	tchee	*red; colour of carnation.*
156	走	tsou	*to walk swiftly, to run.*
157	足	tsoo	*the foot*
158	身	shin	*the body or person; self.*
159	車	kiou	*a wheel or carriage.*
160	辛	sin	*hot, pungent, bitter, afflicting.*
161	辰	shin	*to advance, a portion of time equal to two hours.*
162	邑	yee	*a city surrounded with walls*
163	辵	tchoo	*walking swiftly; a hasty motion.*
164	酉	yan	*ripe, new wine.*
165	釆	pien	*to tear asunder, to seperate, to distinguish.*
166	里	lee	*a measure about one third of a mile, a village*

OF VIII STROKES

167	金	kin	*metal; gold*
168	長	chang	*long, remote; distant.*
169	門	mun	*the outer door.*
170	阜	foo	*a mound of earth*
171	隶	tai	*until, at, or to a certain point*
172	隹	tchuy	*birds with short tails*
173	雨	yeu	*rain.*
174	青	ching	*azure*
175	非	fui	*false, low, the negative.*
176	面	mien	*the face, the surface*
177	革	kee	*skins with the hair on, to change*
178	韋	wy	*soft leather; back to back*
179	韭	kieu	*onions, leeks, pot herbs*
180	音	yin	*sound, a tone of music.*

OF IX STROKES

181	頁	yee	*the head.*
182	風	fung	*the wind, manner; custom.*
183	飛	fooi	*to fly as a bird*
184	食	tchee	*to eat, prepared rice.*
185	首	shieu	*the head, the origin*
186	香	shiang	*smell, fragrance*

OF X to XVII STROKES

187	馬	ma	*a horse*
188	骨	koo	*a bone*
189	高	kau	*high, eminent, noble*
190	髟	piau	*long hair*
191	鬥	tou	*to fight, a single combat*
192	鬯	tchiang	*fragrant herbs to mix with wine*
193	鬲	lee	*a vessel used for boiling rice*
194	鬼	quoi	*a spirit a ghost a demon*
195	魚	yeu	*a fish*
196	鳥	niau	*a bird*
197	鹵	loo	*salt or brackish water*
198	鹿	lo	*a stag*
199	麥	moo	*wheat; corn*
200	麻	ma	*hemp.*
201	黃	whang	*yellow.*
202	黍	shieu	*millet*
203	黑	shee	*black, dark*
204	黹	tchee	*needle-work, embroidery.*
205	黽	ting	*a tripod, a vessel used in cooking.*
206	鼎	mung	*a toad or frog.*
207	鼓	koo	*a drum.*
208	鼠	shiau	*a mouse a rat*
209	鼻	pee	*the nose.*
210	齊	shee	*even, level, to put in order*
211	齒	tchee	*the teeth, rank, order*
212	龍	loong	*a dragon*
213	龜	quey	*a tortoise*
214	龠	yoo	*a pipe or musical instrument of reeds*

IN COMPOSITION

No. 9 is	亻	
18 „	刂	
61 „	忄	
64 „	扌	
85 „	氵	
86 „	灬	
130 „	月	
140 „	艹	
152 „	阝	*placed on the right*
170 „	阝	*placed on the left*
163 „	辶	

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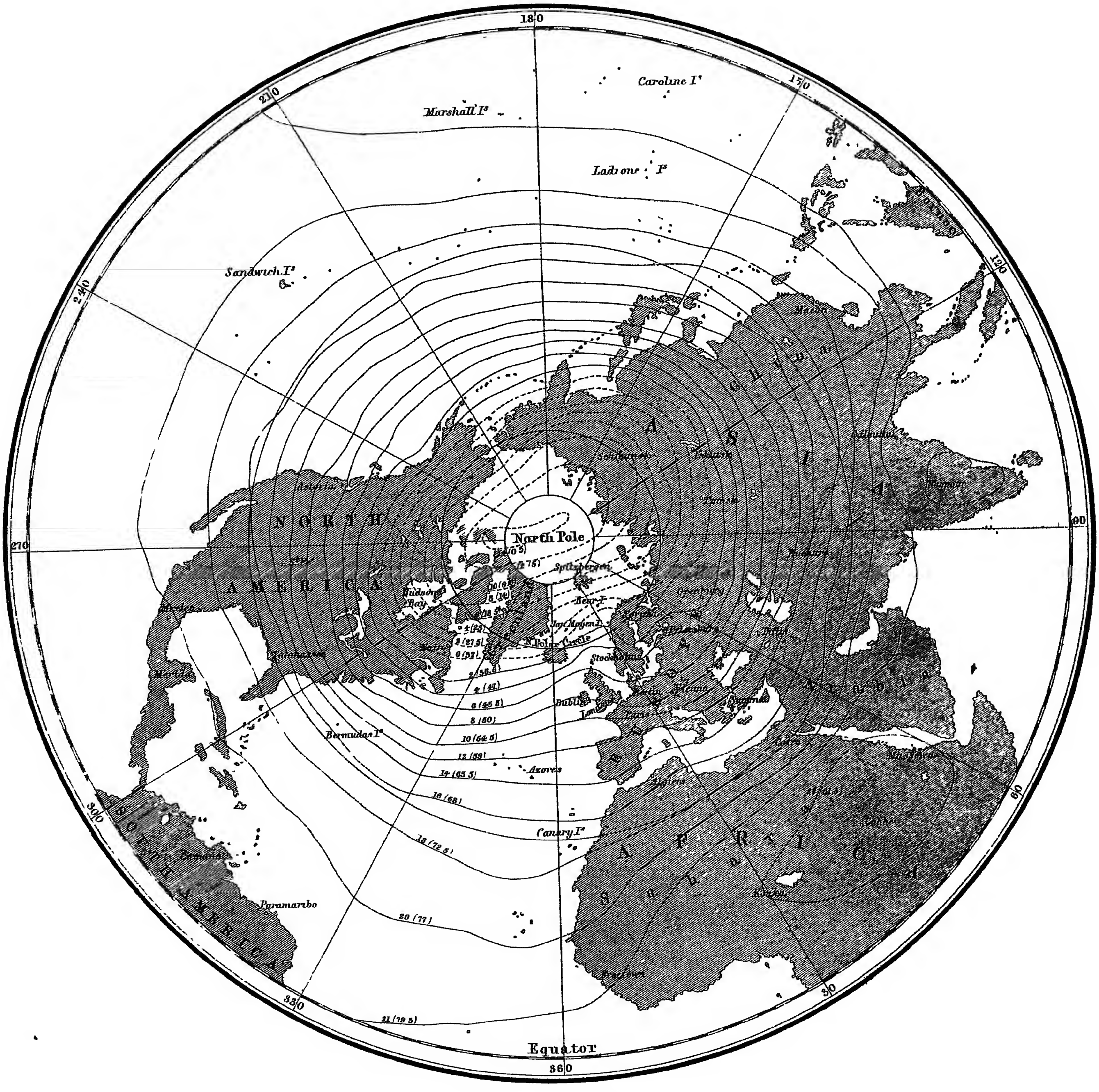
ANNUAL ISOTHERMS, ON M. DOVE'S POLAR PROJECTION.

PLATE CLXXIV.



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———— *Lines above 32° F*

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